

# GETTING INTO THE “SPIRIT” OF INNOVATIVE THINGS: LOOKING TO COMPLEMENTARY AND SUBSTITUTE PROPERTIES TO SHAPE PATENT PROTECTION FOR IMPROVEMENTS

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## I. INTRODUCTION

Technological progress is a cumulative endeavor, and how patent protection should be structured to most effectively promote technological progress in light of its cumulative nature is the subject of many distinct and robust debates.<sup>1</sup> One thread in these debates addresses the conditions under which the patent protection given to earlier inventors should be expansive enough to encompass later-developed improvements.<sup>2</sup> Patent applicants are

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1. See, e.g., *infra* notes 116 & 213 (discussing several patent doctrines that are controversial because they implicate the cumulative nature of technological progress).

2. The number of articles relevant to this topic is enormous, as nearly every discussion of claim scope implicates patent protection for improvements, at least tangentially. For articles that are focused on patent scope and improvement and that address the mechanics of patent law, see Mark A. Lemley, *The Economics of Improvement in Intellectual Property Law*, 75 TEX. L. REV. 989 (1997); Robert Merges, *Intellectual Property Rights and Bargaining Breakdown: The Case of Blocking Patents*, 62 TENN. L. REV. 75 (1994); Robert P.

clearly entitled to protection for the set of nonobvious things that they disclose in their patent applications, and thus make available to the public, at the time of filing.<sup>3</sup> In improvement scenarios, inventors acting at a later point in time make innovative changes to the things disclosed by earlier patentees, generating new things that the earlier patents did not make available to the public. The debate over patent protection for later-developed improvements addressed in this Article centers on the conditions under which initial inventors’ patent rights should reach beyond the set of things that inventors actually make available to the public at the time they file their patents and into the improved things that are only made available to the public by subsequent inventors.<sup>4</sup>

This Article stirs the pot on patent protection improvements with a two-step argument. First, it demonstrates that there is a blind spot in the conventional theory on optimal patent protection for after-arising improvements.<sup>5</sup> This theory has been developed on the basis of only a subset of improvement cases (that this Article calls *classic-improvement* cases), and it has ignored another subset (that this Article calls *overlooked-improvement* cases) that lies in plain sight. Although many classic-improvement cases are

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Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 909–11 (1990). For articles addressing patent scope and improvement from a purely economic perspective, see James Bessen & Eric Maskin, *Sequential Innovation, Patents, and Imitation*, 40 RAND J. ECON. 611 (2009); Howard F. Chang, *Patent Scope, Antitrust Policy, and Cumulative Innovation*, 26 RAND J. ECON. 34 (1995); Jerry R. Green & Suzanne Scotchmer, *On the Division of Profit in Sequential Innovation*, 26 RAND J. ECON. 20 (1995); Ted O’Donoghue et al., *Patent Breadth, Patent Life, and the Pace of Technological Progress*, 7 J. ECON. & MGMT. STRATEGY 2 (1998); Suzanne Scotchmer, *Standing on the Shoulders of Giants*, 5 J. ECON. PERSP. 29 (1991).

3. The set of things that a patent “discloses” and thus “makes available to the public” is used here as shorthand for the set of things that is both enabled for and possessed by the person having ordinary skill in the art. This set is smaller than the set of things that can fall within the scope of a claim that is valid under the enablement and written description requirements. See *infra* notes 130–33 and accompanying text.

4. A distinct, yet interconnected, debate about patent protection for improvements that this Article does not address centers on the nonobviousness requirement. See 35 U.S.C. § 103 (2006). Scholars involved in this debate often presume that earlier patentees can control later improvements and examine the conditions under which the later-acting improvers should be able to patent their improvements and obtain blocking patents. See, e.g., Robert M. Hunt, *Patentability, Industry Structure, and Innovation*, 52 J. INDUS. ECON. 401 (2004); Ted O’Donoghue, *A Patentability Requirement for Sequential Innovation*, 29 RAND J. ECON. 654 (1998); Suzanne Scotchmer, *Protecting Early Innovators: Should Second-Generation Products Be Patentable?*, 27 RAND J. ECON. 322 (1996).

5. On a doctrinal level, the Article also identifies a flaw in a common understanding of the mechanism through which earlier patentees’ rights can encompass later-developed improvements. See *infra* Part VIII (presenting and undermining the strong fixation theory of peripheral claims).

legitimately contested, the overlooked-improvement cases are all “easy” cases in which the literal scope of earlier-issued patents routinely and uncontroversially grows over time to encompass later-developed improvements.<sup>6</sup> Critically, the conventional theory that outlines when earlier patents should encompass later improvements cannot explain why overlooked-improvement cases are “easy” cases. A puzzle therefore emerges. Contemporary theory suggests that a set of common, everyday improvement cases should have one outcome (or at least that their outcomes should be highly contested), when, in practice, the cases routinely and uncontroversially yield the opposite outcome. Theory that fails to explain how law does, and should, operate is ripe for revision. The second step of this Article’s argument therefore amends the conventional theory on patent protection for improvements, correcting its blind spot and reducing the explanatory gap between theory and practice. There is a to-date-hidden factor that reliably distinguishes the overlooked- and classic-improvement cases in which courts are employing the different rules. Furthermore, there is a convincing story about why this factor is a normative trump card that allows earlier-issued patents to encompass later-developed improvements as a matter of routine only in the overlooked-improvement cases.

Identifying the new factor requires some conceptual heavy lifting because seeing it entails a shift in one of the most basic conceptual frameworks, or paradigms, structuring contemporary understandings of patent protection.<sup>7</sup> Today, the inventions that give rise to patent rights are only identified as the sets of innovative *things* that an inventor discloses, and these innovative things are taken to be the primitives of what an inventor invents. This conceptual framework is a coarse-grained framework that blinds contemporary patent scholarship to the factor that differentiates overlooked- and classic-improvement cases. What is needed to see this factor is a finer-grained framework that gets into the “spirit” of innovative things—i.e., that recognizes a “spirit” of inventions that is somehow embodied in particular

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6. The cases are “easy” because the outcome is routine and uncontroversial. The term “easy” remains in quotation marks throughout the Article because, prior to this Article, there was no coherent explanation of the outcome in logical, doctrinal terms. *Cf.* Mark Kelman, *Interpretive Construction in the Substantive Criminal Law*, 33 STAN. L. REV. 591, 662–69 (1981) (discussing the important role of the interpretive construction of facts by courts in criminal cases that are “easy” only in the sense of their outcomes being uncontroversial in the relevant legal community).

7. The mention of paradigms invokes Kuhn. *See infra* notes 337–40 and accompanying text (arguing that the overlooked cases have been overlooked because the focus on properties as the locus of invention that is required to identify them does not fit with the dominant conceptual paradigms of contemporary patent theory).

features of the things that are disclosed and claimed by the earlier patentee.<sup>8</sup> To structure this finer-grained analysis, this Article appropriates the metaphysical concept of the innovative *properties of things*. A property is an intuitive and familiar entity. It is simply “what is variously called a feature, quality, attribute or . . . a way that something is,”<sup>9</sup> and things, in turn, can be identified by the sum total of the properties that they possess.<sup>10</sup> Paying attention to innovative properties in improvement cases requires sustained effort, as it runs against the grain of contemporary patent discourse. However, the payoff is worth the effort. This Article proves the pragmatic value of identifying the innovative properties of things, rather than innovative things in their entirety, as the locus of invention when assessing the optimal reach of earlier-filed patents into later-developed improvements. A focus on innovative properties corrects the blind spot in the contemporary theory on patent protection for improvements, reducing the gap between the theory and reality of contemporary patent practice by revising the theory to create a better fit with reality. It is necessary to identify, explain, and justify an uncontroversial and desirable feature of real-world patent rights that already exists today, namely the different treatment afforded to classic and overlooked improvements.<sup>11</sup> In brief, the descriptive insight enabled by a focus on properties is that the properties invented by successive generations of inventors in improvement scenarios can relate to each other differently in different types of improvements. Classic improvements involve later improvers who *refine* the properties invented by the earlier patentees: the more general of the earlier inventor’s innovative properties persist in the

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8. The proposal to pay attention to the “spirit” of an invention has a clear conceptual kinship with the point of novelty approach to patent law that is often denigrated by both scholars and courts. *See infra* notes 64–68 (discussing the point of novelty approach). However, this Article develops an argument about the role that the point of novelty should, and already does, play in patent law in a different direction than previous scholarship has taken it. *See infra* notes 69, 318 (comparing this Article’s focus on properties as the locus of invention in improvement cases with recent scholarship that addresses a point of novelty approach or central claiming).

9. Chris Daly, *Properties*, in *ROUTLEDGE ENCYCLOPEDIA OF PHILOSOPHY* (E. Craig ed., 1998) (discussing disagreements among philosophers about the nature and existence of properties). This definition of property conveys a metaphysical concept, and it is entirely distinct from the legal concept of property—whatever that legal concept is. *Cf.* Thomas C. Grey, *The Disintegration of Property*, in *LIBERTY, PROPERTY AND THE LAW* (Richard A. Epstein ed., 2000) (discussing the difficulty of defining property as a legal concept).

10. *See infra* note 72.

11. Another effect of a focus on innovative properties is the refinement of judicial and scholarly analysis of optimal protection for classic improvements. *See infra* notes 242–48 and accompanying text (introducing the concept of the “least-general naked property” of a classic improvement).

improvement, but the more specific of his innovative properties are supplanted by the improver's innovative properties. In contrast, overlooked improvements involve later improvers who invent new properties that simply *compound with* the properties invented by the earlier patentees in the improved thing: the earlier and later innovators' innovative properties both are fully present in the improvement.

A focus on properties, rather than things in their entirety, as the locus of invention in improvement cases also explains why courts should treat classic- and overlooked-improvement cases differently, as they already do. (Again, paying attention to innovative properties in improvement scenarios does not mandate a radical shift in the on-the-ground scope of contemporary patent protection. It alters patent theory so that it is better able to account for a desirable feature of the contemporary patent regime.) One of the core principles of patent law is that inventors should be rewarded in proportion to the value of their inventions. When inventions are defined in terms of innovative properties, this proportionality principle mandates differential treatment for classic and overlooked improvements. In a classic improvement, the persistence of some, but not all, of the earlier innovator's properties in the improvement gives the earlier inventor a weaker normative claim to rights that encompass the improvement. In contrast, in an overlooked improvement, the persistence of all of the earlier innovator's properties in the improvement gives the inventor a very strong normative claim to rights that encompass the improvement. Thus, when properties are viewed as the locus of invention, the contested nature of the overlooked improvement cases and the "easy" nature of the classic-improvement cases both make good economic sense.

Perhaps the most compelling payoff of identifying properties as the locus of invention is that, for the first time, the economic concepts of complements and substitutes can be brought to bear on the crafting of optimal claim scope in improvement cases. Today, patent scholarship on improvement uses the concepts of complements and substitutes in a variety of ways. However, these concepts have no relevance to the crafting of optimal claim scope in general or the differential reach of earlier-filed claims into classic and overlooked improvements in particular. This Article demonstrates that the concepts of complements and substitutes can be turned into useful tools for crafting optimal patent scope if, and only if, innovative properties are identified as the goods that are either complements or substitutes. Overlooked improvements result from successively-invented, complementary properties that are instantiated in the self-same thing, and the normative claim of earlier inventors to rights that encompass later-developed improvements is at its strongest when the successively-invented properties

are pure complements. Therefore, the scope of earlier-filed claims should routinely be construed so as to encompass later-developed, overlooked improvements. In contrast, classic improvements result from successively invented properties of the self-same thing that are complement-substitute mixtures, and the normative claim of earlier inventors grows weaker as the substitute properties come to predominate the mixture. Therefore, the reach of earlier-filed claims into classic improvements should remain a contested issue.<sup>12</sup> In sum, by understanding properties as the locus of invention in improvement cases, the legal doctrine that courts use to craft claim scope can be revolutionized to incorporate the economic concepts of complements and substitutes.

On a more theoretical level, a fine-grained focus on the innovative properties of things is a fruitful addition to patent theory because it provides a link in the contemporary conceptualization of patent rights that heretofore has been missing. Contemporary patent theory is replete with discussions of innovative ideas, but the role of innovative ideas in the patent regime is ambiguous. To reflect the fact that patent claims are not limited to the set of things that a patentee makes available to the public and that they should grow over time to encompass improvements, patents are often characterized as granting property rights in ideas.<sup>13</sup> Yet, at the same time, ideas per se are clearly beyond the reach of patent protection.<sup>14</sup> This paradox can be resolved by understanding that patent claims describe and propertize sets of things, not ideas themselves, but that the scope of the set of things that can be claimed is defined roughly as the set of things that embody an inventor's innovative ideas in a sufficiently important or prominent way. It would be helpful to be able to talk about patent protection in a manner that is not paradoxical and that reserves a semantic space for the important facts that ideas per se are not patentable and that later innovators can often freely appropriate the knowledge generated and disclosed by earlier patentees. What is needed to clear the air is a concept that provides the missing link between innovative ideas and innovative things and that captures how ideas are embodied in patented things. The notion that claimed things have a

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12. Because the framework positions properties of things, rather than things in their entireties, as the relevant goods, the import of a later-developed complement or substitute invention is the opposite of the import of a later-developed complement or substitute work in the fair use analysis of copyright. *See infra* note 303.

13. *See, e.g.,* Tun-Jen Chiang, *The Levels of Abstraction Problem in Patent Law*, 105 NW. U. L. REV. (forthcoming 2011) (discussing claims to the idea of curing AIDS at different levels of generality).

14. *See infra* notes 117–18 and accompanying text (discussing idea-only cumulative innovation cases).

“spirit” represents one attempt to provide this missing link, however vague or other-worldly it may seem. The notion of the innovative properties of things is another candidate for the missing link, one that is both more capable of a precise formulation and more firmly rooted in the material world of infringing things than the notion of an inventive “spirit” of things ever could be. The properties of things can be framed as the entities that instantiate ideas in things; things that possess certain properties can be said to embody certain ideas. In sum, a fine-grained focus on the innovative properties of things, rather than a coarse-grained focus on innovative things in their entirety not only helps to solve pragmatic problems in the administration of patent rights (e.g., to factually differentiate the classic and overlooked improvements that courts are already treating differently as well as to normatively justify why these two types of improvements should continue to receive this differential treatment), but it also provides a missing link between ideas and things in the concepts that structure contemporary patent theory.

This Article proceeds in six substantive parts, a coda, and a conclusion. Taking the form of an extended introduction, Part II lays out the problem that motivates this Article and sketches a solution to this problem. It reviews the contemporary theory on patent protection for improvements and points out its blind spot, illustrating the insights that the theory yields when classic improvements are at issue but also highlighting the inapplicability of the theory to overlooked improvements. Part II also offers a high-level overview of how this blind spot can be corrected. What is needed is a shift in the conceptual framework that is used to understand the nature of invention. Properties of things, rather than things in their entirety, must be viewed as the locus of invention in improvement cases. For clarity, Part III defines an “improvement” as the term is employed in this Article.

The following three parts describe the difference between classic and overlooked improvements and demonstrate that overlooked improvements are already routinely treated as “easy” cases in the courts. Part IV defines a classic improvement in terms of successively invented properties: the later-invented property refines the earlier-invented property. Part V does the same for an overlooked improvement: the later-invented property simply compounds with the earlier-invented property in the improved thing. It also illustrates three categories of overlooked-improvement cases in which courts routinely allow earlier-issued patents to encompass later-developed improvements. Part VI reinforces the distinction developed in the previous two Parts, representing it in visual form.

Part VII is the heart of the normative argument. It explains why the principle of proportionality of contribution and reward counsels that classic



improvements should result in the contested infringement cases that they do (in which the conventional theory on improvements gains traction) and why overlooked improvements should result in the “easy” infringement cases that they do (in which the conventional theory is irrelevant). It also illustrates how the economic concepts of complements and substitutes can be used to explain how claim scope is, and should be, crafted in improvement cases if, and only if, properties are identified as the locus of the inventions created by successive inventors.

Part VIII, a coda, takes a step back and briefly considers the implications of the arguments presented in this Article for the peripheral claiming regime. Principally, it is not the on-the-ground scope of peripheral claims that must change. It is rather what we understand peripheral claims to be that must change. The dominant, thing-centric conceptual framework of what constitutes an invention is often defended with the argument that it is a necessary artifact of the contemporary peripheral claiming regime. This argument has no merit. A shift to a focus on properties as the locus of invention in improvement cases is entirely compatible with a peripheral claiming regime. However, this shift does require a concomitant shift in common understandings of what peripheral claims already are and how they already operate. Once again, a paradigm shift in the theory of peripheral claims is needed if this theory is to map onto the reality of peripheral claiming. Part IX concludes.

## **II. THE PUZZLE AND A QUICK SKETCH OF ITS RESOLUTION**

This Part offers an extended introduction. It both discusses a shortcoming in contemporary patent theory on improvements and offers an overview of how to remedy this shortcoming. Section II.A introduces the conventional theory on patent protection for improvements. It identifies factors that are thought to increase or decrease the strength of a patent owner’s normative argument for control over a later-developed improvement. Section II.B argues that the conventional theory has a blind spot because it gains traction in explaining the optimal outcomes of some improvement cases (what this Article calls classic-improvement cases) but not others (what this Article calls overlooked-improvement cases). Section II.C provides a high-level overview of the change to the conventional theory that is needed to correct the blind spot. It proposes a shift from an exclusive focus on things in their entireties to the properties of things as the locus of invention in improvement cases.

A. THE CONVENTIONAL THEORY ON PATENT PROTECTION FOR IMPROVEMENTS

In its most basic formulation, the incentive-to-invent justification of patent rights involves free-riders or pirates. By preventing later actors from copying the very technologies that earlier actors invent, patent rights increase the incentives for the earlier actors to invest in the invention and commercialization of technology.<sup>15</sup> Patent protection for improvements adds a significant wrinkle to this justification. When the issue is the reach of earlier-filed patents into later-invented improvements, there are inventors on both sides of the infringement suit.<sup>16</sup> A simple policy of favoring inventors over free-riders is not dispositive. Instead, there are four distinct factors that are conventionally considered in determining the optimal reach of earlier-filed patents into later-developed improvements.<sup>17</sup>

First, the relative importance of the earlier and later inventions should affect the reach of patent protection into improvements. Whether earlier-filed patents should encompass later-developed improvements determines whether improvers owe a portion of their profits to earlier inventors, and it therefore affects the inter-generational division of the rewards of patent protection.<sup>18</sup> To reinforce the proportionality of contribution and reward in

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15. *But cf.* Christopher A. Cotropia & Mark A. Lemley, *Copying in Patent Law*, 87 N.C. L. REV. 1421 (2009) (arguing that only a small number of patent cases even involve allegations of copying). For a brief overview of the incentive-to-invent justification of patent rights, see *infra* notes 196–98 and accompanying text.

16. If the same firm generates both the earlier invention and the later improvement, then many of the issues raised in the conventional theory on patent protection for improvements are moot. However, the first and second generation inventors in an improvement scenario will often not be the same party because the earlier inventor is unlikely to be able to keep the information about the earlier invention secret (particularly while simultaneously obtaining patent protection and commercializing it) and different potential improvers likely possess specialized information and capacities. *See* Bessen & Maskin, *supra* note 2, at 620.

17. The normative debates discussed in the remainder of this Section assume that patent protection for later-developed improvements is sometimes desirable, and they focus on when and how much protection for later-developed improvements there should be. As a doctrinal matter, however, a more basic question is still the subject of considerable controversy. Judicial rhetoric in patent cases and scholarship often bolsters a strong fixation theory of literal claim scope under which the literal scope of a patent claim can never grow over time in the manner that is needed to encompass later-developed improvements. *See infra* notes 308–11 and accompanying text.

18. Green & Scotchmer, *supra* note 2, at 21; Scotchmer, *supra* note 2, at 30. Importantly, this inter-generational distribution of profit is not a “mere” distributional issue of the type that is often overlooked in discussions of static efficiency and tangible property regimes. *See* Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089, 1098–101 (1972) (segregating

patent law,<sup>19</sup> everyday improvements that yield moderate increases in social value should fall within the rights of earlier patentees, but radical improvements that generate large increases in social value should not.<sup>20</sup> Inversely, the greater the social welfare increase attributable to the invention disclosed in the earlier-issued patent, the farther the patent should reach into later-developed improvements.<sup>21</sup>

Second, the nature of the industry in which the improvements occur is viewed as relevant to patent protection for improvements, at least at the margin. Robert Merges and Richard Nelson famously argue that the reach of earlier patents into later-developed improvements should be scrutinized more carefully in industries in which technical advance proceeds in a “cumulative” rather than a “discrete” fashion and in which skepticism about a frictionless market for patent licenses is warranted.<sup>22</sup> Here, the concern is less about ensuring that inventors are rewarded in proportion to their contributions and more about preventing bargaining impasses in which later inventors are unable to acquire the rights from earlier inventors that are needed to continue the inventive process in a competitive fashion.<sup>23</sup>

A third policy concern implicated in patent protection for later-developed improvements addresses the magnitude of patent rents that are available for distribution among successive inventors. Economists interested in cumulative innovation sometimes work with a “quality ladder” as a stylized model of improvement.<sup>24</sup> The quality-ladder model assumes that each

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distributional concerns from efficiency concerns). The reward from invention creates incentives, so the distribution of the reward among different generations of inventors is a dynamic efficiency issue under an incentive-to-invent justification of patent rights. Scotchmer, *supra* note 2, at 30.

19. See Lemley, *supra* note 2, at 1073 (arguing in the context of patent protection for improvements that “efficiency is best served by some sort of calibration, however rough, between the importance of the invention and the scope of the patent”); *infra* Section VII.A (addressing the policy basis of this proportionality).

20. This argument is often made to justify patent law’s reverse doctrine of equivalents. See Lemley, *supra* note 2, at 1008–13 (distinguishing between the rights of “significant” and “radical” improvers as a descriptive matter); *id.* at 1065, 1070 (defending this distinction as a normative matter); Merges & Nelson, *supra* note 2, at 909–11 (arguing that earlier inventors should not have rights to hold up radical improvers). The reverse doctrine of equivalents, and its placement of radical improvers beyond the reach of earlier patentees, has also been defended as a means of preventing bargaining breakdown between the owners of blocking patents. Merges, *supra* note 2, at 91–102.

21. Ensuring adequate rewards for especially important inventions underlies pioneer theory in patent law. See Lemley, *supra* note 2, at 1072–73.

22. Merges & Nelson, *supra* note 2, at 880–908.

23. *Id.*

24. SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES 149–52 (2004); O’Donoghue et al., *supra* note 2, at 5–7.

successive innovating firm produces an improvement before the expiration of the earlier patent that is of higher quality than the previous one. The “leading breadth” of a patent—that is, the reach of patent scope into improvements—is measured in quality increments: an earlier patent encompasses only the improvements that do not exceed a certain quantum of increase in quality. Under this model, the optimal reach of a patent into improvement depends on the desired magnitude of the overall incentive to innovate to be created by the patent regime. The deeper patents reach into improvements, the larger the supra-competitive profits that are created. Assume an increase from X to 2X in the quality increment that defines the leading breadth of a patent. Making the simplifying assumption that improvements continue to arrive at the same rate, a firm must now share its profits in any given time period through a licensing agreement with a larger number of other firms, but this loss is balanced by the gain that comes from a patent covering the highest quality product (whoever produced it) during a time period that is twice as long. The difference maker is that the quality difference between the highest-quality, patented product and its closest unpatented substitute is twice as great, so the patentees’ collective per-period profits will be larger.<sup>25</sup> Thus, under a quality-ladder model of improvement, the reach of a patent into improvements should be greater when the optimal strength of patent-induced incentives is higher,<sup>26</sup> as, for example, would be the case if the sunk costs of innovation in an industry were larger than in other industries.

A fourth policy concern affecting the optimal reach of patents into later-developed improvements is the importance attributed to the prospect function of patent rights. The prospect theory of patent law suggests that patent protection should create incentives to prevent the wasteful duplication that results when the development of nascent technologies into marketable products occurs in an uncoordinated fashion.<sup>27</sup> The more important one believes the prospect function of patent law to be, the deeper the reach of patent protection into later-developed improvements should be.<sup>28</sup>

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25. See *infra* notes 272–75 and accompanying text (discussing the impact of unpatented substitutes on the private value of a patent).

26. SCOTCHMER, *supra* note 24, at 134, 149–52.

27. The canonical presentation of prospect theory is Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265 (1977), although Kitch’s argument is more descriptive than normative.

28. The four factors addressed in the text do not form an exhaustive list of the conventional wisdom that could be brought to bear on patent protection for improvements. For example, James Bessen and Michael Meurer argue that patent claims that reach far beyond the set of things disclosed in a patent and far into later-developed improvements are

## B. THE BLIND SPOT

In many improvement cases—cases that this Article refers to as classic-improvement cases—the conventional theory on patent protection for improvement seems to gain traction in explaining how infringement allegations against improvers should be resolved. For an example of a classic improvement, consider the aviation industry just after the turn of the twentieth century, and a stylized telling of Glen Curtiss’s improvement on the Wright Brothers’ patented invention.<sup>29</sup> The Wright Brothers realized that an airplane could be stabilized by raising and lowering different portions of the wing surface at the same time. They disclosed airplanes that could perform these simultaneous adjustments because the wings had a flexible frame that allowed the entire surface of the wing to be warped.<sup>30</sup> Curtiss then borrowed from the Wright Brothers the notion of an airplane that could be stabilized by raising and lowering different parts of the wing at the same time. In doing so, Curtiss produced an improved airplane that the Wright Brothers had not themselves invented or disclosed in their patent. He invented wings with ailerons—discrete flaps that could move independently of the rest of the wing—that supplanted wing-warping technology.<sup>31</sup> The successive inventions of Curtiss and the Wright Brothers exemplify the type of improvement scenario that is commonly addressed by the improvement debate. In such scenarios, the improvement debate focuses on whether the set of things within the scope of the Wright Brothers’ patent claim can grow over time, extending beyond the set of things actually disclosed by the patent (airplanes that use wing-warping technology) and into later-developed improvements (airplanes that use ailerons).<sup>32</sup>

In the context of the Wright Brothers/Curtiss patent infringement suit, the factors addressed in the conventional theory on patent protection for

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inherently more “abstract,” have fuzzier boundaries, and therefore entail higher social costs. JAMES BESSEN & MICHAEL J. MEURER, *PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAYWERS PUT INNOVATORS AT RISK* 187–214 (2008) (arguing that abstract software claims—i.e., software claims reaching far into after-arising technologies—provide poor public notice). This argument highlights a cost in the form of poor public notice of earlier-filed patents that reach deep into later-developed improvements.

29. For a fuller historical account of Curtiss’s work and its relationship to the Wright Brothers’ work, see SETH SHULMAN, *UNLOCKING THE SKY: GLEN HAMMOND CURTISS AND THE RACE TO INVENT THE AIRPLANE* (2002).

30. U.S. Patent No. 821,393 (filed Mar. 23, 1903).

31. See SHULMAN, *supra* note 29, at 133–34 (discussing the historical development of ailerons).

32. The Wright Brothers’ patent fight with Curtiss on this precise point is legendary. For one judicial opinion in this dispute, see *Wright Co. v. Herring-Curtiss Co.*, 204 F. 597, 614 (W.D.N.Y. 1913), *aff’d*, 211 F. 654 (2d Cir. 1914).

improvements make sense.<sup>33</sup> That is, there is good reason to believe that they should be relevant to the outcome if patent protection is to optimally promote cumulative innovation, even if any given factor is not dispositive. First, the more significant the Wright Brothers' invention in terms of the social value that it creates, and the smaller the additional increment of social value contributed by Curtiss, the stronger the case for allowing the Wright Brothers' patent to encompass airplanes stabilized with ailerons.<sup>34</sup> Second, the more cumulative the pattern of technological advance and the less confidence inspired by the market for patent licenses, the stronger the case for allowing Curtiss to be free of the Wright Brothers' patent.<sup>35</sup> Third, the more costly the process of creating and commercializing the innovations in the airplane industry, the stronger the need to reduce competition and augment the monopoly power attributable to the patent regime, and thus the deeper earlier patents should reach into later-developed improvements.<sup>36</sup> Fourth, the more prominence one gives to the prospect function of patents, the more certain one becomes that the Wright Brothers' patent should encompass Curtiss's improved airplane.<sup>37</sup>

While the conventional theory has traction when classic improvements are at issue,<sup>38</sup> all improvements are not classic improvements. There is a distinct set of improvement cases—cases that this Article refers to as overlooked-improvement cases—that have been largely ignored in patent scholarship. Overlooked-improvement cases are “easy” cases in the sense that their outcomes are routine and uncontroversial: earlier inventors' patents expand to encompass the later-developed improvements.<sup>39</sup> Most importantly for the argument here, the conventional theory has little, if any, purchase in overlooked-improvement cases. The factors on which the conventional theory focuses are simply unable to explain how overlooked improvement are (and should be) resolved.

For a simple example of an “easy” overlooked-improvement case, consider a hypothetical improvement on the Wright Brothers' patented technology. Imagine that a later inventor makes an unexpected advance in

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33. *See supra* Section II.A (listing the factors considered in the conventional theory).

34. *Cf. supra* notes 18–21 and accompanying text.

35. *Cf. supra* notes 22–23 and accompanying text.

36. *Cf. supra* notes 24–26 and accompanying text.

37. *Cf. supra* notes 27–28 and accompanying text.

38. Although the factors considered in the conventional theory are all relevant in classic-improvement cases, a focus on properties as the locus of invention reveals an additional factor that is also relevant. *See infra* notes 242–48 and accompanying text (introducing the concept of a classic improvement's least-general naked property).

39. *See supra* note 6 (defining an “easy” case).

the art of canvas-making, and that he develops a much-improved, revolutionary, and unforeseen canvas that can be stretched over the flexible frame of a wing-warping airplane. In relation to the Wright Brothers’ patent, a wing-warping airplane that uses the improved canvas is clearly an improvement. A later inventor has made a change to the things that were earlier disclosed by the Wright Brothers, generating new things that were not made available to the public at the time the Wright Brothers’ patent was filed.<sup>40</sup> Yet, the Wright Brothers’ infringement suit would be an “easy” case. It would be “easy” in the sense that a court would clearly rule in favor of the Wright Brothers, as the literal scope of a patent in the mechanical arts routinely grows over time to encompass devices made out of after-arising materials.<sup>41</sup> It would also be “easy” in the sense that this doctrinal rule has proven uncontroversial in the patent community. When after-arising material cases in the mechanical arts are recognized as improvement cases at all (and they frequently are not recognized as such), the uncontroversial outcomes are accepted as being in line with common sense: a patent on a new mechanism for a doorknob would reach into doorknobs made of any and all after-arising materials because, well, “a doorknob is a doorknob.”<sup>42</sup>

Critically, the conventional theory on the reach of patents into improvements cannot explain why the overlooked cases are “easy” cases. To illustrate this point, tweak the facts of the hypothetical improved-canvas airplane scenario so as to make every factor listed in the conventional theory weigh against allowing the earlier-filed patents to encompass the later-developed improvements.<sup>43</sup> First, adjust the relative importance of the inventions. Assume that the Wright Brothers’ patent on wing-warping

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40. The Wright Brothers claimed “a normally flat aeroplane” (with “aeroplane” meaning a wing surface) that could be warped. U.S. Patent No. 821,393 (filed Mar. 23, 1903). The improved-canvas wing is an improvement, as the term is used in this Article, because the set of distinct things described by the claim must therefore grow over time after the claim is filed if the claim is to encompass the improved-canvas wing. *See infra* Section III.A.2 (presenting the new-thing criterion of an improvement). If the Wright Brothers’ patent had claimed only the frame of an airplane wing, then the combination of the claimed frame and an improved canvas would not be an improvement because the frame in the improved-canvas wing is the same frame that would have been disclosed and claimed by the Wright Brothers. *See infra* notes 110–16 and accompanying text (noting that disclosed-thing cumulative innovation cases are not improvement cases).

41. Robin Feldman, *Rethinking Rights in Biospace*, 79 S. CAL. L. REV. 1, 28 (2005); Michael J. Meurer & Craig Allen Nard, *Invention, Refinement and Patent Claim Scope: A New Perspective on the Doctrine of Equivalents*, 93 GEO. L.J. 1947, 1976–77 (2005).

42. Feldman, *supra* note 41, at 3.

43. *See supra* Section II.A (listing the factors considered in the conventional theory).

technology is a minor improvement over the prior art,<sup>44</sup> and that the improved canvas is important in that it completely revolutionizes the industrial fabric industry.<sup>45</sup> Second, assume that the airplane industry is an industry characterized by cumulative technological advance and problematic markets for patent licenses.<sup>46</sup> Third, assume that invention and commercialization in the airplane industry require little, if any, sunk costs. Fourth, reject the prospect function of patents.<sup>47</sup> The irrelevance of the conventional theory is put on full display because including the assumptions in the hypothetical does not derail the intuition that, well, a wing-warping airplane is a wing-warping airplane, regardless of the canvas employed,<sup>48</sup> and that the Wright Brothers' patent should encompass the improved-canvas airplane.<sup>49</sup> Even if patent protection were to be trimmed back to something resembling a minimalist core, it is hard to imagine a viable patent regime in which the improved-canvas airplane is not within the scope of the Wright Brothers' patent. A case that the conventional theory suggests should be resolved by preventing the earlier-filed patent from encompassing the improvement (or, at the least, should be controversial) is in fact an "easy" case in which the earlier-filed patent does encompass the improvement.

For another example of an overlooked, "easy" improvement case that illustrates the blind spot in the conventional theory on patent protection for later-developed improvements, consider a functionally defined software patent with an apparatus claim.<sup>50</sup> A classic-improvement case might involve an allegedly infringing apparatus programmed with improved software that performs the claimed functions in a manner that is more efficient than the

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44. For example, assume counterfactually that someone before the Wright Brothers had figured out the trick to stabilizing an airplane by simultaneously raising and lowering wing surfaces, that the Wright Brothers only invented wing-warping as a means of achieving this end, and that wing-warping was a less valuable technology than the prior art.

45. For example, assume that wing-warping airplanes become commercially viable only when the new, lighter canvas that is strong enough to withstand the wear of constantly being stretched as a wing flexes becomes available at a reasonable cost.

46. These assumptions are not far-fetched. *See* Merges & Nelson, *supra* note 2, at 890–91 (discussing the airplane industry at the turn of the twentieth century as an industry characterized by cumulative technical advance); *cf.* SHULMAN, *supra* note 29, at 169–85 (discussing the patent fights in the airplane industry before the pooling of patents during World War I).

47. Furthermore, allowing the Wright Brothers' patent to encompass the improved-canvas airplane does not seem to entail any greater fuzziness in the meaning of an "aeroplane," so the concern that patents that reach into later-developed improvements are somehow more "abstract" does not apply to overlooked improvements. *See supra* note 28.

48. *Cf.* Feldman, *supra* note 41, at 3.

49. *Cf. infra* Part VII (outlining an economic justification of this position).

50. *See infra* Section V.B.2 (discussing software improvements at greater length).



manner disclosed in the software patent. Here, the conventional theory on patent protection for improvements has merit.<sup>51</sup> Now, assume a different improvement on the same software patent. Assume that the allegedly infringing apparatus is software that performs the specified functions in the precise manner that is disclosed in the patent, but the hardware on which the program runs is after-arising hardware. Like the improved-canvas airplane, the improved apparatus that consists of after-arising hardware is an improvement in the sense that the set of things within the earlier-issued patent must grow over time for literal infringement to lie.<sup>52</sup> Nonetheless, it would be an “easy” case for the courts: software apparatus claims routinely grow over time to describe the identical software running on after-arising hardware.

Furthermore, the case would remain an “easy” case even if one makes all of the assumptions that, under the conventional theory, would support preventing the earlier-filed patent from encompassing the later-developed improvement.<sup>53</sup> In other words, assume that the early software advance is a minor advance and the later hardware advance is a major advance, that the software industry progresses through a cumulative pattern of technical advance and that markets for patent licenses are full of friction,<sup>54</sup> that sunk costs are low in the fields of computer-related technology, and that the prospect function of patents is not important. Again, the intuition that computer software is computer software, regardless of the hardware on which it is running, is strong.<sup>55</sup> Despite the fact that many generations of hardware improvements occur during the twenty-year term of a software patent, no court has ever held that software running on after-arising

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51. See *supra* Section II.A (discussing the factors considered in the conventional theory). In brief, the earlier patentee’s assertion of rights to exclude others from the improvement should be more carefully scrutinized as the improved software becomes more important in relation to the software disclosed in the patent, the nature of technological advance in the industry becomes less cumulative, the sunk costs of invention in the industry become smaller, and the prospect function of patents becomes less important.

52. See *infra* Section III.A.2 (presenting the new-thing criterion of an improvement).

53. See *supra* Section II.A (discussing the factors considered in the conventional theory).

54. The software industry is already widely viewed as an industry in which technical advance is frequently cumulative. Bessen & Maskin, *supra* note 2, at 612; Julie E. Cohen & Mark A. Lemley, *Patent Scope and Innovation in the Software Industry*, 89 CALIF. L. REV. 1 (2001); Pamela Samuelson et al., *A Manifesto Concerning the Legal Protection of Computer Programs*, 94 COLUM. L. REV. 2308 (1994).

55. Cf. Feldman, *supra* note 41, at 3. Furthermore, allowing the earlier-filed claim to encompass the later-developed improvement does not entail any greater fuzziness in the meaning of an “apparatus,” so the concern that patents that reach into later-developed improvements are somehow more “abstract” does not apply to overlooked improvements. See *supra* note 28.

hardware is a non-infringing improvement.<sup>56</sup> Software patents as a category are controversial for some commentators.<sup>57</sup> However, assuming that patent protection for software exists as a categorical matter, the fact that an earlier-filed software claim should encompass the software executed on after-arising hardware is anything but controversial. It is difficult to imagine a viable patent regime in which software apparatus claims, if they are permitted, would not encompass the disclosed software running on later-developed hardware.

There is nothing odd or unusual about these examples of overlooked improvements. They are not once-in-a-blue-moon events. Rather, they involve ordinary, work-a-day occurrences. Yet, the scholarly literature on patent protection for improvements has more or less ignored them,<sup>58</sup> and they demonstrate the incompleteness of the contemporary theory on patent protection for improvements. To the extent that overlooked improvements have avoided sustained analytical attention, they have simply been hiding in plain sight.<sup>59</sup> Once the blind spot is brought to our attention and the “easy” cases are acknowledged as facts about the reality of contemporary patent protection that must be accounted for, a puzzle arises. There is a radical disconnect between an everyday, uncontroversial practice of treating

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56. See *infra* notes 175–77 and accompanying text.

57. See, e.g., BESSEN & MEURER, *supra* note 28, at 187–214.

58. One common theme in both the doctrine and scholarship relating to the disclosure doctrines is that broader claims are permitted when the claimed technology is more predictable. See, e.g., *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988); Sean B. Seymore, *Heightened Enablement in the Unpredictable Arts*, 56 UCLA L. REV. 127 (2008). To the extent that the mechanical arts are viewed as predictable, this theme might seem to explain the outcome of the overlooked improvement cases, like the improved-canvas airplane. The argument would be that the art is predictable, so the claims in the mechanical arts are allowed to reach deep into later-developed improvements. However, predictability is a red herring in any attempt to explain the optimal reach of earlier-filed patents into after-arising technology. Kevin Emerson Collins, *Enabling After-Arising Technology*, 34 J. CORP. L. 1083, 1094–98 (2009) (discussing the limitations of using predictability to determine the reach of patent protection into after-arising technology). Not all overlooked improvements are predictable. The later-developed material may have been highly unexpected (and thus not predicted), and yet the earlier-filed mechanical patent will encompass devices made from it. Furthermore, predictability cannot differentiate classic and overlooked improvements. The later development of other materials in general may have been expected, but the later development of other means of simultaneously raising and lowering surfaces on an airplane in general would likely have been expected, too.

59. These cases have been able to hide in plain sight because, to employ a Kuhnian frame, they cannot be explained using the dominant conceptual paradigm that identifies things as the primitives of a patentable invention and that is (inaccurately) understood to be a necessary artifact of the contemporary peripheral claiming regime. See *infra* notes 337–40 and accompanying text.

overlooked improvements as “easy” cases and a contemporary theory that suggests the practice should, at least under some circumstances, be highly controversial.<sup>60</sup> To eliminate the explanatory gap between the theory and reality of contemporary patent protection, something has to give. As outlined in the following Section, this Article resolves the puzzle by defending the practice and amending the theory so that it is capable of explaining the practice.<sup>61</sup>

C. THE CORRECTIVE LENS: PROPERTIES, NOT THINGS, AS THE LOCUS OF INVENTION

Given that the conventional theory on patent protection for improvements gains normative traction in the classic-improvement cases but not in the overlooked-improvement cases, the simplest way to correct the blind spot would be to identify an additional factor that distinguishes overlooked improvements from classic improvements. The normative importance of this factor must be so great that the new factor trumps the factors addressed in the conventional theory on improvements that weigh in favor of allowing the improver to escape the earlier-issued patent. This Article adopts this find-a-new-factor approach to correcting the blind spot in the conventional theory. However, in order to identify this factor, it has to undermine and replace one of the most widely-shared conceptual frameworks structuring contemporary understandings of patent law and theory.

Contemporary patent discourse is insistent on the notion that *innovative things* in their entirety are the primitives of the inventions that are protected by patent claims.<sup>62</sup> What is an inventor’s patentable invention? Today, the only permissible way to answer this question is to point to the set of things encompassed by the claims to which the inventor is legally entitled. As Jeff Lefstin has noted, “[i]n modern patent parlance, ‘the claim,’ ‘the invention,’

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60. As a doctrinal matter, the existence of the “easy” overlooked-improvement cases also undermines the strong fixation theory of literal claim scope. *See infra* Part VIII (presenting and undermining this theory).

61. The opposite tack is also possible, at least in theory. One could argue that infringement cases involving overlooked improvements should not be “easy” cases in which the rights of earlier-filed patent owners routinely expand over time. However, if patents are to structure a market for embodied ideas, this argument would be difficult to defend on a normative level. *See infra* Part VII (defending differential treatment of classic and overlooked improvements as a normative matter).

62. “Primitives” refers to basic units of a system that are “not derived from something else.” THE AMERICAN HERITAGE COLLEGE DICTIONARY 1087 (3d ed. 2000). *Cf. infra* note 87 (noting that this Article does address process claims).

and ‘the patent’ are essentially synonymous.”<sup>63</sup> This approach to identifying inventions as sets of things operates on a coarse level of granularity. Precisely what it is about the claimed things that makes them inventive is ignored. Any attempt to identify what an inventor has invented at a level of granularity that is finer-grained than a set of things—that is, any attempt to identify the “spirit” or point of novelty of the patented things that differentiates them from the prior art—is categorically dismissed.<sup>64</sup>

This dismissal of the relevance of the “spirit” or point of novelty of an invention is often justified with dubious reasoning. Sometimes, the dismissal is justified with the inaccurate assumption that a finer-grained approach is incongruous with the modern “peripheral” claiming regime.<sup>65</sup> Sometimes, it may be grounded in the highly questionable twin intuitions that innovative things are stable, real-world entities that make for a good conceptual foundation for patent protection and that the “spirit” of an invention is a nebulous mental construct that is administratively unmanageable.<sup>66</sup>

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63. Jeffrey A. Lefstin, *The Formal Structure of Patent Law and the Limits of Enablement*, 23 BERKELEY TECH. L.J. 1141, 1145 (2008). Oskar Liivak has similarly noted that “[t]he invention itself has no substantive existence other than as a short-hand for the subject matter that a patentee can claim.” Oskar Liivak, *Rescuing the Invention from the Cult of the Claim 9* (Feb. 24, 2011) (unpublished manuscript), available at <http://ssrn.com/abstract=1769270>. Liivak also offers a historical explanation for this state of affairs. One purpose of the 1952 Patent Act was to change the way of measuring how much of a technical advance was needed to obtain patent protection. The Act replaced problematic judicial discussions of “the requirement of invention” with the nonobviousness provisions of § 103. A substantive definition of an inventor’s invention for the purpose of determining claim scope—substantive in the sense that it does not simply reference the set of things encompassed within a valid claim—is distinct from the concept of the amount of inventiveness required to surmount the nonobviousness threshold. Nonetheless, because both concepts are associated with the word “invention,” a substantive definition of what an inventor has invented was the baby that was thrown out with the bathwater of the requirement of invention in post-1952 opinions. *Id.* at 40–42.

64. For an extended analysis of the courts’ rejection of the relevance of the “spirit” of an invention, see Bernard Chao, *Breaking Aro’s Commandment: Recognizing That Inventions Have Heart*, 20 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 1183 (2010); Mark A. Lemley, *Point of Novelty* 3–9 (Stanford Pub. Law, Working Paper No. 1735045, 2011), available at <http://ssrn.com/abstract=1735045>.

65. For typical language rejecting the use of the “spirit” of an invention in the construction of a peripheral claim, see *Ormco Corp. v. Align Tech., Inc.*, 498 F.3d 1307, 1322–23 (Fed. Cir. 2007) (“This court . . . has rejected a claim construction process based on the ‘essence’ of an invention.”). The assumption that peripheral claims and a focus on the “spirit” of the invention cannot coexist as a logical matter is addressed, and rebutted, below. See *infra* Part VIII.

66. The concept of the innovative properties around which this Article is structured provides an intuitive, real-world grounding for discussions of the “spirit” of an invention. Inversely, it is important not to overstate the case that innovative things are stable, real-world entities. The things at issue in the determination of claim scope and validity are thing-

However, the motivation to ignore the point of novelty of an invention in patent law may also be grounded in an application of the classic rules-standards debate that should not be lightly tossed aside.<sup>67</sup> Identifying the “spirit” of an invention is an information-intensive and error-prone exercise. It takes work to identify the one or more ways in which a patented invention differs from the prior art. Positioning coarse-grained innovative things as the primitives of invention means that less information needs to be considered to decide issues. It is easier to say that a thing is innovative than to say precisely why a thing is innovative, especially if there are several alternative reasons why a thing is innovative. The analysis that follows from focusing on innovative things rather than an innovative “spirit” may, at times, result in greater deviation from the ideal scope of a valid patent claim. However, under some circumstances, the cost of this deviation may be outweighed by benefits of more predictable outcomes and less costly adjudication. Using only innovative things to define patent rights may, in some circumstances, be an efficient proxy for the innovative “spirit” of things, even if the latter more closely reflects a patentee’s contribution to technological progress.<sup>68</sup>

Therefore, this Article does not make a blanket claim that it is always important to identify the innovative “spirit” of the things encompassed within a valid patent claim. This Article launches a much more targeted attack. Whatever the merits of this refusal to parse the nature of invention more finely in the context of other patent doctrines, it proves to be highly problematic in the context of patent protection for improvements.<sup>69</sup>

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types, not thing-tokens. Types are mental constructs that people carry in their heads, just like the “spirit” of an invention. Kevin Emerson Collins, *The Reach of Literal Claim Scope into After-Arising Technology: On Thing Construction and the Meaning of Meaning*, 41 CONN. L. REV. 493, 514–38 (2008) (illustrating the importance of “thing construction” in patent law). Cf. Michael J. Madison, *Law as Design: Objects, Concepts, and Digital Things*, 56 CASE W. RES. L. REV. 381 (2005) (mulling on the importance of the definition of things in intellectual property in general).

67. The primary dimension of the rules-standards debate at issue portrays rules as entrenched generalizations that impose costs in the form of over- and under-inclusiveness in relation to the rule’s justification. FREDERICK SCHAUER, *PLAYING BY THE RULES: A PHILOSOPHICAL EXAMINATION OF RULE-BASED DECISION-MAKING IN LAW AND IN LIFE* (1991). Rules and standards can also be defined by the ex ante and ex post time at which law is made. See Louis Kaplow, *Rules Versus Standards: An Economic Analysis*, 42 DUKE L.J. 557 (1992).

68. See SCHAUER, *supra* note 67, at 145–49 (addressing the efficiency justification of over- and under-inclusive rules).

69. Recent scholarship suggests that interest in a patent doctrine that pays more attention to the “spirit” of an invention (or its heart, core, essence, or point of novelty) may be on the rise. See Chao, *supra* note 64, at 1227–38 (arguing that the heart of an invention has relevance in many patent doctrines); Lemley, *supra* note 64 (considering instances in which the point of novelty of an invention does and should have relevance in patent doctrine).

Whenever a coarse-grained, rule-like factual analysis is employed instead of a fine-grained, standard-like one, information is lost. In other words, a more granular picture provides a lower-resolution image and reveals less detail. Similarly, the coarse-grained understanding of invention that positions things as the primitives of what an inventor invents and that structures contemporary patent theory is a low-resolution conceptual framework. Sometimes, the information lost in a coarse-grained analysis is not important, but, when the issue is patent protection for later-developed improvements, it is. It is the root cause of the inability of the conventional theory on improvements to identify and justify the distinction that already exists between the outcomes of contested classic-improvement cases and “easy” overlooked-improvement cases. The factor that differentiates classic and overlooked improvements can only be measured with reference to the “spirit” of the inventions produced by the earlier and later inventors that exist in any improvement scenario. To identify the systematic difference between classic and overlooked improvements, the locus of invention must be identified at a finer-grained level.

To talk about the vague concept of the “spirit” of a set of patented things in a precise and accessible manner, this Article argues that it is useful to identify innovative properties of things, rather than innovative things in their entirety, as the locus of invention. A property of a thing “is what is variously called a feature, quality, attribute or . . . a way that something is.”<sup>70</sup>

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However, no court or scholar has addressed the role that the “spirit” of an invention has to play in determining patent protection for improvements or the reach of peripheral claims into after-arising technology. Even advocates of the use of a point of novelty approach to patent law in other contexts usually adhere to the strict rule that the determination of the scope of a peripheral claim and a point of novelty approach are incompatible. Chao, *supra* note 64, at 1187 (“The heart of the invention should not be considered when the law needs to determine when something falls within the boundaries outlined by a patent’s claims.”). In contrast, this Article argues that the point of novelty of an invention must be considered even when using the “all elements” rule and determining the scope of a valid peripheral claim. *See infra* Part VIII.

70. Daly, *supra* note 9. To the same end, consider the following common-sense definition of a “property”:

Asked to describe a given tomato, you might cite its redness, its size and its age. In doing so, some philosophers would claim, you have cited some of the tomato’s properties. A property is what is variously called a feature, quality, attribute or (as some philosophers put it) a way that something is. A property is supposed to be an entity that things (including particulars, such as tomatoes or people) have.

*Id.*; *see also* Chris Swoyer, *Properties*, in STANFORD ENCYCLOPEDIA OF PHILOSOPHY § 1.1 (rev. ed. 2000), *available at* <http://plato.stanford.edu/entries/properties/> (offering another common-sense definition of a property). Only a rough, working definition of a property is needed here, and only such a definition is possible. A definitive philosophical definition of a

Properties are familiar metaphysical entities. *Being red* is a property, as is *being six inches long* and *being on the edge of a desk*.<sup>71</sup> Properties are finer-grained entities than things are. *Being red* is only one of many properties possessed by a McIntosh apple. Things, in turn, can be defined on an intuitive level by the sum total of the properties that they possess.<sup>72</sup> Properties of things offer a new way of describing what an inventor has invented that is more specific than talk about sets of innovative things.<sup>73</sup> Grossly described, inventors who produce patentable inventions create new things. For example, the inventor of a slow-release pill has created a pill, or set of pills if the slow-release matrix works with many different drugs, that did not previously exist. At a more detailed level, however, what inventors do when they invent things is to create innovative properties of things. They reconfigure material so that it possesses properties that the things in the prior art did not possess, and any property not possessed by the prior art is an innovative property (at least in the sense that it makes the things that possess it novel things). For example, the inventor of the first slow-release version of a pill endows things with innovative properties like *having a particular matrix structure in which the drug is embedded* or *being able to release an active ingredient slowly over time in the human digestive tract*.<sup>74</sup> Identifying the innovative properties as the locus of invention is a more fine-grained way of talking about invention. Stating that an inventor invented a set of things does not convey as much information as stating that an inventor invented the particular properties that make the thing innovative. The reason that talk of properties conveys a finer-grained understanding of invention is that patented things do not have a fully new slate of properties. They are agglomerations of properties, some of which

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property would entail a complex ontological discussion that is beyond the scope of this Article. Philosophers who study properties even disagree about whether properties exist. *See generally* Daly, *supra* note 9, § 1.

71. For clarity, this Article uses the stylistic convention of putting all properties recited in the text in italics.

72. The notion that things can be defined by a set of properties is a corollary of “Leibniz’s Law,” which holds that no two discernable objects have exactly the same set of properties. Peter Simons, *Identity of Indiscernibles*, in ROUTLEDGE ENCYCLOPEDIA OF PHILOSOPHY, *supra* note 9 (discussing the identity of indiscernibles).

73. Properties also provide a convenient (but today absent) link between the distinct realms of material things and ideas per se, both of which are important in patent theory. Properties can be taken to be the entities that instantiate or embody innovative ideas in things. *See infra* note 220 and accompanying text.

74. Innovative properties can be either structural or functional. This distinction is important in determining an inventor’s rights in classic-improvement cases as functional properties often operate at a higher level of generality than structural properties do. *Cf. infra* notes 242–48 and accompanying text (introducing the concept of the “least-general naked property” of a classic improvement).

existed in the prior art and some of which did not (and are thus the locus of the inventor's invention). Patentable things must have at least one novel and nonobvious property to be patentable, but they also possess many properties that prior-art technologies already possessed at an earlier point in time.<sup>75</sup> For example, the newly invented slow-release pills discussed above are newly invented things that have properties like *being round*, *having active chemical entity X*, and *weighing 0.1 ounces*, all of which are properties of prior art pharmaceuticals as well.

Focusing on properties of things, rather than things in their entirety, as the primitives of what an inventor has invented enables a finer-grained analysis of invention in improvement cases. If the conventional framework is adopted and innovative things are taken to be the primitives of what an inventor invents, then all that can be said about the intrinsic qualities of an improvement in relation to the things disclosed and claimed by the earlier patentee is that the improvement is a new thing that was not made available to the public by the earlier inventor's patent disclosure. In this information-poor environment, one cannot even coherently pose a question about the extent to which the improvements still embody or manifest in some way the invention that justified the earlier-issued patent. To do so would require a concept of an invention that facilitates a comparison between two sets of things: the set of things made available by the earlier patentee and the set of things produced by the later improver. A concept of an invention that is itself a set of things, without more, cannot perform this job.

Thus, in this information-poor environment, the only way to draw distinctions between different improvement cases is to look outward to the context in which the earlier- and later-invented sets of things exist. This outward-looking approach is precisely the one that the conventional theory on patent protection for improvements takes. It looks to consumer demand for the earlier-invented things and the later-improved things.<sup>76</sup> It looks to the patterns of technical advance and licensing in an industry.<sup>77</sup> It looks to the magnitude of the sunk costs of innovation in an industry.<sup>78</sup> It toggles

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75. The argument is not that any inventor's achievement can be correctly summarized as a single advance or that patented things possess a sole innovative property. Innovative things may possess multiple, distinct innovative properties. They may also embody multiple, nested innovative properties that describe the technical progress generated by an inventor at varying levels of generality. The multiple levels of generality are critical to understanding classic-improvement cases in terms of successively invented properties. *See infra* Section V.A (defining a classic improvement in terms of successively invented properties).

76. *See supra* notes 18–21 and accompanying text.

77. *See supra* notes 22–23 and accompanying text.

78. *See supra* notes 24–26 and accompanying text.



between different mechanisms through which patent rights can be welfare-enhancing tools.<sup>79</sup>

By zooming in more precisely on innovative properties of things as the inventions of the successive inventors, the information-rich nature of the environment becomes apparent. Even as coarser-grained things change over time, finer-grained properties can remain constant, allowing an earlier inventor’s invention to be tracked through later-developed improvements. The intrinsic qualities of the earlier-invented and later-improved things can be compared, and the factor that distinguishes overlooked from classic improvements comes into focus. The difference between the two types of improvements stems from two different ways in which the properties invented by successive inventors relate to each other in an improved thing.

In a classic improvement, the properties invented by the improver *refine* the properties invented by the earlier inventor.<sup>80</sup> The improvement possesses the most general of the earlier inventors’ innovative properties, but the improver’s innovative properties displace the most specific of the earlier inventor’s innovative properties. In other words, the improver’s invention *compounds with* the earlier inventor’s invention framed in its most general fashion, but it *supplants* the earlier inventor’s invention framed in its most specific fashion. For example, Curtiss’s improved airplane continued to embody the Wright Brothers’ innovative idea about raising and lowering wing-surfaces simultaneously.<sup>81</sup> Curtiss’s improvement still possessed the property *having a plurality of surfaces that can be raised and lowered simultaneously*. However, Curtiss’s innovative property—*having a flap (aileron) that can move independently of the wing surface*—displaced the Wright Brothers’ more specific idea about wing-warping, as planes with ailerons do not possess the property *having a wing surface that is capable of being warped*.

In contrast, overlooked improvements do not involve the refinement of properties. The overlooked improvements involve later-invented properties that only compound with, and do not supplant at all, the earlier-invented properties.<sup>82</sup> For example, the process of improving the airplane to generate the improved-canvas version does not displace the properties that embody the Wright Brothers’ technological advance in an airplane. The improved

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79. See *supra* notes 27–28 and accompanying text.

80. This relationship of refinement is explored in more detail *infra* Part IV.

81. The following analysis to distinguish classic and overlooked improvements builds on the discussion of the inventions of the Wright Brothers and Curtiss. See *supra* notes 29–32, 40 and accompanying text. The identical analysis can be built on a software example. See *supra* notes 51–52 and accompanying text; *infra* Section V.B.2.

82. This relationship of pure compounding is explored in more detail *infra* Part V.

canvas airplane still possesses the full range of the Wright Brothers' innovative properties at all levels of generality, from *having a plurality of surfaces that can be raised and lowered simultaneously* to *having a wing surface that is capable of being warped*.<sup>83</sup> The improver's innovative properties—including *being made of a later-developed canvas*—only compound with the Wright Brothers' innovative properties. The Wright Brothers' technological advance is wound up in the properties that enable a wing to warp; the Wright Brothers neither invented any canvas nor pioneered advances in the use of the existing canvas in airplane construction. The improved canvas is a distinct advance in a different technological area that is built on an independent foundation of knowledge, and it is embodied in properties of the airplane that are functionally independent of the properties that embody the advance of wing-warping. Thus, despite the fact that the improved-canvas airplane is an improvement that was not disclosed to the public by the Wright Brothers' patent, it embodies the Wright Brothers' invention just as much as the wing-warping airplanes that were actually disclosed by the Wright Brothers' patent.

Importantly, a shift to a focus on properties as the locus of invention is not proposed because precision is an end in and of itself.<sup>84</sup> Adopting a fine-grained conceptual framework in which inventors invent properties of things brings to light a factual difference that distinguishes classic and overlooked improvements. This factual difference does not register in a coarse-grained conceptual framework that takes things in their entirety to be the primitives of what an inventor invents. A focus on properties as the locus of invention is desirable because it is a tool that can do what the contemporary focus on things as the primitives of invention cannot. By allowing courts and scholars to differentiate classic and overlooked improvements, it can reduce the gap between theory and practice and explain an uncontroversial feature of how the contemporary patent regime already works.<sup>85</sup>

### III. DEFINING AN IMPROVEMENT

The legal and economic literature on patent protection for improvements defines an improvement in many different ways. To head off confusion,

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83. *But cf. infra* note 158.

84. In fact, precision can have costs if the information needed to be more precise is costly to obtain and consider. *See supra* notes 67–68 and accompanying text (framing the choice between things and properties as the locus of invention in terms of the rules-standards debate).

85. A focus on properties as the locus of invention also reveals an additional factor that is relevant when determining the reach of earlier patentees' rights into later-developed classic improvements. *See infra* notes 242–48 and accompanying text (introducing the concept of a classic improvement's least-general naked property).

Section III.A provides the three criteria that define an improvement as the term is used in this Article. To clarify this definition, Section III.B emphasizes that improvement is only one species of the broader genus of means through which cumulative innovation occurs. Section III.C briefly addresses the doctrinal mechanics of how earlier inventors’ patent claims can extend to later-developed improvements. The purpose of this short digression into patent doctrine is simply to demonstrate that patent doctrine, at least on its rhetorical surface, does not provide any basis for distinguishing classic and overlooked improvements.

A. THE THREE CRITERIA THAT DEFINE AN IMPROVEMENT

This Article uses the term “improvement” as a term of art that requires a definition.<sup>86</sup> This Section provides this definition by identifying the three necessary criteria of an improvement.

1. *The Thing Criterion*

The first criterion is that improvements are things—the entities that are described and privatized by patent claims.<sup>87</sup> This criterion is important because the term “improvement” could be used to refer to an idea or increment of newly discovered technological knowledge that makes it possible for humans to conceive and/or make new things. Here, however, it is not. For clarity, this Article refers to these increments of technological knowledge as innovative ideas or advances.

2. *The Timing (or New-Thing) Criterion*<sup>88</sup>

Improvements are not disclosed or made available to the public by any earlier-issued patent (or other prior art).<sup>89</sup> Improvement stories always feature two inventors, one acting after the other.<sup>90</sup> The first invents a technology and

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86. A key feature of the definition is that it avoids reference to the legal outcome of a patent infringement suit. For example, an improvement cannot be defined as a later-developed technology that falls within the scope of an earlier-filed claim. Such a definition would lead to circular reasoning, as the goal of the exercise is to identify which improvements should be within the control of an earlier inventor.

87. The phrase “improvement-as-thing” is therefore redundant, but this Article periodically uses it nonetheless for emphasis. Things include machines, manufactures, and compositions of matter. *See* 35 U.S.C. § 101 (2006). Processes are also patent-eligible subject matter, *id.*, but this Article brackets discussion of process claims and defers it to a later date.

88. Both the second and third criteria illustrate that an improvement can only be defined in relation to a particular patent.

89. *See supra* note 3.

90. It is possible for a single person acting at different times to fill both roles, but the reach of the earlier patent into improvements is not as important in this situation. *See supra* note 16.

patents it, and the second improves on it.<sup>91</sup> The second inventor uses the ideas disclosed in the earlier patent as inputs in an inventive process, and he produces things that are intrinsically new<sup>92</sup> and that are an inventive stride beyond the things disclosed by the earlier inventor. For simplicity, improvements always involve technological advances over the prior art, which at the time of the improvement includes the earlier patent disclosure.<sup>93</sup> The later-developed improvement can therefore never be disclosed by a patent on the earlier-developed, improved-upon technology. An improver makes new things after the filing of the earlier patent. He does not make, use,

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91. Despite what its everyday meaning might suggest, an improvement in patent law need not be technically superior to the prior art. It need not be better at satisfying consumer preferences or reducing production costs. It merely needs to be innovatively different from the prior art. Giles S. Rich, *The Principles of Patentability*, 28 GEO. WASH. L. REV. 393 (1960) (explaining that an invention need not be better than the prior art to be patentable).

92. The phrase “intrinsically new” denotes that the inventor must produce a new thing and not simply discover a new purpose for an old thing or put an old thing into a new context that contains after-arising things. See *infra* text accompanying notes 110–16 (noting that disclosed-thing cumulative innovation cases are not improvement cases). For a detailed discussion of an intrinsic property and how it differs from an extrinsic property, see Collins, *supra* note 66, at 520–36.

93. A patent specification directly discloses, and thus makes available to the public, only the small set of things that it describes in full. (Even this is an idealization, however, as things are never described “in full.”) However, it also constructively discloses the broader set of things that the person having ordinary skill in the art would have readily thought of, and understood how to make, after reading the disclosure. See *infra* notes 130–33 and accompanying text (discussing patent law’s disclosure doctrines). Therefore, many later actors who make minor changes to the precise things disclosed in full in a patent specification do not generate improvements as the term is used in this Article because they produce things that were constructively disclosed. *But cf.* Lemley, *supra* note 2, at 1007–08 (labeling such later actors as “minor improvers”). For convenience, it is simplest to assume that the threshold of what divides a thing that is not constructively disclosed by a specification from a thing that is, and the threshold of what constitutes a patentable improvement that satisfies the nonobviousness requirement, are identical. That is, it is simplest to assume that all improvements involve patentable advances over the prior art, that all improvers can obtain patent protection for their improvements, and that overlapping blocking patents will result if the earlier inventor’s claim is allowed to encompass the improvement. *Cf. infra* text accompanying note 297 (distinguishing overlapping and economic blocking patents). However, whether the improver actually seeks patent protection at the PTO is irrelevant to the issue at hand, namely whether the earlier patentee’s rights should encompass the improvement. Furthermore, it is possible to imagine that the threshold of an advance that generates a thing that is not constructively disclosed by an earlier patent and the threshold of a patentable advance should not perfectly align. However, this additional wrinkle would not affect the distinction between classic and overlooked improvements explored in this Article. A perfect alignment of the thresholds is therefore assumed to simplify the analysis.

or sell things that were disclosed and made available to the public by the earlier patent upon which he improves.<sup>94</sup>

3. *The Embodies-the-Earlier-Advance Criterion*

A later-developed thing is an improvement in relation to an earlier-patented technology only if it continues to embody in some way the technological advance that justified the issuance of the earlier patent.<sup>95</sup> This criterion may at first be counterintuitive to readers steeped in patent discourse because the term “embodiment” already has a common meaning in patent rhetoric. It is used as a noun to mean a thing that is disclosed in a patent specification or, more broadly, at least a thing that falls within the scope of a patent.<sup>96</sup> This conventional meaning of “embodiment” is unhelpful here because it reinforces the dominant paradigm in which things are the primitives of what an inventor invents.<sup>97</sup> To the extent that the term “embodiment” should still be used at all as a noun in this Article, it means a property, or a set of properties, of a thing, not a thing in and of itself.<sup>98</sup>

The embodies-the-earlier-advance criterion is needed because it differentiates an improvement from a generic after-arising technology.<sup>99</sup> Without this criterion, every after-arising technology would be an improvement. For example, assume that a first, earlier inventor invents a new drug that cures the common cold, and a second, later inventor invents a new coffee sleeve. The new coffee sleeve is a thing (satisfying the thing criterion),<sup>100</sup> and it is a new thing, not disclosed in the drug patent, that embodies an advance over the state of the art at the time the drug patent was

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94. The phrase “later-developed improvement” is therefore redundant, but this Article periodically uses it nonetheless to differentiate the issue of the patent protection that the earlier inventors can get for subsequent improvements from the issue of the patent protection that the later-acting improvers can get for their own improvements.

95. In turn, what it means for a thing to embody an earlier inventor’s advance or idea can be taken to be nothing more than what it means for a thing to possess at least one innovative property that is attributable to the earlier inventor. *See supra* notes 70–75 and accompanying text (introducing the concept of a property); *infra* note 220 and accompanying text (positioning a property as the entity that instantiates an idea in a thing).

96. *See, e.g.*, *AK Steel Corp. v. Sollac*, 344 F.3d 1234, 1244 (Fed. Cir. 2003) (using a “disclosed embodiment” to describe a technology revealed in the specification); *Waymark Corp. v. Porta Sys. Corp.*, 245 F.3d 1364, 1368 (Fed. Cir. 2001) (using “infringing embodiment” to describe a technology that falls within a patent claim).

97. *See supra* notes 62–67 and accompanying text (presenting this dominant paradigm).

98. *Cf. supra* note 96 (noting uses of “embodiment” that refer to things).

99. Although this distinction is conceptually important to understand the mechanics of patent protection, little of economic import turns on the distinction between improvements and after-arising technology that is not an improvement. *See infra* note 123.

100. *See supra* Section III.A.1.

filed (satisfying the timing, or new-thing, criterion).<sup>101</sup> Yet, the concept of an improvement loses its utility if its meaning is so broad that the coffee sleeve is an improvement on the drug patent. Later-developed things that are entirely unrelated to the ideas that justified the issuance of an earlier patent should generically be after-arising technologies, not improvements. The embodies-the-earlier-advance criterion provides an intuitive upper limit on the notion of an improvement that allows improvements to occur only when the later-developed thing continues to embody in some way the technological advance of the earlier patentee.

The economic literature on improvements offers two definitions of an improvement that could be used to provide this limit without reference to the notion of a thing embodying an earlier inventor's advance. However, neither is satisfactory for the purpose of this Article because neither corresponds to how the patent regime actually works.

First, an improvement could be identified with a process-oriented definition under which an improvement exists whenever a later innovation is facilitated by an earlier one.<sup>102</sup> Following this definition, a later-developed thing could only be an improvement on an earlier-developed thing if the later inventor actually knew of and built upon the earlier inventor's work in some way, whether consciously or unconsciously. In other words, the status of a later-developed thing as an improvement would be contingent on a later actor getting a leg up from a prior actor. This definition is fatally over- and under-inclusive with respect to the actual patent regime. There are many cases in which products made by earlier-generation inventors facilitate the inventions of later-generation inventors that are not improvement cases.<sup>103</sup> For example, the earlier invention of a particular type of blast furnace may facilitate the later invention of a new type of metal alloy, but the metal alloy is not an improvement on the furnace. Inversely, there are many improvement cases in which the later inventor is ignorant of the earlier inventor's work, meaning that there is no actual facilitation. Copying is not an element of a cause of action in patent infringement,<sup>104</sup> and thus independent improvement

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101. See *supra* Section III.A.2.

102. Scotchmer, *supra* note 2, at 31 (discussing a variety of ways in which earlier inventions can facilitate the development of later inventions).

103. See, e.g., *infra* notes 110–16 and accompanying text (discussing disclosed-thing cumulative innovation cases); *infra* notes 117–18 and accompanying text.

104. See *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1328–30 (Fed. Cir. 2009). In contrast, copyright requires copying as an element of infringement. *Arnstein v. Porter*, 154 F.2d 464, 468–69 (2d Cir. 1946).

is not a defense to patent infringement.<sup>105</sup> Later generations may produce things that are improvements on the things generated by earlier inventors and that infringe earlier patents even if the later generations are entirely unaware of the earlier inventors’ efforts.<sup>106</sup>

Second, the economic literature identifies improvements as economic substitutes. An improvement could exist whenever a later-developed thing is an economic substitute for an earlier-developed thing.<sup>107</sup> While it is true that most—but not all—improvements are things that are economic substitutes for earlier-patented things,<sup>108</sup> the inverse statement does not hold true. It is difficult to conceive of a later-developed mouse poison as an improvement on an earlier-developed mousetrap as the term “improvement” is commonly used in patent law.

#### B. IMPROVEMENT AS A SPECIES OF CUMULATIVE INNOVATION

Technological progress is a cumulative endeavor. The outputs of the work of earlier generations of inventors are inputs into the work of later generations of inventors.<sup>109</sup> Improvements clearly implicate cumulative innovation. Earlier inventors produce innovative things, and later inventors figure out a way to make better things that still embody some of the innovative ideas of earlier inventors. However, it is important not to equate cumulative innovation with improvements or assume that a solution to the problem of patent protection for improvements in patent law is a silver bullet for the problem of distributing rewards among multiple generations of inventors. Improvements are only a species of the broader genus of mechanisms through which cumulative innovation occurs, and cumulative innovation presents many challenges to the patent regime that do not involve

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105. One can reasonably argue that independent invention should be a defense to patent infringement. *See, e.g.,* Oskar Liivak, *Rethinking the Concept of Exclusion in Patent Law*, 98 GEO. L.J. 1643 (2010); Samson Vermont, *Independent Invention as a Defense to Patent Infringement*, 105 MICH. L. REV. 275 (2006) (considering the implications of an independent-inventor defense). A component of this argument is that the reach of an earlier patentee’s rights into later-developed improvements should be contingent on process, too, and that later-developed improvements should infringe earlier-issued patents only when the later actor has actually learned something from the earlier inventor.

106. Recognizing that independent invention can yield improvements, it is still possible to identify constructive facilitation in all improvement cases. If the later improver had known of and read the earlier patentee’s disclosure, the disclosure would have facilitated the improver.

107. *See infra* Section VII.C.1 (defining complements and substitutes).

108. *See infra* notes 276–78 and accompanying text.

109. Rebecca S. Eisenberg, *Patents and the Progress of Science: Exclusive Rights and Experimental Use*, 56 U. CHI. L. REV. 1017, 1055 n.161 (1989) (listing sources from the sociology of science that discuss the cumulative nature of technological progress).

improvements. To clarify what improvements are by illustrating what they are not, this Section briefly addresses two types of cases that implicate cumulative innovation but do not involve improvement.

First, there are cumulative innovation cases in which later innovators use the exact things disclosed and made available to the public by earlier inventors. These cases are *disclosed-thing* cumulative innovation cases. They are not improvement cases because the things that the later innovators make or use do not satisfy the timing (or new-thing) criterion of an improvement.<sup>110</sup> In some disclosed-thing cases, the earlier-disclosed things are components of products that also contain after-arising technologies. For example, earlier-invented smaller chips (A) allow later inventors to design innovative, light-weight devices (B) that are sold to consumers with the chips integrated therein (A+B).<sup>111</sup> After-arising component cases are not improvement cases: the earlier-filed claim to A can encompass the combination of A+B without any expansion in the set of distinct things that it describes.<sup>112</sup> To be an improver in the technical sense that raises the issue of the reach of patent protection into later-developed things, the later innovator must produce an A' that does not contain an A as a component. In other disclosed-thing cumulative cases, later inventors discover new uses for earlier-invented technologies. The earlier patentees of things may control those things even when the things are being used in later-discovered ways.<sup>113</sup> Again, the earlier patents can encompass the later new-use innovations without having to encompass any new thing, so new-use innovation cases are not improvement

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110. See *supra* Section III.A.2.

111. Some after-arising component cases involve infringing technologies that can be intuitively called improvements, even though they are not improvement cases in the technical sense. For example, assume that an earlier inventor patents chemical A, a cleaner. A later inventor may invent chemical B, an additive that does not change A's chemical structure but that increases A's cleaning efficacy. In an everyday sense, the later inventor has created an improvement, as A+B cleans better than A does. In the more technical, patent sense, however, there is no improvement. The combination A+B infringes the earlier claim to A not because A+B is an improvement but because the A in A+B is the same old A that the earlier inventor disclosed in her patent specification. The later inventor has used A as a component in combination with a distinct, complementary, and after-arising thing.

112. The scope of the claim to A does not need to expand to encompass A+B because the new property of A that has been invented by the later innovator—its property of *being in a combination with B*—is an extrinsic property of A and therefore does not define the thing-type A as distinct from other thing-types. See Collins, *supra* note 66, at 520–36 (distinguishing between intrinsic and extrinsic properties).

113. See *A.B. Dick Co. v. Burroughs Corp.*, 713 F.2d 700, 703 (Fed. Cir. 1983) (“[A] pencil structurally infringing a patent claim would not become noninfringing when incorporated into a complex machine that limits or controls what the pencil can write.”).



cases.<sup>114</sup> In yet other disclosed-thing cases, the later inventor may use a tangible instance of an earlier-disclosed thing as an input into technological progress but not as a part of whatever product (if any) is eventually invented. For example, the disclosed thing may be a research tool.<sup>115</sup> Despite the fact that they are wound up in the process of cumulative innovation, the later inventors in these disclosed-thing cases have generated improvements.<sup>116</sup>

Second, there are *idea-only* cumulative innovation cases. In idea-only cases, an idea qua idea—that is, a thought about or a representation of knowledge itself—is both the input into and the output of the later actors’ efforts. Later actors use the knowledge generated by earlier inventors and disclosed in patent specifications as an input into further mental progress in technological ideas per se, and they generate new mental knowledge without generating any new things at all. For example, an earlier inventor may patent a molecule that is useful for treating a disease. The patent specification discloses the structure of the molecule. After the patent has been filed, someone else may learn the knowledge of the protein structure disclosed patent specification, appropriate an idea qua idea from the earlier patent, and have a “Eureka!” moment. He may realize that if a molecule with the

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114. Again, the scope of the claim to A does not need to expand to encompass A when used in a later-developed manner because the new property of A that has been invented by the later innovator—its property of *being put to a new use*—is an extrinsic property of A and therefore does not define the thing-type A as distinct from other thing-types. See Collins, *supra* note 66, at 520–36 (distinguishing between intrinsic and extrinsic properties).

115. See SCOTCHMER, *supra* note 24, at 132–33.

116. Because they involve cumulative innovation, disclosed-thing cases raise the specter of first-generation rights impeding second-generation progress. Cf. *infra* Section VII.C.2.a (framing the successive inventions in cumulative innovation as complements). However, whatever tempering of the first-generation rights is required to address the problem cannot be accomplished by tailoring the size of the set of distinct things that falls within claim scope. Armed only with the rights to the set of things that is needed to prevent “pirates” from copying their inventions, patentees have sufficient patent scope to reach the conduct of the later inventors in disclosed-thing cases. Rather, the tempering must be achieved with other policy levers. User-specific defenses to patent infringement, such as the experimental use defense, are the topic of much commentary in research tool cases. See, e.g., Eisenberg, *supra* note 109; Katherine J. Strandburg, *What Does the Public Get? Experimental Use and the Patent Bargain*, 2004 WISC. L. REV. 81. Less powerful remedies, such as the denial of injunctive relief or the lowering of the reasonable royalty, are commonly discussed as ways of dealing with after-arising component cases. See *eBay Inc. v. MercExchange, L.L.C.*, 547 U.S. 388, 396–97 (2006) (Kennedy, J., concurring) (stating that injunctive relief may not be appropriate when a patented invention is a small component of a larger product); Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991 (2007) (addressing the royalty stacking problem that results from many reasonable-royalty damages in multi-component products). The reverse doctrine of equivalents, too, can be used to excuse a later innovator in a disclosed-thing cumulative innovation case from infringement. See *infra* note 140 and accompanying text.

molecular structure revealed in the patent has a particular biological activity, then perhaps the metabolic pathway in a cell must include a particular step in order for the molecule to have that activity. The later actor may go on to discover a previously unknown metabolic pathway. Idea-only cases like this hypothetical clearly involve cumulative innovation: the later actor was spurred along or sped up by the work of the earlier actor. Yet, in sharp contrast to the disclosed-thing cases, the later actor is categorically beyond the reach of the patent rights of the earlier inventor. The reason why later actors are allowed to forgo compensating the earlier actors is that patent protection does not propertize ideas per se, but instead, only grants rights to exclude from sets of things (and processes) that embody innovative ideas.<sup>117</sup> Ideas and advances are bits of knowledge, and newly discovered knowledge qua knowledge must be placed into the public domain as part of the quid pro quo of patent protection.<sup>118</sup> The later actor is free to use the knowledge discovered and disclosed by the earlier patentee without running afoul of patent rights, and the subsequent generation of new knowledge does not infringe, either.

The disclosed-thing and idea-only cumulative innovation cases anchor the two ends of a spectrum. In between them lie cases in which a later inventor uses the ideas, but not the things, disclosed by the earlier patentee as

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117. Supreme Court case law addressing patents is full of off-hand references to the fact that ideas per se cannot be propertized with a patent claim. *See, e.g.*, *Rubber-Tip Pencil Company v. Howard*, 87 U.S. (20 Wall.) 498, 507 (1874) (“An idea of itself is not patentable, but a new device by which it may be made practically useful is.”). However, many of these cases do not directly address the fact that ideas, advances, and knowledge themselves, whether in the form of human thought or worldly representations like written texts, cannot be patented. Rather, many of these cases address the issue of patent scope: sets of things that are defined by ideas drawn at excessively high levels of generality cannot be patented, either. *See* Kevin Emerson Collins, *Bilski and the Ambiguity of “An Unpatentable Abstract Idea,”* 15 LEWIS & CLARK L. REV. 37 (2011) (distinguishing two distinct concepts of what it means to patent an idea). The simplest way to demonstrate that an idea per se—in the sense of knowledge itself—is not patentable is to recognize that even “idea free-riders”—who engage in no subsequent invention at all—are off the hook so long as the inventive idea disclosed in a patent is used only qua idea. Billing themselves as experts, idea free-riders can legally profit from conveying the knowledge disclosed in a patent to interested parties. *See* *Teletronics Pacing Sys., Inc. v. Ventritex, Inc.*, 982 F.2d 1520, 1523 (Fed. Cir. 1992) (holding that the dissemination of data about a device falling within a patent’s claims is not an infringing activity).

118. Kevin Emerson Collins, *Semiotics 101: Taking the Printed Matter Doctrine Seriously*, 85 IND. L.J. 1379, 1427–30 (2010) (discussing the duality of privatizing claims and publicizing disclosures in patent law); Kevin Emerson Collins, *Claims to Information Qua Information and a Structural Theory of Section 101*, 4 I/S: J.L. & POL’Y FOR INFO. SOC’Y 11 (2008), reprinted in *PATENT CLAIMS: JUDICIAL INTERPRETATION AND ANALYSIS* (ICFAI Univ. Press 2009) (same).

inputs into technological progress and produces new, innovative things. The later innovator's use of the ideas disclosed by the earlier patentee does not infringe the earlier innovator's rights,<sup>119</sup> but the later innovator's production of new, innovative things may infringe the earlier patentee's rights. These intermediate cases can, in turn be grouped into three categories by drawing two lines. The first line marks the distinction between improvements and non-improvement after-arising technologies that are facilitated by the patentee's disclosure. As discussed above, improvements result only when the later-developed thing still embodies in some way the earlier patentee's innovative idea.<sup>120</sup> Inversely, in a non-improvement after-arising technology, the earlier patentee's disclosure may have facilitated the later innovator's work, but the things that the later innovator produces are unrelated to the things protected by the earlier patent. Because patents describe and propertize innovative sets of things, not innovative ideas per se, the earlier patentee never obtains rights that are sufficiently broad to encompass the later innovator's newly invented, unrelated thing.<sup>121</sup> For example, if a later innovator reads an earlier patent on a drug that discloses the metabolic pathway into which a drug intervenes, he may be inspired to develop an entirely different drug that has its effect by intervening in the same pathway but in a different manner.<sup>122</sup> Here, the later innovator has gotten a leg up from an earlier innovator, but the earlier patent does not encompass the later-developed technology. The second line distinguishes two sets of improvements: those that infringe the earlier patentee's rights and those that do not. The question here is whether the later-developed thing embodies the innovative ideas of the earlier patentee in a manner that is sufficiently strong or important to merit including that thing within the earlier patentee's rights.<sup>123</sup> The conventional theory on improvement addresses the optimal

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119. See *supra* notes 117–18 and accompanying text (discussing idea-only cumulative innovation cases).

120. See *supra* Section III.A.3.

121. Cf. R. Polk Wagner, *Information Wants To Be Free: Intellectual Property and the Mythologies of Control*, 103 COLUM. L. REV. 995, 1000 (2003) (arguing that “even perfectly controlled works” in the sense of inventions that are governed by the maximum allowed amount of intellectual property rights “nonetheless transfer significant information into the public domain” because of the creative connections that later innovators may make).

122. Here, the later innovator is engaging in rational drug design. Michael A. Carrier, *Two Puzzles Resolved: Of the Schumpeter-Arrow Stalemate and Pharmaceutical Innovation Markets*, 93 IOWA L. REV. 393, 402 (2008) (describing “rational drug design” as the process of “working backwards from knowledge of a disease's biochemistry”).

123. The line between improvements to which the normative claim is the weakest and non-improvement after-arising technology is a fuzzy one. For example, someone who reads a patent and understands a new chemical's structure may be inspired by that structure to create a new mechanical device, such as a stapler, that employs a similar spatial

position of this line,<sup>124</sup> as does the distinction between classic and overlooked improvements around which this Article is structured.

### C. THE MECHANICS OF PATENT PROTECTION FOR IMPROVEMENTS

Contemporary patents contain two distinct types of texts, each of which serves a distinct function. By volume, the bulk of a patent is usually the specification—a text that teaches the public about an invention.<sup>125</sup> The specification often describes why an invention is a technological advance over the prior art, and it provides detailed explanations of particular working examples of an invention. At the end of the specification, patents also contain claims. Claims are short (at least in a relative sense) descriptions of the sets of technological things that constitute the patent owner’s legal interest.<sup>126</sup> Contemporary claims are “peripheral” claims because they list a set of properties that a thing must possess to be included in the claim and thereby establish the outer bounds (or periphery) of a patentee’s interest *ex ante*.<sup>127</sup> For example, the first inventor of the coffee sleeve might claim “an insulating band tapered in the shape of a truncated cone to fit the conical outer surface of a disposable coffee cup.”<sup>128</sup> The claims usually describe a set of things that is broader than the examples described in detail in the specification. For example, the specification may explain in detail how to make a coffee sleeve that is two inches tall, but valid coffee-sleeve claims may encompass sleeves of many different heights.

While claims can encompass a set of things that reaches beyond the precise things disclosed in full in the specification, patent applicants are not

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configuration. It is tempting to think of the stapler as unrelated to the molecule, but the stapler does possess a property *having a certain structural configuration* that was earlier possessed by the chemical. At the end of the day, the fuzzy nature of this line is not problematic as the line carries no legal consequences. Neither improvements in which the normative claim of the earlier patentee is the weakest nor non-improvement after-arising technologies are likely to infringe earlier-filed claims.

124. *See supra* Section II.A.

125. *SRI Int’l v. Matsushita Elec. Corp. of Am.*, 775 F.2d 1107, 1121 n.14 (Fed. Cir. 1985) (en banc) (“Specifications teach.”).

126. *Id.* (“Claims claim.”). Technically, claims are part of the specification. *In re Gardner*, 480 F.2d 879, 879 (C.C.P.A. 1973). This dual status makes sense because claim language can both define a patentee’s legal interest and teach the public about the invention at the same time.

127. Lefstin, *supra* note 63, at 1145 (“[Peripheral claims] recite a set of characteristics, or properties, that define the subject matter encompassed by the patent.”). For a longer discussion of the nature of peripheral claims and their compatibility with a focus on properties as the locus of invention, see *infra* Part VIII.

128. For the sake of readability, this and all other hypothetical claims employed in this Article ignore the complex and stilted conventions of claim drafting.

free to claim whatever set of things they please. The Patent Act codifies a number of validity doctrines that constrain the claimable set. Some validity doctrines, including novelty and nonobviousness, work retrospectively to ensure that the claimed set of things is an invention in the colloquial sense, i.e., that it embodies a sufficiently important advance over the prior art to merit patent protection.<sup>129</sup> Other doctrines operate prospectively. They constrain the reach of patent claims into technologies that do represent an advance over the prior art. Among other doctrines, the disclosure doctrines of enablement and written description perform this task.<sup>130</sup> The disclosure doctrines are appropriately named: they limit the scope of a claim to a set of things that is commensurate with the contribution to technological progress that an inventor discloses in the patent specification. Enablement requires that an inventor teach the person having ordinary skill in the art (“PHOSITA”) to make and use a set of things without undue experimentation that is commensurate with the claimed set of things at the time the patent is filed.<sup>131</sup> Written description requires an inventor to demonstrate to the PHOSITA that the claimed set of things is commensurate with the claimed technology that was “invented” or “possessed” at the time of filing.<sup>132</sup>

The inquiries specified in the disclosure doctrines can be used to identify a core set of technologies that can be claimed. For simplicity, the set of things that the PHOSITA at the time of filing could actually (1) make and use without undue experimentation and (2) recognize as possessed, is the set of things that a patent *discloses* or *makes available to the public*.<sup>133</sup> This set of

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129. 35 U.S.C. §§ 102, 103 (2006) (codifying the novelty and nonobviousness doctrines). The “prior art” has a technical definition that is roughly captured as the publicly accessible technological status quo at the time of an invention. *See* § 102.

130. *Id.* § 112, ¶ 1. Other doctrines that perform this function—or, at least, could, if courts were inclined to use them as policy levers—include: claim construction, *Phillips v. AWH Corp.*, 415 F.3d 1303, 1321 (Fed. Cir. 2005) (en banc); a prohibition on the use of purely functional claim limitations at the point of novelty construed according to their ordinary meanings, *Halliburton Oil Well Cementing Co. v. Walker*, 329 U.S. 1, 9 (1946); § 112, ¶ 6; and a prohibition on claims to abstract ideas under the patentable subject matter provision of § 101, see *O’Reilly v. Morse*, 56 U.S. (15 How.) 62, 113 (1853).

131. *Genentech, Inc. v. Novo Nordisk A/S*, 108 F.3d 1361, 1365 (Fed. Cir. 1997).

132. *See Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336 (Fed. Cir. 2010) (en banc).

133. The important question is whether the PHOSITA could make and use a particular thing, and recognize it as being possessed, at the time of filing. It is irrelevant whether a claim can remain valid under the enablement and written description doctrines while encompassing the thing. The validity of a claim depends on the commensurability of the disclosure and the claims, and the enablement and written description doctrines commonly sanction the validity of claims that encompass things beyond the set of things that is actually enabled and possessed. *See, e.g., Collins, supra* note 58, at 1093–125 (discussing reasons why

things is larger than the small set of things that the specification discloses in full. It includes at least all things that the PHOSITA could have made and would have thought of making after reading the disclosure. Assuming novelty and nonobviousness, the set of things that is disclosed or made available to the public is the core of patent protection. By definition, improvements lie beyond this core.<sup>134</sup> Whether a patent claim can extend beyond this core to encompass improvements is contingent on both the language employed by the patent drafter and the rules of claim construction, validity, and infringement that the patent regime enforces.

For an earlier patent to literally encompass a later improvement, the claim must be drafted by the patent drafter with broad, generic language that describes the later-developed improvement.<sup>135</sup> The need for the claim language to describe the improvement puts the availability of patent protection for later-developed improvements in part at the mercy of the patent drafter. The patent drafter bears the burden of describing the set of claimed things generically enough that the language describes yet-to-be developed products.<sup>136</sup> A patent drafter who fails to recognize the unnecessary limitations that are in the claim may not obtain protection for an inventor that encompasses later-developed improvements even if, as a normative matter, the case for giving the inventor such protection is strong. To hold constant the variability in claim scope that can be attributed to the skill of patent drafters, this Article assumes that patent drafters always draft the broadest permissible claims.

Assuming that the patent drafter did not make an obvious error, there are a number of doctrines that courts can invoke to sculpt the patentee's protection. Some determine the permissible level of generality at which a claim can be drawn. Claim construction—the process through which judges

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enabled claims can reach into after-arising technology). If claims could not encompass any things that were not disclosed by the specification, there would be no literal patent protection for later-developed improvements.

134. *See supra* Section III.A.2.

135. The need to describe the allegedly infringing thing with a claim is not an issue that is particular to improvements. Failure to draft a sufficiently generic claim can also result in a failure to obtain rights to exclude from things that are disclosed and made available to the public by the specification.

136. For example, a later-developed, improved coffee sleeve that is folded in a nonobvious geometry or that is made of a later-developed material would be likely to fall within the scope of the claim to “an insulating band tapered in the shape of a truncated cone to fit the conical outer surface of a disposable coffee cup.” However, a later-developed coffee sleeve in the shape of a doughnut likely would not, as a doughnut shape is likely not “tapered in the shape of a truncated cone” and it arguably is not a “band” at all (although these conclusions would be actively debated by the parties during claim construction).

determine the meaning of claim language to the PHOSITA—can expand or restrict the reach of a patent into improvements.<sup>137</sup> The validity doctrines, including the disclosure doctrines of enablement and written description, can effectively narrow claim scope if courts invalidate claims drafted without many limitations as incommensurate and uphold claims drafted with more limitations.<sup>138</sup> In addition, a court can expand or contract patent protection beyond the literal scope of a claim through either the doctrine of equivalents (“DOE”)<sup>139</sup> or the reverse DOE.<sup>140</sup>

This overview of the patent doctrine that courts use to dole out protection for later-developed improvements overlooks many nuances, but it is designed to make only a simple point. The distinction between classic and overlooked improvements is nowhere to be found in the relevant patent doctrine that determines the reach of claims into after-arising technology, or at least nowhere on its rhetorical surface. The differential treatment afforded to these two types of improvements can be seen only in the outcomes of cases, not in how courts explain the outcomes. That is, it can be seen in what courts do, but not in what they say.

#### IV. CLASSIC IMPROVEMENTS AND SUCCESSIVELY INVENTED PROPERTIES

This Part defines a classic improvement—the type of improvement that is wound up in the stories that undergird the conventional theory on patent protection for improvements—in terms of the innovative properties produced by successive generations of inventors. Consider a hypothetical improvement story based on a simple technology. Abby is an earlier inventor

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137. When defining the meaning of claim language to the PHOSITA, courts have leeway to look both to dictionary definitions and the particular way in which words are used in the specification (and thus to embodiments disclosed in the specification). *Phillips v. AWH Corp.*, 415 F.3d 1303, 1322–24 (Fed. Cir. 2005) (en banc). The more heavily courts rely on the specification as an interpretive source, the more closely the scope of a claim is likely to be restricted to the disclosed embodiments and the more likely it is to exclude later-developed improvements. More drastically, claim construction is supposed to determine the meaning of the words at the time of filing, and some patent opinions have suggested that words construed at the time of filing categorically cannot describe later-developed technologies. Collins, *supra* note 66, at 550–53 (discussing the fixation of denotational, rather than ideational, meaning during claim construction).

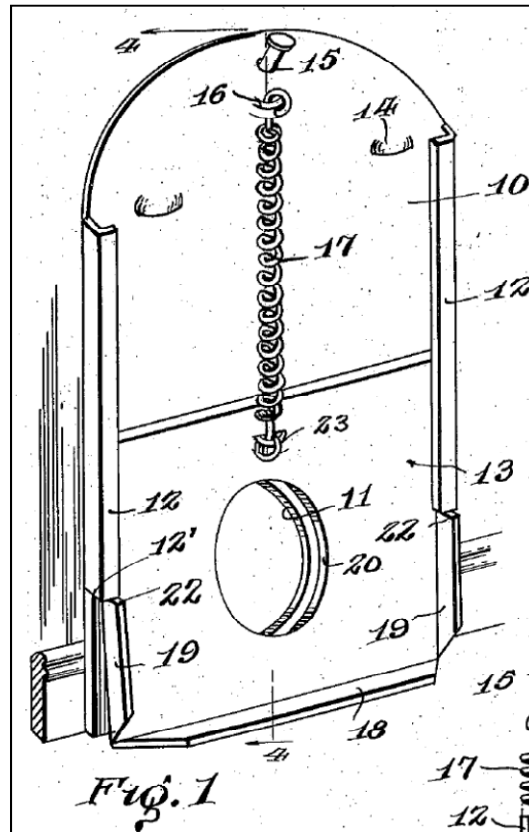
138. *See supra* notes 130–32 and accompanying text.

139. It is widely acknowledged that the DOE can expand a patentee’s protection beyond literal claim scope and into after-arising technology. *Warner-Jenkinson Co., Inc. v. Hilton Davis Chem. Co.*, 520 U.S. 17 (1997).

140. *Scripps Clinic & Research Found. v. Genentech, Inc.*, 927 F.2d 1565, 1581 (Fed. Cir. 1991).

in the art of mousetraps. Before Abby's invention, the state-of-the-art mousetrap was an upside-down box over a piece of cheese with a short stick holding one side of the box above the floor. The person attempting to catch the mouse would tie a string to the stick, wait nearby, and pull when a mouse went under the box. Abby invents the first spring-loaded mousetrap: a device that stores potential energy in a spring and that uses the jostling motion caused by the presence of a mouse to release kinetic energy, trapping or killing the mouse. The working example of a mousetrap that Abby actually conceives and discloses in her patent is illustrated in Figure 1:

Figure 1: Abby's Two-Plate Mousetrap<sup>141</sup>



There are two plates, each with a hole in the center and one being able to slide in relation to the other. Cheese is placed in a box with Abby's mousetrap forming one side of that box, or the mousetrap is placed over a mouse hole in the wall. The spring must be stretched from its resting

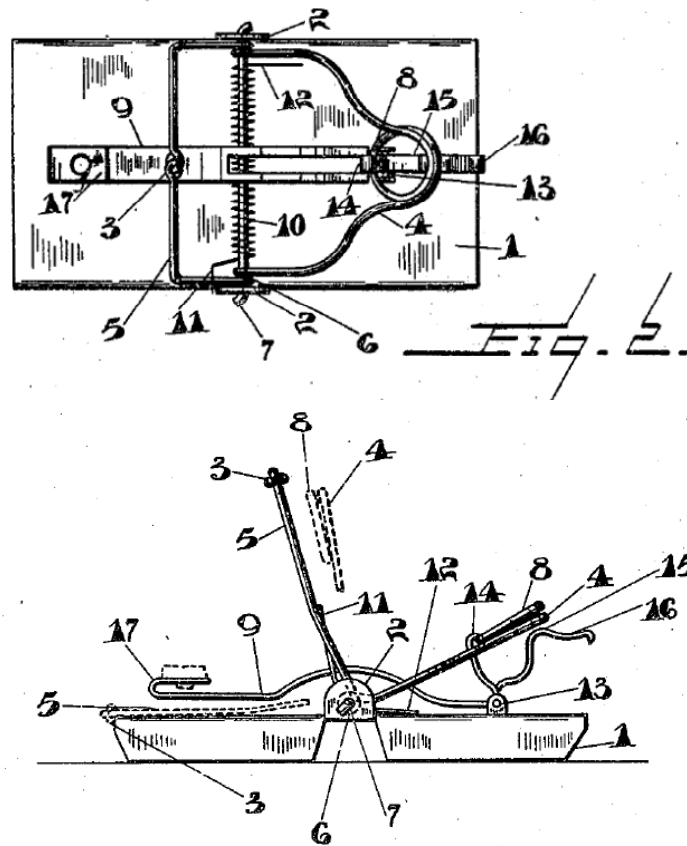
141. Figure 1 is taken from U.S. Patent No. 2,059,164 (filed Dec. 2, 1935), but the facts of the hypothetical are fabricated to provide a simple teaching tool.



position for the two holes to align so that a mouse can attempt to pass through. Although there is a stop mechanism that can hold the holes in alignment and keep the spring in tension, the jostling motion caused by a mouse passing through the aligned holes destabilizes the stop mechanism, allowing the spring to shift one plate with respect to the other, trapping or killing the mouse.

After Abby files her patent, Bernard invents an improved spring-loaded mousetrap that is, more or less, the standard mousetrap design that one can still buy in the local hardware store today. General familiarity with such mousetraps is presumed:

Figure 2: Bernard's Fixed-Base Mousetrap<sup>142</sup>



Where Abby's trap keeps the spring in tension longitudinally, Bernard's trap places a torsional force on the spring. Where Abby's trap involved

142. Figure 2 is taken from U.S. Patent No. 1,342,255 (filed Apr. 30, 1919), but the facts of the hypothetical are fabricated to provide a simple teaching tool.

sliding plates, Bernard's trap has a wire moving in an arc in relation to the base. Bernard's mousetrap is a patentable improvement over the disclosure of Abby's patent.<sup>143</sup>

The Abby-Bernard hypothetical reaffirms that there are two distinct technological advances made at different points in time whenever the question of the reach of patent scope into improvement is raised. First, there is the advance in technical knowledge that justifies the issuance of the earlier patent whose scope is at issue. The things described by a valid patent claim must embody an advance by definition as a doctrinal matter: the advance explains why the things described by a claim satisfy the retrospective validity requirements of patent law.<sup>144</sup> Second, every improvement embodies at least one advance produced by the improver that occurs after the time the patent is filed.<sup>145</sup>

The Abby-Bernard hypothetical strongly resembles many of the historical examples of earlier patents and later, allegedly-infringing improvements.<sup>146</sup> The family resemblance follows from two facts about the way in which the later advance relates to the earlier advance.

First, considering the successive advances not as embodied in the improvement as properties but rather as ideas per se, the work of the later inventor builds on the work of an earlier inventor in a strong sense of the word. The inventors' contributions to progress are cumulative in that the later inventor must stand on the shoulders of the earlier inventor even to be in a position to make her contribution to technological progress.<sup>147</sup> But for Abby's general idea of a spring-loaded mousetrap, Bernard would not have been in a position to make the advance that he did when he did. But for Abby's shoulders, Bernard would have had to make the more fundamental

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143. However, whether Bernard actually seeks patent protection is irrelevant to the hypothetical. The only question at issue is whether the improvement falls within the scope of the earlier-issued patent. The answer to this question does not depend on whether Bernard seeks patent protection.

144. *See supra* text accompanying note 129 (noting the role of the novelty and nonobviousness requirements).

145. *See supra* Section III.A.2.

146. *See, e.g., supra* text accompanying notes 29–32, 40 (discussing the Wright Brothers/Curtiss patent dispute); *see also* Bessen & Maskin, *supra* note 2, at 613 (citing historical examples of classic improvements to define the concept of “sequential” innovation); Merges & Nelson, *supra* note 2, at 884–97 (citing historical examples of classic improvements to define “cumulative” innovation).

147. The shoulder-standing may be constructive rather than actual, given that actual facilitation is not a criterion of an improvement. *See supra* note 106.

advance of the spring-loaded mousetrap himself in order to produce his particular mousetrap.<sup>148</sup>

Second, considering the advances as they are embodied in the improvement as properties, the later advance *refines* the earlier advance. The refinement relationship of the classic improvement is possible because Abby's earlier patented technology embodies a technological advance that can be described at different levels of generality. At a high level of generality, the advance embodied in Abby's mousetrap is the very idea of a spring-loaded mousetrap itself—i.e., the idea of a mousetrap that can store potential energy in a spring and automatically unleash mouse-trapping kinetic energy in response to the presence of a mouse. In other words, the claimed mousetraps embody Abby's general idea because they possess the property *being a device in which the jostling motion of a mouse transforms the potential energy stored in a spring into the kinetic energy required to catch a mouse*. At a lower level of generality, the advance embodied in Abby's mousetrap is the idea of storing potential energy in an elongated spring and releasing it as kinetic energy in the form of one plate with a hole that slides in relation to another. Thus, a mousetrap embodies Abby's newly-discovered, specific idea in part because it has the property *being made of sliding plates*.

Because the properties that instantiate Abby's advance can be described at different levels of generality, the properties that instantiate Bernard's later advance in the improvement can relate to properties that instantiate Abby's advance in multiple ways at the same time. The after-arising advance that gives rise to Bernard's improvement is a new mechanism for storing potential energy and using kinetic energy to catch a mouse. In other words, a mousetrap embodies Bernard's newly discovered idea because it has the property *being made of a wire that can move in an arc in relation to a fixed base*. In relation to Abby's most general innovative property, Bernard's innovative property compounds with, or adds itself to, Abby's property.<sup>149</sup> The improvement-as-thing—that is, the improved mousetrap produced by Bernard—possesses both the property *being a device in which the jostling motion of a mouse transforms the potential energy stored in a spring into the kinetic energy required to catch a mouse* (Abby's general property) and the property *being made of a wire that can move in an arc in relation to a fixed base* (Bernard's innovative property).

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148. The metaphor of one inventor standing on another's shoulders is not entirely accurate, as the platform upon which the later inventor builds is only part of the earlier inventor's contribution. A classic improvement is perhaps more akin to a piggy-back ride: the later inventor gets the advantage of some of the earlier inventor's height, but not all of it.

149. “Compound” is used here loosely in the pharmacological sense of the word—to mix two entities together. It is not used in the financial sense of compound interest.

However, the property that instantiates Bernard's advance in the improvement supplants or replaces the property that instantiates Abby's more specific advance. By storing potential energy in a torsional force, Bernard's mousetrap no longer stores energy in a longitudinal force. Because it has the property *being made of a wire that can move in an arc in relation to a fixed base*, the improvement no longer has the property *being made of sliding plates*. Any single, indivisible mousetrap will embody either Abby's specific idea or Bernard's specific idea, but not both.<sup>150</sup>

## V. OVERLOOKED, "EASY" IMPROVEMENTS AND SUCCESSIVELY INVENTED PROPERTIES

The conventional theory on patent protection for improvement implicitly focuses on classic improvements, but not all improvements fit the mold of a classic improvement. Elaborating on the hypothetical presented in Part IV, *supra*, Section V.A defines an overlooked improvement in terms of the innovative properties generated by successive inventors. Section V.B offers an illustrative list of three scenarios in which overlooked improvements are likely to occur.

### A. AN EXAMPLE AND ITS GENERALIZATION

Taking Abby's invention of the spring-loaded mousetrap presented above as the earlier-patented invention,<sup>151</sup> assume that Bob, too, produces an improved mousetrap. Bob invents a nonobvious metal alloy that makes cheaper, better springs.<sup>152</sup> Bob then manufactures sliding-plate mousetraps that follow the precise arrangement of mechanical parts that Abby discloses in her specification, except that he makes his springs out of his after-arising alloy.

Like Bernard's mousetrap, Bob's mousetrap is clearly an improvement. It is an after-arising thing that was not disclosed or made available to the public

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150. It is possible for a mousetrap to embody both specific ideas in the sense that Abby's mousetrap and Bernard's mousetrap can be glued together to form a double-wide mousetrap with two trigger mechanisms. However, this physical aggregation of the earlier- and later-invented things presents an after-arising component issue, not an improvement issue. *See supra* text accompanying notes 110–16 (discussing disclosed-thing cumulative innovation cases that do not involve improvements).

151. *See supra* Part IV.

152. Any one of a number of different advances could underlie Bob's discovery. He may have been the first to conceive of a molecule with a particular chemical structure, or he may have been the first to figure out how to make a long-desired compound. This distinction is of importance in determining the reach of a patent into improvement in some contexts, but it is irrelevant in the hypothetical presented in the text.

by Abby’s patent specification and that does not contain a thing disclosed by Abby’s patent as a component; it still embodies Abby’s technical advance in some way.<sup>153</sup> Yet, Bob’s mousetrap differs from Bernard’s mousetrap—and all classic improvements—in two important ways.

First, considering the successive advances not as embodied in the improvement as properties but rather as ideas per se, the improver does not need to stand on the shoulders of the earlier patentee to achieve her technical advance. Bernard, the classic improver, got a boost from Abby in order to be in a position to achieve his advance.<sup>154</sup> Bob does not. Bob achieves an advance in metallurgy. The technical barrier confronting Bob would be the same whether Bob produces his advance before or after Abby makes her advance in mousetrap technology.<sup>155</sup> As idea generators who contribute to technological progress, Bob and Abby stand side by side, not one on the shoulders of the other. However, the improvement-as-thing exists only because of the accumulation of the two advances. To risk stretching a metaphor too far, the improvement can be held aloft only by the concerted effort of both Bob and Abby. The improvement is the result of cumulative innovation only in the weak sense that two advances both must occur for the improvement to be produced, but neither one of the advances in knowledge builds on a platform provided by the other. Each advance rests on its own technological bottom in a different art.<sup>156</sup> It is possible to imagine getting to

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153. See *supra* Section III.A (defining an improvement).

154. The boost may have been constructive. See *supra* text accompanying note 106.

155. Interestingly, however, if Bob were to invent first, Abby’s later-developed mousetrap would technically not be an improvement on Bob’s patent claim. Bob would likely claim a new composition of matter, which is an extremely narrowly framed thing that would be literally present as disclosed by Bob’s earlier patent in Abby’s later-improved mousetrap. If Bob’s advance were to come first, Abby’s after-arising advance would create a variant of the component problem, not an improvement problem. See *supra* notes 110–16 and accompanying text (distinguishing the after-arising component problem from the improvement problem). This asymmetry—the need for Abby’s patent to grow in scope over time to encompass an improved thing but the lack of a need for Bob’s patent to grow in scope over time to encompass the same improved thing—demonstrates one of the biases that the nature of things introduces into a peripheral claiming regime. See Collins, *supra* note 66, at 514–36 (discussing the importance of “thing construction” in patent law).

156. Professor Tim Holbrook has argued that the DOE should more readily encompass after-arising technologies when the later advance occurs in a field of endeavor that is different from the field of endeavor of the patent. Timothy R. Holbrook, *Equivalency and Patent Law’s Possession Paradox*, 23 HARV. J.L. & TECH. 1, 37–40 (2009). Professor Holbrook justifies this argument on a “fairness principle.” *Id.* at 7. This Article argues that the divergence of the technological fields of the successive advances is a relevant factor—but not the only factor—when determining the conditions under which literal claim scope—should simply the DOE—should encompass after-arising technology. It also argues that the distinction can be explained as a matter of efficiency, not fairness. See *infra* Part VII.

the same endpoint (that is, producing the same technological thing) with the two advances occurring in the opposite order. This inversion is not possible in a classic improvement, because the earlier inventor's advance is a foundation for the later inventor's advance.<sup>157</sup>

Second, considering the advances as they are embodied in the improvement as properties, the earlier and later advances are both fully embodied in the improvement-as-thing. In the improved mousetrap, the properties that instantiate Bob's after-arising advance only compound with, and do not supersede in any way, the properties that instantiate Abby's earlier-patented advance. This relationship of pure addition exists regardless of the level of generality at which Abby's advance is framed. Bob's improved mousetrap embodies his after-arising advance (the idea of the new alloy) as well as both Abby's earlier-patented general advance (the idea of a self-actuating, spring-loaded mousetrap) and her earlier-patented specific advance (the idea of an elongated spring connected to a sliding plate). Bob has displaced some properties of the things that constitute Abby's patented technology—e.g., the property of *being made out of an earlier-existing metal*—but only those properties that have nothing to do with the properties that embody Abby's innovative ideas. Bob did not make an advance in the arrangement of the mechanical components in a mousetrap design; Abby did not make an advance in the molecular structure of the mousetrap parts.<sup>158</sup>

In sum, the sets of properties that instantiate the successive inventors' innovative ideas in an improvement are effectively independent of one another. One set can be altered without mandating any change in the other set. A thing can have two distinct sets of properties, each of which is capable of being altered or changed within certain parameters without having a significant impact on the other. When the successive advances wound up in improvement stories are manifest in properties of improved things that are

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157. One can imagine a possible world in which Bernard's mousetrap is produced before Abby's. In this possible world, however, Bernard must make a different technological advance than he did in the actual world. He must do what Abby did in the actual hypothetical, namely generate the general idea of the spring-loaded mousetrap.

158. If Abby's advance were characterized as the idea of making a spring-loaded mousetrap out of then-existing metals, then Bob's innovative properties could be viewed as part-superseding properties. Thus, the distinction between classic and overlooked improvements may be one of degree rather than kind. However, the characterization of Abby's advance as the idea of making a spring-loaded mousetrap out of then-existing materials is misleading. It elides the things that Abby invented with the contribution to the storehouse of knowledge that she made. To describe the thing that Abby made in full, it is necessary to note that she worked with existing metals, but her use of existing metals is in no way necessary to describe her advance, i.e., her marginal contribution to the progress of technical ideas.

independent variables, the advances can compound with each other (and not supplant each other) in the improvement.

B. THREE REASONS FOR PROPERTY INDEPENDENCE

Things are complex entities. There is no single, catch-all explanation for why two sets of properties of a thing are effectively independent variables and thus for why successive advances that alter those properties lead to an overlooked improvement. This Section offers three distinct underlying reasons for property independence in the things claimed by a patent: claimed things with naturally independent properties, claimed things with properties that have engineered independence, and claim language that recites prior-art context.<sup>159</sup> In the course of identifying these three groups of overlooked improvements, this Section also provides evidence to demonstrate that they are “easy” cases in the sense that courts routinely allow earlier-filed patents to encompass overlooked improvements without so much as raising a caution flag.<sup>160</sup>

1. *Things with Naturally Independent Properties*

Some properties of an indivisible thing are, within certain bounds, naturally independent. A simple example in the mechanical arts is the property of shape and the property of materiality.<sup>161</sup> One can make two things that differ in shape without requiring any difference in materiality; one can make two things that differ in materiality without requiring any difference in shape.<sup>162</sup> If successive advances yield first the geometry and then the materiality of an improved mechanical device, there is no refinement

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159. These three categories are intended as an illustrative, not exhaustive, list of conditions that are fertile for the development of overlooked improvements.

160. *See supra* note 6 (defining an “easy” case). In fact, courts may not even recognize overlooked improvements as being later-developed things at all. *See infra* note 177.

161. In the chemical and biochemical arts, however, materiality and shape are not independent. The materiality of a molecule is its atoms, and a molecule’s atoms determine its shape. The fact that there are fewer properties that are naturally independent variables when claims describe inventions on a molecular scale explains in part why claims to mechanical inventions are widely viewed as reaching farther into after-arising technology than claims to chemical and biochemical inventions are. *Cf.* *Spectra-Physics, Inc. v. Coherent, Inc.*, 827 F.2d 1524, 1533 (Fed. Cir. 1987) (suggesting that narrow disclosures can enable broad claims in the mechanical arts). There are fewer overlooked improvements when claims describe inventions on a molecular scale because molecules do not have sets of intrinsic properties that can vary independently.

162. There are limits to the independence. For example, claimed shapes or arrangements of parts may be defined in part by the functions that they perform, and not all materials allow the shapes or arrangements to perform the required functions. A mousetrap with a spring made of cheese would be an inoperative mousetrap.

or supplanting of the successively invented properties. The properties compound with each other in the improvement-as-thing, yielding an overlooked improvement. Bob's improvement on Abby's patented invention is an overlooked improvement for this reason.<sup>163</sup> Similarly, assume that an earlier inventor invents and patents a new mechanical device—say, a plastic gizmo that controls Venetian blinds—having some nonobvious interrelation among its parts and that a later inventor invents a new material—say, a more durable, cheaper type of plastic. Venetian blinds gizmos that are improved because they are made out of the new plastic are overlooked improvements.<sup>164</sup> To the same end, imagine an earlier patent on a pill that is formed into a new shape that is easier to swallow and the later invention of a new chemical that is an effective pharmaceutical. A pill that is made in the patented shape and that contains the new chemical is an improvement over the patent that discloses the pill shape. It was not disclosed to the public in the earlier-filed patent on the pill shape; the literal scope of a claim to a “pill” or “pharmaceutical compound” molded into the specified shape must expand over time to encompass pills made out of the after-arising chemical.<sup>165</sup> More specifically, the after-arising pill is an overlooked improvement. The properties that embody the earlier-patented advance (geometry) and the properties that embody the later-developed advance (materiality) are, within certain limits, naturally independent.

Overlooked improvements that arise from successive advances that are embodied in naturally independent properties routinely wind up within the literal scope of earlier-filed claims. For example, the literal scope of a patent on an advance in the mechanical arts routinely extends into mechanical devices that are improved because they are made out of after-arising materials.<sup>166</sup> This rule reflects the common-sense position that a patent on a doorknob encompasses after-arising, improved doorknobs made out of newly invented materials because a “doorknob is a doorknob”—i.e., it is still

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163. See *supra* Section V.A.

164. Cf. Collins, *supra* note 58, at 1111–22 (elaborating on this hypothetical).

165. See *supra* Section III.A (defining an improvement).

166. See Feldman, *supra* note 41, at 28; Meurer & Nard, *supra* note 41, at 1976–77. Of course, a claim in the mechanical arts cannot literally read on a device made of any after-arising material if materiality is a strict claim limitation. For example, a claim to a “plastic widget” cannot literally read on a widget made out of an after-arising metal, even if it might be able to grow over time to encompass a widget made from an after-arising plastic. Cf. *infra* note 327 and accompanying text (discussing improvements to a hypothetical claim to a “plastic widget”).



the earlier inventor’s invention on every relevant level of generality—regardless of the material out of which it is made.<sup>167</sup>

2. *Things with Properties Engineered To Be Independent*

In some technologies, the independence of two groups of properties of a single, indivisible thing is engineered, not natural. For example, consider the computer industry in which hardware and software are often developed separately.<sup>168</sup> The functional properties of a programmed computer are, within certain limits, independent of the physical properties of the computer that executes the program.<sup>169</sup> The gates and switches can be shuffled and reshuffled, and yet the computer—whatever its final internal configuration—can still perform the same software-scripted functions.<sup>170</sup> Software can run on all types of computers with markedly different physical architectures. In fact, “[p]resent-day computers are built of transistors and wires, but they could just as well be built, according to the same principles, from valves and water pipes, or from sticks and strings.”<sup>171</sup> The independence of the functional capacities of software and the physical characteristics of computers is not a natural phenomenon. It exists only because it has been engineered. It is only because the computer industry has developed a set of technical standards and intermediary technologies that software can run on a wide variety of hardware.<sup>172</sup>

Because software and hardware have engineered independence, computer-related technologies give rise to many overlooked improvements. Assume an earlier “apparatus” claim to a software invention—that is, a claim to a physical computer that has been programmed with newly developed software.<sup>173</sup> Now, assume the later development of new computer hardware on which the software can be executed. The improved thing—that is, the after-arising hardware executing the earlier-claimed software—is clearly an

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167. Feldman, *supra* note 41, at 3.

168. *Microsoft Corp. v. AT&T Corp.*, 550 U.S. 437, 450 (2007) (“Software . . . is a stand-alone product developed and marketed ‘for use on many different types of computer hardware . . . .’”).

169. *See* W. DANIEL HILLIS, *THE PATTERN ON THE STONE*, at ix (1998) (“Computers are understandable because you can focus on what is happening at one level of the hierarchy without worrying about the details of what goes on at the lower levels.”).

170. Again, the reshuffling can only be done within limits. Many configurations of gates and switches—including anything that I could make—cannot be exchanged for a functioning computer.

171. HILLIS, *supra* note 169, at viii.

172. *See, e.g., id.* at 56–58 (discussing interpreters and compilers).

173. Apparatus claims to software inventions are commonplace. *See, e.g., Arrhythmia Research Tech., Inc. v. Corazonix Corp.*, 958 F.2d 1053 (Fed. Cir. 1992).

improvement. It is an after-arising thing that is not disclosed or made available to the public in the specification of the software patent and that does not contain any disclosed thing as a component; it still embodies in some way a technical advance that is attributable to the software inventor.<sup>174</sup> Yet, the later advance is embodied in a set of properties of the improved thing that, within bounds, has engineered independence in relation to the set of properties that embody the earlier advance.

Overlooked improvements that can be traced to properties with engineered independence also routinely wind up within the literal scope of earlier claims. Here, the proof of a negative proposition is required. The effective life-span of computer hardware is extremely short, as hardware becomes outdated within several years of its purchase. The life of software and software patents, however, is much longer. Software patents have a duration of twenty years from the date on which the patent is filed, and their functionally-defined claims mean that they encompass many iterative versions of the software programs marketed to the public.<sup>175</sup> Therefore, running earlier-developed software on after-arising hardware must be commonplace. If software patents were made obsolete every time a new generation of computer hardware arrived on the market, then all of the arguments made today about the detrimental effects of software patents<sup>176</sup> would be moot as an economic matter, yet they clearly are not. If software apparatus claims did not literally encompass software being run on after-arising hardware, one would expect judicial opinions finding noninfringement of software patents for this reason. However, none of these cases exist. No argument of non-infringement of a software apparatus claim has ever been accepted by a court based on the fact that the allegedly infringing device incorporates later-developed hardware. In sum, software apparatus claims literally encompass overlooked improvements routinely in the contemporary patent regime.<sup>177</sup>

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174. See *supra* Section III.A (defining an improvement).

175. Some software claims may become obsolete before their terms expire because the market no longer demands the claimed functionality.

176. See, e.g., BESSEN & MEURER, *supra* note 28, at 187–214.

177. In fact, after-arising hardware programmed with earlier-patented software is likely not even recognized as an improvement. Software apparatus claims are commonly drafted with “means-for” limitations, such as “a means for choosing a random number.” Means-for limitations (and all other purely functional claim limitations) are construed under the special rules of claim construction set forth in 35 U.S.C. § 112, ¶ 6 (2006). It is black-letter law that means-for claim limitations cannot encompass after-arising technology. See *Chiuminatta Concrete Concepts, Inc. v. Cardinal Indus., Inc.*, 145 F.3d 1303, 1310–11 (Fed. Cir. 1998). However, given the rapid evolution of computer hardware, it is likely that means-for limitations in computer software patents routinely encompass after-arising hardware

The inverse scenario, too, gives rise to overlooked improvements that routinely fall within literal claim scope in the contemporary patent regime. Imagine an earlier claim to hardware, and the later development of a new software operating system. The hardware patentee brings a suit against someone who is running the new operating system on the precise hardware disclosed in the patent specification. It is black-letter law in the area of software patents that a machine programmed with new software is a new machine for the purposes of novelty and nonobviousness,<sup>178</sup> so a computer programmed with the nonobvious software is an after-arising thing in relation to the disclosure of the earlier hardware patent. Again, however, no argument has ever been addressed in the Federal Circuit that earlier-patented computer hardware is beyond the reach of the hardware patent just because it is running later-developed software.

### 3. *Claims with Prior-Art Context Limitations*

Sometimes, the compounding of successively invented properties in an improvement is not grounded in the independence of the properties of any single, indivisible thing. Rather, the compounding derives from the way in which claims frame the things. In a peripheral claiming regime, inventors often file both independent claims describing the thing that they have invented and dependent claims that recite as limitations both that thing and some of the prior-art context in which it is found. For example, the inventor of an eraser may claim both an “eraser” in isolation and an “eraser attached to a pencil.” Generically formulated, an inventor who has invented thing A may claim both “A” and “A+B,” with B being a thing that is divisible from A and part of the prior-art context in which A is often found. By filing a claim to “A+B,” the inventor has framed the things claimed by the patent to include more physical matter. As more context limitations are added to the claim language, the claimed thing becomes physically larger and the claim scope becomes smaller.<sup>179</sup>

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executing the disclosed software. The point here is not that the literal interpretation of black-letter law on the construction of means-for claims should prevent the reach of software patents into later-developed hardware. Rather, the point is that the courts have not yet realized the implications of a per se bar on the literal infringement of after-arising technology. Some overlooked improvements raise such “easy” cases that they simply have not been recognized as improvements at all.

178. *In re Bernhart*, 417 F.2d 1395, 1400 (C.C.P.A. 1969).

179. Patent applicants file claims with prior-art context limitations as a safety net. Even if a claim to “A” turns out to be obvious, the claim to “A+B” may be nonobvious because combining A with B may generate unexpected properties. Additionally, there are several reasons why patent applicants might recite prior-art context limitations as the broadest, independent claims of a patent. The problem may be a conceptual error on the part of a

Claims with prior-art context limitations give rise to overlooked improvements whenever it is the prior-art context rather than the invented thing that is improved. Assume that A is a newly invented thing, that B is a prior-art limitation, and that the inventor claims both “A” and “A+B.” A later improver comes up with an improved version of B—call it B’. With respect to the claim to “A,” the invention of B’ is a later-developed component, not an improvement. The claim to “A” can read on A+B’ because the A present in the combination of A+B’ is the same old A disclosed in the earlier patent.<sup>180</sup> However, with respect to the claim to “A+B,” the invention of B’ does yield an improvement. As defined by the claim, the relevant thing that needs to have been disclosed in the earlier patent specification is A+B’, not simply A. The set of things described by the claim “A+B” must grow over time after the claim has been filed if A+B’ is to infringe. The set of things encompassed within a claim to an “eraser” need not expand over time after filing if it is to encompass an eraser attached to an after-arising pencil, but the set of things encompassed within a claim to an “eraser attached to a pencil” does.

Improvements that alter the properties of the not-inventive-yet-claimed context of an earlier invention wear their status as overlooked improvements on their sleeves. Property independence corresponds to thing independence—or, more accurately, to divisible sub-thing or divisible part independence. If the claimed things are composed of more than one distinct sub-thing or part, the properties of the independent distinct sub-things or parts can vary independently. The earlier advance may be embodied in one part of the claimed thing, and the later advance may be embodied in a distinct part.

There is no black-letter law stating that patents can expand over time to include improvements on prior-art, context limitations recited in a claim. However, to the extent that a disclosure doctrine would be called upon to invalidate the claim to “A+B” discussed above<sup>181</sup> as overbroad because it encompasses the allegedly infringing technology A+B’, the result would seem

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claim drafter. Sometimes, B is so ingrained in prevailing conceptions of how A is used that it may not occur to the claim drafter to claim “A” apart from “A+B.” *Cf.* *Larami Corp. v. Amron*, 27 U.S.P.Q.2d 1280 (E.D. Pa. 1993) (holding a claim to a new water-gun trigger mechanism was not infringed because the claim recited a gun “having a chamber therein for liquid” and the allegedly infringing technology had an external water reservoir). Patent drafters may also include context limitations because claims that describe larger physical entities may result in larger damages. Lemley, *supra* note 64, at 25–27.

180. *See supra* text accompanying notes 110–16 (discussing disclosed-thing cumulative innovation cases).

181. *See supra* text accompanying note 180.

to violate a basic principle of patent law. When the allegedly infringing technology is A+B', the argument that the claim to “A” is enabled and possessed but that the claim to “A+B” is not would mean that an independent claim remains valid as a dependent claim is invalidated. However, dependent claims are widely presumed to be enabled if the independent claims from which they depend are enabled.<sup>182</sup>

For an anecdotal example of a claim that likely has a prior-art, context limitation, consider the Federal Circuit’s opinion in *Superguide Corp. v. DirecTV Enterprises*.<sup>183</sup> The *Superguide* court addressed the scope and validity of claims based on the invention of interactive electronic television programming guides—the ones that replaced the supplements in the Sunday paper.<sup>184</sup> The court construed the meaning of the claim term “regularly received television signal,”<sup>185</sup> a likely example of a prior-art context limitation (as the inventor did not claim to have invented regularly received television signals). At the time the patent was filed, the regularly received signals were analog, but they were digital by the time of infringement. While a concurrence argued that the claim was limited to interactive electronic television programming guides that employed analog signals,<sup>186</sup> the majority allowed the claim to encompass digital signals.<sup>187</sup> This facet of the *Superguide* holding allowed literal claim scope to expand over time to encompass an overlooked improvement. The claim recited a prior-art context limitation. The allegedly infringing technology was an improvement because of an after-arising alteration of this context.

## VI. VISUAL REPRESENTATIONS OF THE DISTINCTION

In a classic improvement, the properties that instantiate the later inventor’s ideas in part compound with, and in part supplant, the properties that instantiate the earlier inventor’s ideas. Figure 3 roughly represents this relationship<sup>188</sup>:

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182. See Lefstin, *supra* note 63, at 1170–74 (discussing the paradox of non-enabled dependent claims).

183. *Superguide Corp. v. DirecTV Enters.*, 358 F.3d 870 (Fed. Cir. 2004).

184. *Id.* at 873.

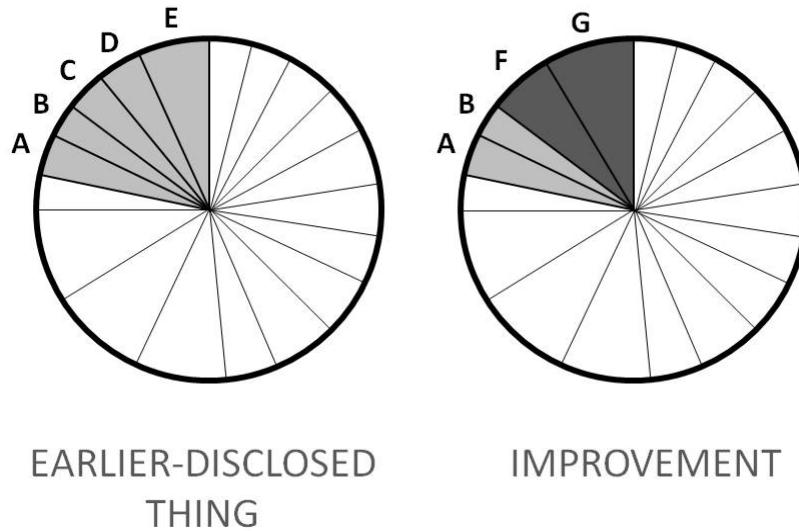
185. *Id.* at 876.

186. *Id.* at 897 (Michel, J., concurring).

187. *Id.* at 876–81 (majority opinion).

188. The representation is rough in part because it fails to capture the fact that there is a hierarchy among properties of different levels of generality, i.e., that some more general properties are entailed by the presence of more specific properties.

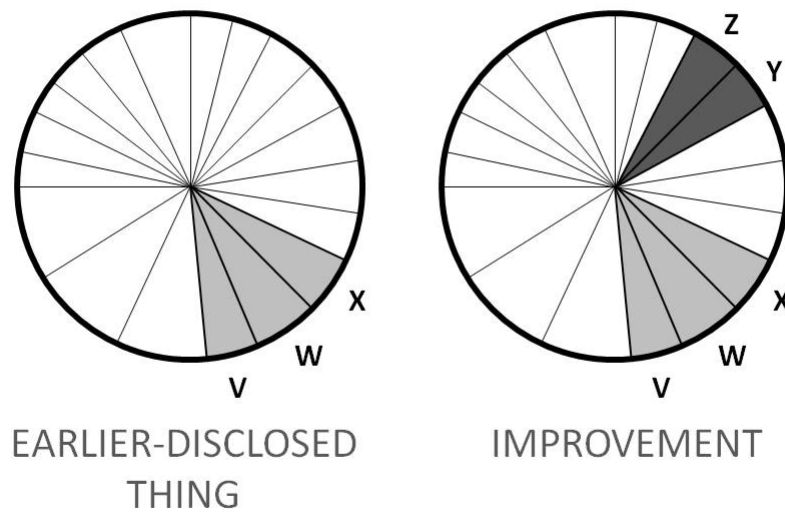
Figure 3: Classic Improvement



In Figure 3, the circles are things, and the pie-shaped wedges are the properties that comprise the things. On the left are the things disclosed and claimed by an earlier patent. Properties A, B, C, D, and E all instantiate the earlier inventor's advance. The other unlabeled properties do not embody the inventor's ideas. On the right is the improvement. Properties F and G instantiate the improver's ideas in the improvement. Properties A and B persist in the improvement. They compound with properties F and G. Properties C, D, and E do not persist in the improvement. They have been supplanted by properties F and G.

In contrast, as Figure 4 illustrates, the properties that instantiate the later advance in an overlooked improvement do not supplant any of the properties that instantiate the earlier advance:

Figure 4: Overlooked Improvement



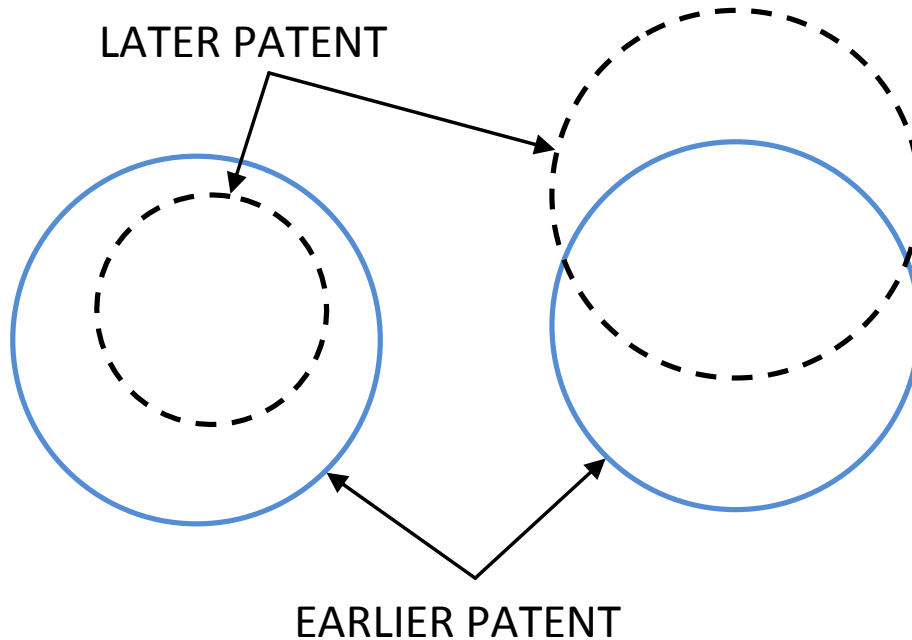
In Figure 4, the properties V, W, and X are all of the properties that instantiate the earlier inventor’s advance in the things disclosed by the earlier patent, and they persist in the improvement. The properties Y and Z instantiate the improver’s advance in the improvement. They compound with properties V, W, and X in the improvement, displacing only properties that did not instantiate the earlier patentee’s ideas.

Assuming that the later inventor also seeks patent protection,<sup>189</sup> Figure 5 illustrates that classic and overlooked improvements implicate different types of blocking patents<sup>190</sup>:

189. See *supra* note 4 (noting that an improver can patent an improvement).

190. Both of these types of blocking patents are overlapping blocking patents. See *infra* note 297 (distinguishing overlapping and economic blocking patents).

Figure 5: Relationship to Blocking Patents



Classic improvements often involve nested blocking patents (on the left of Figure 5), in which the improver's patent scope is entirely subsumed within the earlier inventor's patent scope. In a classic improvement that involves refinement, the earlier inventor's more general properties persist in the improvement and compound with the improver's properties.<sup>191</sup> If the earlier patentee is able to obtain a claim that encompasses the later-developed improvement, then the claim will reference the more general properties, and it will be drafted at a sufficiently high level of generality so to encompass all of the improver's patentable things.<sup>192</sup> Overlooked improvements are more likely to involve offset blocking patents (on the right of Figure 5). The earlier inventor and later improver usually work in distinct technological fields,<sup>193</sup> so

191. If the earlier inventor is denied a patent at that relatively high level of generality and is limited to a more specific level of generality that corresponds to the specific properties that are supplanted in the improvement by the improver's properties, then the earlier inventor's rights do not encompass the improvement at all, and there are no blocking patents.

192. See *infra* notes 242–48 and accompanying text (noting the relationship between the permissible level of generality of a valid peripheral claim and whether classic improvements infringe earlier-filed patents).

193. See *supra* text accompanying notes 154–57.



the later improver’s invention is likely to have some embodiments that do not require the use of the earlier inventor’s properties. An improved canvas can be used in devices other than airplanes;<sup>194</sup> Bob’s after-arising metal can be used in devices other than spring-loaded mousetraps.<sup>195</sup>

## VII. WHY CLASSIC AND OVERLOOKED IMPROVEMENTS MERIT DISTINCT TREATMENT

This Part uses a conceptual framework that identifies properties as the locus of invention to analyze the optimal reach of earlier-filed patents into later-developed improvements. Section VII.A presents a normative goal of the patent regime: patent claims should track in some way the set of things that embody inventors’ innovative ideas. Section VII.B uses a focus on properties as the locus of invention to explain why this goal means that overlooked-improvement cases should be “easy” and classic-improvement cases should be contested. It also introduces the concept of the least-general naked property that should be added to the conventional theory on patent protection for improvements in classic-improvement cases. Section VII.C reveals a conceptual bonus of focusing on properties as the locus of invention. The innovative properties generated by successive inventors can be identified as pure complements in the overlooked-improvement cases and as part-complement, part-substitute mixtures in the classic-improvement cases, allowing these well-established economic concepts to have a newfound relevance to crafting claim scope.

### A. CRAFTING A MARKET FOR *IDEAS* FROM RIGHTS THAT GOVERN *THINGS*

This Section establishes the normative concern that, in the following Section, is used to drive the analysis of patent protection for improvements. It states two basic principles of patent law and derives a logical corollary from them. First, patent rights should create a market for innovative ideas—that is, a market in which inventors are rewarded in rough proportion to the social value of their ideas, as measured by consumers’ willingness to pay. Second, patent rights propertize sets of things, not ideas per se. For a patent regime that respects both of these principles to function effectively, these two principles entail a third: the sets of things governed by patent rights must track the sets of things that embody inventors’ ideas.

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194. *Cf. supra* text accompanying note 40.

195. *Cf. supra* text accompanying note 152.

The first principle is that patents are a market-based solution to the problem of insufficient incentives for the generation of innovative ideas. Under an incentive-to-invent justification for patents, patents augment the inefficiently low incentives for individuals to invest in generating the innovative ideas that are needed to produce welfare-enhancing, innovative products.<sup>196</sup> The ideas required to produce technologically innovative things are often costly to generate. Yet, once the ideas are produced, competitors are often able to gain access to them cheaply and quickly by examining the products that inventors must sell in order to profit from their ideas. Under these conditions, rational actors may not invest in generating the innovative ideas. They may see down the road that marginal-cost pricing in a competitive market will deprive them of the ability to recoup the costs sunk into idea generation, so they choose to spend their time and money on endeavors other than research and development.<sup>197</sup> To address this incentives problem, the patent regime establishes property rights (or, at least, property-like rights)<sup>198</sup> in inventions. Such rights are not the only means of addressing inefficiently low incentives to invent.<sup>199</sup> However, they have the virtue of enlisting the distributed intelligence of the market to make decisions that the government is arguably not very competent to make because it lacks the required information.<sup>200</sup> If patentees get rights to exclude others from socially valuable uses of their innovative ideas, patent rewards will be proportional to the social value of inventors' ideas, with social value being measured by consumers' willingness to pay.<sup>201</sup> This proportionality, in turn, means that the

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196. The incentive-to-invent justification of patent rights described in the following sentences is well established. *See, e.g.*, SUBCOMM. ON PATENTS, TRADEMARKS, AND COPYRIGHTS OF S. COMM. ON THE JUDICIARY, 85TH CONG., AN ECONOMIC REVIEW OF THE PATENT SYSTEM (Comm. Print 1958) (Study No. 15 prepared by Fritz Machlup, Johns Hopkins Univ.) (presenting a historical overview of several justifications of the patent regime, including the incentive-to-invent justification).

197. This before picture is not as bleak as it is sometimes made out to be. Some of the costs of invention can be recouped even without patent protection. *Cf.* Wesley M. Cohen, Richard R. Nelson & John P. Walsh, *Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)* (Nat'l Bureau of Econ. Research, Working Paper No. W7552, 2000), available at <http://ssrn.com/abstract=214952> (providing empirical data of firms' use of patents and other mechanisms for appropriating profits from invention).

198. *See infra* note 210 (noting a debate over the extent to which property in tangible resources and intellectual property are birds of a feather).

199. *See* Brian D. Wright, *The Economics of Invention Incentives: Patents, Prizes, and Research Contracts*, 73 AM. ECON. REV. 691 (1983) (discussing prizes and government contracts for research).

200. *Id.* at 691–92; Scotchmer, *supra* note 2, at 30.

201. The alignment of the magnitude of patent rewards and the social value of patented inventions is commonly cited as a beneficial feature of patent protection. *See, e.g.*, FED.

magnitude of patent rents will reflect what consumers want, “thus channeling productive efforts” of inventors “in directions most likely to enhance consumer welfare.”<sup>202</sup> Because of this proportionality—that is, because “the profit available from exclusive control of the innovation will be correlated with its social value”—a patent regime encourages potential innovators to perform the important task of “screen[ing] their ideas by comparing cost to some measure of expected social value.”<sup>203</sup> In sum, to harness the power of the rational individuals’ drive to maximize private welfare and use it to drive inventive activity toward the production of the most socially valuable ideas, patents must structure a market for ideas, i.e., they must create property rights that reward inventors in proportion to the social value of their ideas. For a patent regime to use a market to incentivize innovation and achieve allocative efficiency among possible research and development expenditures, patents on innovative ideas that generate larger welfare gains must yield larger profits for their inventors, all else being equal.<sup>204</sup>

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TRADE COMM’N, THE EVOLVING IP MARKETPLACE: ALIGNING PATENT NOTICE AND REMEDIES WITH COMPETITION 2 (2011), available at <http://www.ftc.gov/os/2011/03/110307patentreport.pdf> (“By aligning the patentee’s market reward with consumer preferences, competition in product and technology markets encourages investment in those inventions that are more likely to be valued by consumers.”); Carl Shapiro, *Patent Reform: Aligning Reward and Contribution*, 8 INNOVATION POL’Y & ECON. 111, 113 (2008) (“[E]conomic efficiency is promoted when the rewards provided to patent holders are aligned with their actual social contributions.”).

202. William Fisher, *Theories of Intellectual Property*, in NEW ESSAYS IN THE LEGAL AND POLITICAL THEORY OF PROPERTY 168, 178–79 (Steven R. Munzer ed., 2001) (citing Harold Demsetz, *Information and Efficiency: Another Viewpoint*, 12 J.L. & ECON. 1 (1969) (discussing a utilitarian theory of intellectual property based on optimizing patterns of productivity)). This argument is sometimes marshaled to argue that intellectual property should aspire to perfect internalization. See, e.g., PAUL GOLDSTEIN, *COPYRIGHT’S HIGHWAY* 178–79 (1994). However, ensuring proportionality between an inventor’s ideas and his rewards, but not perfect internalization, has some value in optimizing patterns of productivity. Although rational actors will not undertake some welfare-enhancing innovative projects because the private returns will not cover the costs of invention when internalization is not perfect, proportionality still effectively channels efforts among the technological endeavors that rational actors will undertake. Proportional, but not perfect, internalization also tempers a market for ideas in a way that, on balance, likely promotes the efficient generation of ideas. See *infra* notes 209–16 and accompanying text. Furthermore, assuming that perfect internalization is not possible in endeavors that do not lead to intellectual property rights, it is likely necessary to prevent over-investment in the generation of technological ideas. Arnold Plant, *The Economic Theory Concerning Patents for Inventions*, 1 ECONOMICA 30, 31–32 (1934). Cf. Glynn S. Lunney, *Reexamining Copyright’s Incentives-Access Paradigm*, 49 VAND. L. REV. 483, 655–56 (1996) (raising this argument in relation to copyright law).

203. See SCOTCHMER, *supra* note 24, at 97.

204. The “all else being equal” caveat is important. See *infra* notes 209–16 and accompanying text (discussing reasons for diverging from proportionality of contribution and reward).

The second principle is that patents propertize sets of things. Although patents structure a market for innovative ideas, they do not propertize ideas per se. They do not meter the mental consumption of newly discovered knowledge itself: one cannot infringe a claim to a newly discovered mousetrap by thinking about the ingenious mechanism that links the cheese to the deadly consequences that await the hungry mouse, nor can one infringe by communicating to the public how to understand the mechanism, how to make it, and how to use it, even if one profits from the communication.<sup>205</sup> Rather, patents grant inventors rights to exclude others from making, using, selling, offering to sell, or importing innovative things.<sup>206</sup> One must make, use, sell, offer to sell, or import an instance of a thing that is actually capable of catching mice to infringe the patent.

Viewed in combination, these two principles reveal an important design feature of the patent regime that, in turn, offers guidance about how patent scope should be determined. Patent rights are a kind of drive-chain technology linking two gears, each of which is located in a distinct ontological realm. Rights to exclude from the specified uses of sets of innovative things (which exist in the material, extra-mental world) are created in order to create a market for innovative ideas (which exist, at least in part, in human minds).<sup>207</sup> This trans-realm design feature—an indirection built into the heart of patent law—has important implications for patent scope. For the drive-chain linkage to work properly, patent rights governing a set of things must reward an inventor in proportion to the value of his innovative ideas, and the set of things governed by a patent must track the set of things that embody an inventor's ideas.<sup>208</sup> As explored in the following Section, this

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205. *See supra* notes 117–18 and accompanying text (noting that idea-only cumulative innovation cases never result in infringement).

206. 35 U.S.C. § 271(a) (2006). *But cf. supra* note 87 (noting that method claims are also eligible for patent protection).

207. The fact that the patent regime uncomfortably straddles the realms of ideas and things can be seen in the fact that the term “invention” in patent law is ambiguous. In one sense, inventions are widely recognized as ideas or mental realizations. *See, e.g., Pfaff v. Wells Elecs.*, 525 U.S. 55, 60 (1998) (stating that, in the context of the on-sale bar of 35 U.S.C. § 102(b), “[t]he primary meaning of the word ‘invention’ in the Patent Act unquestionably refers to the inventor’s conception rather than to a physical embodiment of that idea”). It is in this sense of an invention that, according to legend at least, inventions can occur when a light bulb goes off in our minds when we are in the shower. In another sense, inventions are commonly identified as the things that are described by patent claims. *See* § 271(a) (defining direct infringement).

208. The indirection at the heart of patent law means that patent protection does not align the private value of a patent to an inventor with the social value of an innovative idea per se. Rather, patent protection tracks the social value of embodied ideas—ideas as they exist embodied in things. The value of ideas per se that are not embodied in things escapes

conclusion is an important driver of the different patent protection doled out to classic and overlooked improvements.

Structuring a market for embodied ideas is a goal of patent protection, but it is not the ultimate or only goal. It is a means to the end of promoting technological progress. The patent regime is not a purely formalist system in which all rules must reinforce the proportionality of the social value of an embodied idea and the private value of a patent. There are often good reasons to stray from strict proportionality.<sup>209</sup> For example, issues related to the cost of producing innovations may be relevant. A strict focus on the proportionality of the social value of ideas and a patentee’s reward would mean that the costs of supplying the ideas required to produce innovative technology would be irrelevant to patent scope determinations.<sup>210</sup> It is

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the patentees’ control. In some cases, researchers who come up with valuable factual discoveries about the world (i.e., ideas per se) without inventing any nonobvious thing are denied patent protection altogether, despite the value of their contribution to technical progress. In patent lingo, these cases are often discussed as cases in which patent applicants are denied all patent protection because they claim a “law of nature” in the abstract rather than an application of the “law of nature.” See *Diamond v. Diehr*, 450 U.S. 175, 185, 191–92 (1981). But see *supra* note 117 (noting that many discussions of unpatentable abstract ideas involve claim scope, not claims describing the use of knowledge per se). In other cases, even when some form of patent protection is available to the earlier innovator, the value of ideas per se is often an externality from the perspective of the patent-owning inventor. See *supra* notes 117–18 and accompanying text (discussing idea-only cumulative innovation cases).

209. For example, the indirection principle at the heart of patent protection and its consequence of leaving knowledge per se beyond the reach of patent rights, see *supra* note 208, can readily be defended as a feature, rather than a bug, of patent protection.

210. The supply-driven vision of what patents do (they cover fixed costs) and the demand-driven vision (they allow inventors to eat a part of what they kill or profit in proportion to their contribution in increasing social welfare as measured by willingness to pay) are sometimes at odds. WILLIAM M. LANDES & RICHARD A. POSNER, *THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW* 300 (2003) (noting the schism between the magnitude of patent rewards and the costs of supplying ideas). The two can be brought into alignment by assuming proportionality between the social value of an invention and the cost of supplying the ideas that are required to produce it, but this assumption often does not reflect reality. Broadly speaking, the schism between supply- and demand-side concerns underlies many of the economic debates over the extent to which patent law, and intellectual property more broadly, should be thought of as a property regime. The stronger the focus on providing sufficient incentives to overcome the problems of supplying innovative ideas, the less intellectual property rights act like property rights and the more they should sanction free-riding when appropriate. The stronger the focus on rewarding inventors in proportion to the value of their innovative ideas, the more intellectual property rights act like property rights. Compare Mark A. Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEX. L. REV. 1031 (2005) (arguing against the property metaphor in intellectual property based on a supply-side goal of providing sufficient incentives), with John F. Duffy, *Intellectual Property Isolationism and the Average Cost Thesis*, 83 TEX. L. REV. 1077 (2005) (arguing that intellectual property should be treated like property and patents should be proportional to the value of

therefore conceivable to imagine a deviation from the proportionality principle in order to provide more incentives when the costs of supplying innovative ideas is high and fewer incentives when the costs of supplying innovative ideas is low.<sup>211</sup> Tempering the proportionality principle when costs of supplying innovative ideas are low and the market reward for those ideas is high also prevents wasteful races.<sup>212</sup> A strict focus on proportionality not only detaches the scope of today's patents from the costs of supplying yesterday's patented inventions, but it also ignores the costs that today's patents impose on tomorrow's innovation. It is therefore also conceivable to imagine a deviation from a strictly enforced proportionality principle when patented inventions are common inputs into future technological progress.<sup>213</sup>

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an inventor's embodied ideas in order to promote efficient allocation of research and development dollars).

211. Supply-oriented arguments are sometimes called "inducement" arguments—that is, arguments in which patent rights are calibrated so as to induce the expenditures required to supply inventions. The nonobviousness requirement is the most common locus of inducement requirements. See *Graham v. John Deere Co.*, 383 U.S. 1, 9–10 (1966); Michael Abramowicz & John F. Duffy, *The Inducement Standard of Patentability*, 120 YALE L.J. 1590 (2011); Tun-Jen Chiang, *A Cost-Benefit Approach to Patent Obviousness*, 82 ST. JOHN'S L. REV. 39 (2008). Inducement arguments are not as common in relation to the doctrines that curtail the reach of patent scope into after-arising technology and improvement, but they are sometimes made. See *supra* notes 24–26 and accompanying text (discussing the quality-ladder model for patent protection for improvements); DAN L. BURK & MARK A. LEMLEY, *THE PATENT CRISIS AND HOW THE COURTS CAN SOLVE IT* 150–53 (2010) (arguing that broad protection in biotechnology is appropriate to provide sufficient incentives for risky, costly research).

212. See Yoram Barzal, *Optimal Timing of Innovations*, 50 REV. ECON. & STATS. 348 (1968).

213. The general concern is that patent rights on "the basic tools of scientific and technological work," *Gottschalk v. Benson*, 409 U.S. 63, 67 (1972), may do more to slow down post-invention progress than they did to speed up pre-invention progress. This general concern is an agglomeration of several distinct specific concerns. In part, the concern is about stealing from Peter to pay Paul. Today's patents on the inputs into tomorrow's research make tomorrow's research more expensive, a questionable move given that research may already be underproduced because of the positive externalities that it entails. See Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257, 279 (2007) (discussing the "demand side" justification of intellectual property rights with spillovers). In part, the concern is about excessively broad claims that give a single firm excessive control over the direction of future research. See *Merges & Nelson*, *supra* note 2, at 908 (arguing in favor of competition rather than coordination in follow-on invention). Similar concerns have been voiced about the control that even a small, bottleneck claim that describes an essential input into many different avenues of research gives to a single patentee. See Eisenberg, *supra* note 109. In part, the concern is also about the anticommons or thicket problems that may result when an excessive number of fragmented rights on basic tools must be gathered together to perform research or develop innovative products. Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCIENCE 698 (1998); Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting*, 1 INNOVATION POL'Y & ECON. 119 (2000).

Finally, a market for embodied ideas is a means to the end of providing incentives to generate valuable technological ideas, but the patent regime may at times be focused on achieving other goals. In some contexts, the principal function of the patent regime may be to foster the efficient management of technological prospects,<sup>214</sup> the commercialization of already-invented technologies,<sup>215</sup> or the disclosure of already-discovered technical information.<sup>216</sup> Deviations from a market for embodied ideas and its proportionality principle may be required for the patent regime to achieve these alternative goals. Nonetheless, an important factor in patent protection, all other things being equal, is creating a market for embodied ideas. For such a market to exist, the private value of patent rights to patent owners should have a rough form of proportionality to the social value of an inventor's ideas, and, in turn, the set of things governed by a patent should track the set of things that embody an inventor's ideas.

B. THE IMPLICATIONS OF FOCUSING ON PROPERTIES AS THE LOCUS OF INVENTION

Assuming that patent claims should track the set of things that embody an inventor's ideas,<sup>217</sup> the important question in administering a patent regime is how the set of things that embody those ideas, and that therefore fall within the scope of a claim, should be identified. Yet, oddly and despite its centrality to the mechanics of a patent regime in which rights to exclude from things are designed to create a market for ideas, what it means for a thing to embody an idea has never been fully examined. One approach to answering this question is effectively to avoid answering it. Things could be assumed to embody ideas in some unspecified manner, and the set of things that embody ideas could be taken to be coextensive with the set of things disclosed and made available by the patent disclosure. Here, innovative things in their entireties are what embody innovative ideas, and things are the primitives of invention.<sup>218</sup> What Abby, Bernard, and Bob have all invented is simply the set of novel and nonobvious things that they disclosed and made available to the public at the time they filed their patents.<sup>219</sup>

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214. See Kitch, *supra* note 27.

215. See Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341 (2010).

216. See *Kewanee Oil Co. v. Bicron Corp.*, 416 U.S. 470, 480–81 (1974).

217. See *supra* Section VII.A.

218. See *supra* notes 62–67 and accompanying text (describing the paradigm in which things are the primitives of what an inventor invents).

219. See *supra* Part IV and Section V.A (presenting hypotheticals involving Abby, Bernard, and Bob).

Another approach to the question, however, is to answer it. Particular innovative properties of things can be taken to be the entities which instantiate innovative ideas in things. Properties can be framed as convenient intermediaries between the ontologically distinct realms of ideas (the entities for which incentives are sought) and things (the entities governed by patent rights) that patent law connects together as an instrumental matter.<sup>220</sup> It is because a thing possesses inter alia the property *being made of sliding plates that can capture mice* that the thing embodies Abby's inventive idea; it is because a thing possesses inter alia the property *being made of a wire that can catch mice and move in an arc in relation to a fixed base* that the thing embodies Bernard's inventive idea; it is because a thing possess inter alia the property *being made of a specific metal alloy* that the thing embodies Bob's innovative idea. Here, properties are the locus of invention.

In some situations, the difference between the thing- and property-centric approaches to invention is only a matter of semantics, and the coarse- or fine-grained nature of the analysis is irrelevant. For example, when a patentee sues someone who has made, used, or sold things that were actually disclosed and made available to the public by the patent at the time of filing, the scope of a patent will be the same regardless of whether things or properties are identified as the locus of invention. At the time a patent is filed, the set of innovative things that an inventor discloses is coextensive with the set of things that possess the inventor's innovative properties.

In improvement cases, however, the granularity at which the locus of invention is identified matters. In particular, it affects the ability of patent scope to track the set of things that embody an earlier inventor's ideas as later-developed improvements are discovered and produced. Even as coarser-grained things change over time, finer-grained properties can remain constant, allowing an earlier inventor's invention to be tracked through the ensuing later-developed improvements.<sup>221</sup> If innovative things are taken to be the primitives of what an inventor has invented, it is impossible to differentiate among a range of improvements and to say that some of the improvements embody an earlier inventor's ideas more than others do. The earlier inventor's invention is a set of things that the patent disclosed and made available to the public at the time of filing, and no improvements fall within that set because all improvements are new things that the earlier

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220. *Cf. supra* notes 207–08 and accompanying text (describing the patent regime as a drive chain that links these distinct realms).

221. *See supra* Section II.C (arguing that a focus on properties permits a finer-grained analysis than a focus on things does).



inventor’s specification did not disclose and make available to the public.<sup>222</sup> Precisely how, or in what way, they are different cannot be ascertained (or is irrelevant) because there is no “spirit” of an invention to track through the line of post-filing improvements. In contrast, if properties are viewed as the locus of invention, there is a way of tracking the persistence of an invention in post-filing improvements. Even if coarse-grained things change over time, certain finer-grained properties may persist in an unchanged state.<sup>223</sup>

Section VII.B.1 demonstrates that the properties invented by the earlier inventor persist in their entirety in overlooked improvements, meaning that earlier-filed patent claims should routinely encompass overlooked improvements and overlooked-improvement cases should be the “easy” cases that they are. Although an overlooked improvement is a new thing, the properties that instantiate the earlier inventor’s ideas in the improvement are old and unchanged. In contrast, Section VII.B.2 demonstrates that the properties invented by the earlier inventor persist in classic improvements, but not in their entirety, meaning that classic-improvement cases should be the contested cases that they are today. Classic improvements continue to embody the earlier inventors’ ideas in some ways, but not in others, making control of classic improvements a highly fact-specific inquiry. Section VII.B.2 also demonstrates that a property-centric framework enables the identification of the least-general naked property of a classic improvement and argues that this factor should be added to the conventional theory on patent protection for improvements in classic-improvement cases.

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222. See *supra* Section III.A.2 (presenting the timing (or new-thing) criterion of an improvement).

223. If patents are intended to structure a market for ideas, see *supra* Section VII.A, and properties are the entities that instantiate ideas in things, see *supra* note 220 and accompanying text, the notion that patent interests should encompass at least the set of things that possess in full the properties invented by an inventor is practically a truism. However, at least for the purpose of constructing a patent regime, there is no metaphysically correct way to determine the level of granularity at which ideas are embodied in things. The open question is whether a focus on things or properties produces a patent regime that better serves the desired normative ends. Cf. *supra* notes 67–68 and accompanying text (framing the choice between things and properties as the locus of invention in terms of the rules-standards debate). Getting into the “spirit” of innovative things and focusing on properties as the locus of invention explains the otherwise inexplicable distinction between classic and overlooked improvements. As explored below in Sections VII.B.1 and VII.B.2, the proof of the value of a focus on properties as the locus of invention in improvement cases lies in its explanatory power and normative purchase. A conceptual framework in which properties are the locus of invention does what a thing-centric framework cannot. It both points out the distinction between classic and overlooked improvements and justifies the differential treatment that each type receives, with classic improvements giving rise to contested cases and overlooked improvements giving rise to “easy” cases.

1. *Overlooked, “Easy” Improvements*

To review, a focus on properties as the locus of invention reveals that an overlooked improvement still possesses all of the properties invented by the earlier inventor.<sup>224</sup> The improver’s advance is embodied in a set of properties that is functionally independent from the set of properties that embodies the earlier advance,<sup>225</sup> so the addition of the improver’s innovative properties to the improvement does not displace the earlier inventor’s innovative properties from the improvement. More concretely, using the facts of the Abby-Bob hypothetical,<sup>226</sup> the properties invented by Abby (i.e., the properties addressing the mechanical configuration of the parts of a mousetrap) are fully present in Bob’s improved mousetrap in which the spring is made out of an after-arising metal. They are present to the same extent that they ever were in the mousetraps that Abby disclosed in her own, earlier patent.

A focus on properties as the locus of invention also explains the “easy” nature of the overlooked-improvement cases. If properties are the entities that instantiate ideas in things,<sup>227</sup> then overlooked improvements still fully embody the earlier inventor’s ideas because they possess all of the properties invented by the earlier inventor. In turn, if patent claims should track the set of things that embody an inventor’s idea,<sup>228</sup> then the earlier inventors’ patents should encompass the later-developed improvements. The conventional theory on improvements has only a minor role to play, if any, in determining the reach of earlier-filed patents into overlooked improvements<sup>229</sup> because the need for some rough form of proportionality between private patent rewards and the social value of innovative ideas simply trumps the factors addressed in the conventional theory.<sup>230</sup> Importantly, one cannot glean this

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224. *See supra* Section V.A.

225. *See supra* Section V.B (discussing factual scenarios that give rise to functionally independent sets of properties).

226. *See supra* Section V.A.

227. *See supra* note 220 and accompanying text.

228. *See supra* Section VII.A.

229. *See supra* Section II.B (demonstrating that overlooked improvements lie in a blind spot of the conventional theory on patent protection for improvements).

230. At first glance, a non-infringement holding might seem simply to mean that an inventor cannot internalize any of the social welfare derived from a set of technologies that fully embody his technical advance. However, the distortion of the market for embodied ideas would be much more severe. Assuming that improvements are substitutes for the things the earlier inventor made available to the public in his disclosure, as they usually are, a non-infringement holding leads to erosion of the patentee’s profits on the things that he did actually disclose and make available to the public in his specification. *See infra* notes 272–78 and accompanying text. A distinct, evidentiary reason why patent protection should perhaps

insight if things are the primitives of invention. Overlooked improvements, like all improvements, are new things that were not disclosed and made available to the public by the earlier inventor's patent. If things are the primitives of invention, then there is no way to track the continuity between an earlier-invented set of things and a later-invented set of things. Only by focusing on innovative properties is this continuity revealed. Although an overlooked improvement is a new thing, the properties that instantiate the earlier inventor's ideas in the improvement are old and unchanged. Particular finer-grained properties invented by an earlier inventor can remain constant over time even as the coarser-grained things change. The change in the things resides in properties of the things other than those properties that instantiate the earlier inventor's ideas.

## 2. *Classic, Contested Improvements*

Again to review, classic improvements are different from overlooked improvements when the focus is on properties as the locus of invention. Unlike in an overlooked-improvement case, there is no simple yes-or-no answer to the following question in a classic-improvement case: “Does the improvement still embody the earlier inventor's innovative ideas?” The answer is both yes and no. When parsed in terms of the properties attributable to the earlier inventor that persist in the improvement, classic improvements are a mixture that presents an uneasy middle ground. They continue to embody the earlier inventor's ideas in some ways, but not in others. The properties that instantiate the earlier inventor's more general advances are still present in the improvement, but the properties that instantiate the earlier inventor's more specific advances have been supplanted from the improvement by the properties that instantiate the improver's advance.<sup>231</sup> More concretely, using the facts of the Abby-Bernard hypothetical,<sup>232</sup> Bernard's improved mousetrap still embodies Abby's general idea because it possesses a property like the property *being a device in which the jostling motion of a mouse transforms the potential energy stored in a spring into the kinetic*

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more readily encompass overlooked improvements is that overlooked improvements are unlikely to be the result of independent invention. The after-arising advances that give rise to overlooked improvements are usually in arts that are different from the art of the earlier patent. *See supra* text accompanying notes 154–57. It is therefore extremely unlikely that the later inventor independently invented the earlier invention. Bob, an expert in metallurgy, is unlikely to have thought up Abby's mousetrap design on his own. Although patent law does not provide an independent-invention defense as a doctrinal matter, *see supra* notes 104–05 and accompanying text, the increased likelihood of copying strengthens the earlier patentee's normative claim to overlooked improvements.

231. *See supra* Part IV.

232. *See id.*

*energy required to catch a mouse.* However, Bernard's improved mousetrap no longer embodies Abby's more specific idea because it does not possess the property *being made of sliding plates*. Abby's more specific property has been supplanted by Bernard's innovative property *being made of a wire that can move in an arc in relation to a fixed base*. Whether an earlier inventor's innovative property persists in the improvement depends on which innovative property is the focus of attention.

Given this partial persistence of the earlier inventor's properties, a focus on properties as the locus of invention explains the contested nature of classic-improvement cases under the conventional theory of patent protection for improvements.<sup>233</sup> If properties are the entities that instantiate ideas in things,<sup>234</sup> then classic improvements still embody some of the earlier inventor's ideas, but not all of them. In turn, if patent claims should track the set of things that embody an inventor's ideas,<sup>235</sup> then the reach of the earlier inventors' patents into classic improvements is legitimately contested.<sup>236</sup> The need to include or exclude the improvement from the earlier patentee's rights in order to structure a market for embodied ideas is not such an overriding concern that it must trump other normative considerations. In this borderline situation, the outward context is important and, hence, the conventional theory that addresses the context in which an improvement comes into being becomes relevant.<sup>237</sup> The earlier patentee's case for infringement is weaker when the classic improvement is very important in relation to the earlier-patented technology,<sup>238</sup> when the pattern of technical

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233. See *supra* notes 29–37 and accompanying text (demonstrating that the conventional theory on patent protection for improvements has relevance in the classic-improvement cases).

234. See *supra* note 220 and accompanying text.

235. See *supra* Section VII.A.

236. Overlooked improvements are “easy” because an improvement that possesses *all* of the properties invented by an earlier patentee should infringe the earlier patent, despite the fact that the improvement is a new thing that was not made available to the public by the earlier patent. See *supra* Section VII.B.1. Classic improvements, however, raise a different threshold question: Should the presence of *any* property invented by an earlier patentee in a later-developed improvement, regardless of the generality of that property, be a sufficient condition for infringement? If one were to answer this question in the affirmative, then all classic improvements, too, would be “easy” cases as improvements by definition still embody at least one property that instantiates an earlier inventor's ideas. However, there are good reasons to be skeptical of such an expansive approach to patent protection for improvements that furthers a goal of perfect internalization. See *supra* note 202.

237. See *supra* notes 76–79 and accompanying text (noting that the conventional theory on improvements can only consider the outward context in which a later invention occurs, not the intrinsic relationship between the earlier- and later-invented things).

238. See *supra* notes 18–21 and accompanying text.

advance in the industry is cumulative and the market for patent licenses is full of friction,<sup>239</sup> when the need for incentives in the industry is low,<sup>240</sup> and when the prospect function of patents plays only a minor role in the justification of patent rights.<sup>241</sup>

A focus on properties as the locus of invention does more than simply highlight the importance of the conventional theory in classic-improvement cases. By examining improvement at a finer-grained level, it also reveals a factor that should be critical in determining the optimal reach of an earlier-filed patent into classic improvements and that should be added to the conventional theory on patent protection for improvements. This additional factor goes unnoticed when things are taken to be the primitives of what an inventor invents because it implicates the nature of the earlier inventor's property that persists in the classic improvement. In particular, it implicates the level of generality of the property that persists in the improvement. In a classic improvement, the most specific of the earlier inventor's innovative properties is uniformly supplanted by the later inventor's innovative property. However, the most specific level of generality at which the earlier inventor's properties persist in the improvement will vary from case to case. The generality of this property—call it the earlier inventor's least-general naked property<sup>242</sup>—is a critical factor to consider in determining whether earlier-filed patents should encompass later-developed classic improvements.

To understand the concept of the least-general naked property in a classic improvement, consider a third hypothetical, once again involving Abby as the earlier inventor in an improvement scenario.<sup>243</sup> Abby is still the first inventor of a spring-loaded mousetrap, and she discloses and makes available to the public a sliding-plate mousetrap. This time, however, Barry creates an improvement. Barry makes a mousetrap in which sheets of wire mesh, rather than plates, slide with respect to each other. The wire mesh is newly engineered for the improved mousetrap. The openings in the wire mesh are large enough for a mouse to pass through. When the trap is triggered and the sheets of wire mesh slide with respect to each other, they catch a mouse, just like the sliding plates with holes did in Abby's mousetrap. However, the wire mesh is less expensive to produce, and it also works better

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239. See *supra* notes 22–23 and accompanying text.

240. See *supra* notes 24–26 and accompanying text.

241. See *supra* notes 27–28 and accompanying text.

242. This property is “naked” in the classic improvement because all of the earlier inventor's less general, i.e., more specific, properties have been stripped away.

243. See *supra* Part IV (describing Abby's earlier invention).

because some “give” in the wire mesh ensnares the mouse more snugly and securely than sliding plates with holes do.

Just like Bernard’s improvement, Barry’s improvement is a classic improvement. His later-developed innovative property is something like *being made of sliding wire meshes with “give.”* In the improvement, Barry’s innovative properties supplant the most specific of Abby’s innovative properties, namely the property *being made of sliding plates with holes.* However, Abby’s more general properties persist in the improvement. For example, Abby’s more general innovative property *being made of sliding planar elements* persists, as both a mesh and a plate are planar elements.

What factual differences between Bernard’s classic improvement and Barry’s classic improvement are relevant in assessing whether Abby has a stronger normative claim to patent rights that encompasses either one or the other?<sup>244</sup> One difference is the level of generality of Abby’s least-general naked property. In the Abby-Barry hypothetical, Abby’s least-general naked property is something like *being made of sliding planar elements.* In the Abby-Bernard hypothetical, it is something like property *being a device in which the jostling motion of a mouse transforms the potential energy stored in a spring into the kinetic energy required to catch a mouse.* In a relative sense, the least-general naked property is much more specific in the Abby-Barry hypothetical. The set of mousetraps that possess this least-general naked property is a subset of the set of mousetraps that possess the least-general naked property in the Abby-Bernard hypothetical.

A coarse-grained focus on things as the primitives of invention does not allow the least-general naked property of a classic improvement to be identified, but a finer-grained focus on properties as the locus of invention does. Furthermore, allowing an earlier inventor’s patent claim to encompass a classic improvement merits more skepticism when the earlier inventor’s least-general naked property is a more general property. The higher the level of generality of the least-general naked property of a classic improvement, the weaker the earlier patentee’s normative claim to patent rights that encompass the improvement. On an intuitive level, this proposition makes sense because it formalizes the notion that some improvers, e.g., Barry,

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244. For the sake of convenience, assume that the conventional theory on patent protection for improvements, *see supra* Section II.A, does not differentiate between Bernard’s and Barry’s inventions. Assume that the relative importance of the two inventions is the same. The mousetrap industry is the same in both, so the same pattern of technical advance and concerns about friction in the market for patent licenses are present.

borrow more of their ideas from earlier inventors than others, e.g., Bernard, borrow.<sup>245</sup>

As an economic matter, this proposition allows the scholarship on improvements to tap into a well-established body of scholarship on the optimal scope of a valid claim. Through an array of doctrines, patent law curtails the level of generality at which patentees can draft claims to protect their inventions.<sup>246</sup> Thus, the inventor of the first cure for the common cold cannot claim generally “a drug capable of curing the common cold” but is instead limited to a more specific claim that is in some way limited by the structure of the molecule that the inventor has created. The costs of claims drafted in the most general or abstract of language are well documented, and it is widely believed that these costs outweigh whatever benefits (in terms of incentives to invent or coordinate) such claims would entail.<sup>247</sup> Paying attention to the generality of the earlier inventor’s least-general naked property in a classic improvement allows the body of scholarship and case law on the permissible generality of claim scope to be brought to bear on improvements. The more general the least-general naked property in a classic improvement, the more general the language in the claim that the patentee would need to be granted in order to have rights that encompass the improvement.<sup>248</sup> If properties are identified as the locus of invention and attention is paid to the earlier inventor’s least-general naked property in a classic-improvement case, the normative concerns about excessive general claims and earlier inventors’ rights to classic improvements merge into the same concern.

Of course, this merger is not a silver bullet for courts grappling with classic-improvement cases. The highest level of generality at which claim scope should be sanctioned is notoriously difficult to identify, and identifying the least-general naked property that gives an earlier inventor rights that encompass an improvement will therefore be equally difficult to identify. The points to be made here are only that the theory on patent protection for improvements has to date failed to incorporate the levels-of-generality debate

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245. Importantly, this intuition cannot be articulated with precision if things are taken to be the primitives of what an inventor invents.

246. See *supra* notes 130–32 and accompanying text.

247. For a recent articulation of this argument that expressly builds on Judge Hand’s levels-of-generality argument in copyright law, see Chiang, *supra* note 13.

248. The connection between the least-general naked property of a classic improvement that can be controlled by an earlier patentee, on the one hand, and the permissible level of generality at which a peripheral claim can be drawn, on the other hand, demonstrates the strong conceptual connection between peripheral claims and properties of things. See *infra* notes 315–17 and accompanying text.

and that this oversight can, and should be, corrected by recognizing the properties of things, rather than things in their entireties, as the locus of invention in improvement cases.

C. REFRAMING COMPLEMENTS AND SUBSTITUTES IN PATENT LAW

The previous Section demonstrated the explanatory value and normative purchase of paying attention on a fine-grained level to innovative properties, rather than only on a coarse-grained level to innovative things as indivisible wholes, when fine-tuning the reach of patents into improvements. This Section reprises this argument, bringing new conceptual tools to bear on the problem. It illustrates that the economic concepts of complements and substitutes can be used to explain why courts do and should treat overlooked improvements as “easy” cases and classic improvements as contested cases. This move is both novel and important because, for the first time, it internalizes the analysis of these well-known economic concepts within patent law proper, i.e., the patent law that determines claim scope and validity.<sup>249</sup>

This Section proceeds in three steps. Section VII.C.1 introduces the economic concepts of complements and substitutes. Section VII.C.2 reviews the ways in which complements and substitutes are employed today in scholarship related to patent law. Importantly, these uses of the concepts do not allow courts to identify a distinction between classic and overlooked improvements or craft claim scope. Section VII.C.3 demonstrates how complements and substitutes can be used to achieve these ends if, and only if, properties are viewed as the locus of invention and are labeled as the goods at issue.

1. *Complements and Substitutes*

In the everyday sense of the word, “substitutes” are goods that can replace or fill in for each other because they satisfy the same consumer need.<sup>250</sup> Nails and industrial strength glue for bonding wood are substitute goods in this common-sense way: I use either one, but probably not both, to join pieces of wood. In contrast, the everyday meaning of “complements” is a set of goods that are two parts of a whole and that consumers tend to consume together because they desire the whole.<sup>251</sup> Hammers and nails are

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249. I have previously offered a rough sketch of this argument in the context of the enablement doctrine. Collins, *supra* note 58, at 1111–24.

250. THE AMERICAN HERITAGE COLLEGE DICTIONARY, *supra* note 62, at 1354 (defining a substitute as “one that takes the place of another; a replacement”).

251. *Id.* at 284 (defining a complement as “something that completes, makes up a whole, or brings to perfection”).



complements: I practically need a hammer to use a nail for its most common purpose and vice versa.

To determine whether goods are complements or substitutes as a technical, economic matter, economists measure the goods' cross-price elasticity of demand.<sup>252</sup> Two goods are substitutes if a decrease in the price of one good results in a decrease in demand of the other good and, inversely, an increase in the price of one good results in an increase in demand for the other good.<sup>253</sup> This technical definition usually maps onto the common-sense definition of a substitute. If consumers are willing to use either one good or the other to fulfill their needs, then a decrease in the price of one will drive consumers toward that good and away from the other. The cheaper nails are, the less likely I am to buy an industrial strength glue when either one or the other can be used to achieve the desired goal of attaching pieces of wood.

In contrast, two goods are complements as a technical matter if a decrease in the price of one good results in an increase in the demand for the other good and, inversely, an increase in the price of one good results in a decrease in the demand for the other good.<sup>254</sup> Again, there is a link between the common-sense and technical definitions of a complement. Consumers tend to consume complementary goods together because the consumer's willingness to pay for the combination of the two goods is more than the sum of the consumer's willingness to pay for the two goods individually.<sup>255</sup> In other words, there is a “synergy” between the two goods.”<sup>256</sup> Because consumers place greater value on consuming the complementary goods together, the price that drives consumer-purchasing decisions is in part the price of the bundle of goods. A decrease in the price of one good in the bundle decreases the price of the bundle as a whole, meaning a consumer will tend to consume more of the bundle and thus more of the other good. All things being equal, the cheaper hammers are, the more nails I will consume.<sup>257</sup>

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252. ROBERT S. PINDYCK & DANIEL L. RUBINFELD, MICROECONOMICS 36 (7th ed. 2008) (“A *cross-price elasticity of demand* refers to the percentage change in the quantity demanded for a good that results from a 1 percent increase in the price of another good.”).

253. *Id.*

254. *Id.* at 24–25.

255. SCOTCHMER, *supra* note 24, at 144; Shapiro, *supra* note 201, at 122–23.

256. Shapiro, *supra* note 201, at 122.

257. Complements and substitutes span a spectrum from being perfect complements and substitutes to not being complements or substitutes at all. Perfect complements and substitutes exist if the goods are consumed together or substituted for each other, respectively, at a one-to-one ratio. PINDYCK & RUBINFELD, *supra* note 252, at 76–77.

## 2. *The Three Existing Frames for Identifying Complements and Substitutes*

In contemporary scholarship on improvements, the concepts of complements and substitutes have been used in three different manners. One looks at the boost that earlier innovators give to later innovators in the process of cumulative innovation and labels the successive innovations as technological complements. A second looks at the things produced by earlier and later inventors and queries whether they are complements or substitutes in the eyes of consumers. A third identifies patent rights as either complements or substitutes. None of these approaches to identifying complements and substitutes, however, offers a conceptual framework that can distinguish classic and overlooked improvements.

### a) Cumulative Innovation and Complements

When innovation is cumulative and later innovations build on earlier ones, the leg up given to the later innovation can be a significant part of the social value created by the earlier innovation.<sup>258</sup> The leg up can come in many forms. The earlier innovation may be necessary to develop the later innovation, it may reduce the cost of achieving the later innovation, or it may speed up the later innovation.<sup>259</sup> Regardless of the form that the boost takes, the process of cumulative innovation can be characterized as the successive discovery of complementary innovations.<sup>260</sup>

Although all cumulative innovation involves the successive invention of complements from this process-oriented viewpoint, there is no single, unified implication of this economic fact for patent protection for improvements. Earlier innovators can give boosts to later innovators through a diverse array of mechanisms, and these different mechanisms result in different allocations

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258. SCOTCHMER, *supra* note 24, at 127; Scotchmer, *supra* note 2, at 31. The notion of an earlier innovation giving a post to a later innovation is related to the process-oriented definition of an improvement that focuses on intergenerational facilitation. *See supra* notes 102–06 and accompanying text. James Bessen and Eric Maskin have defined this type of innovation as “sequential” innovation. Bessen & Maskin, *supra* note 2, at 612 (defining sequential innovation as a process in which “each successive invention builds on the preceding one”). They also use the term “complementary” as a term of art and in a manner that differs from its use in this Article. *Id.* at 612 (defining complementary innovative paths as non-redundant innovative paths).

259. SCOTCHMER, *supra* note 24, at 127; Scotchmer, *supra* note 2, at 31. The fraction of the earlier innovation’s value that lies in the boost can also vary. *See* Green & Scotchmer, *supra* note 2, at 22 (discussing an earlier innovation that has no direct value to consumers).

260. Shapiro, *supra* note 201, at 124–25.

of rights among the earlier and later inventors.<sup>261</sup> Many of these mechanisms through which cumulative innovation occurs do not involve improvements at all, at least as the term is used in this Article. In research tool cases, neither the products nor the knowledge generated by the later innovator is likely to fall within the scope of the earlier innovator’s claim, but the later innovator must compensate the earlier patentee for the use of the very research tool disclosed in the patent.<sup>262</sup> In cases in which the earlier-patented invention is improved by the later creation of a new component, the very things disclosed in the earlier patent must still be made, sold, and used as part of the “improved” technology.<sup>263</sup> In idea-only cumulative innovation cases, the scales tip in the other direction. The earlier innovator’s rights do not reward him for the boost that he gives to later innovators, as the knowledge disclosed in a patent is free for all to use qua knowledge.<sup>264</sup> When the mechanism through which cumulative innovation occurs is improvement, the presumption is that the earlier patent disclosure gives a boost to the improver to develop the improvement.<sup>265</sup> The improvement possesses some property that was invented by the earlier patentee,<sup>266</sup> and the improver was able to use the knowledge of this earlier-invented property disclosed in the specification as a platform upon which to pursue further technological progress.<sup>267</sup> All improvement cases implicate these intergenerational boosts; all improvers have benefited from the value created by earlier patentees.

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261. The root cause of the different mechanisms yielding different allocations is the fact that patents treat the sets of things an inventor invents, not the ideas per se he generates, as property (or something akin thereto). *See supra* notes 205–08 and accompanying text.

262. *See supra* note 115 and accompanying text. In addition to the fact that research tools and the innovations that they facilitate are complements, research tools are often implicated in another, distinct complementary relationship. Two (or more) research tools of the same generation that are both inputs into the next generation of innovation are complements. SCOTCHMER, *supra* note 24, at 144. The need to acquire licenses to a large number of complements to achieve the next generation innovation can lead to licensing difficulties. *See supra* note 213.

263. *See supra* notes 111–12 and accompanying text. The inclusion of a large number of complementary components in a single good can lead to a royalty stacking problem, *see supra* note 116, and raise Cournot-complement problems, *see infra* notes 279–80 and accompanying text.

264. *See supra* notes 117–18 and accompanying text.

265. Because independent invention is not a defense to patent infringement, the boost from the earlier patentee to the later infringer should be understood as a constructive boost: if the later improver had known of and read the earlier patentee’s disclosure, the improver would have gotten a boost. *See supra* note 106.

266. *See supra* Section III.A.3.

267. Unlike in a case involving a research tool or a later-developed component, the improver never needs to use a thing that was actually disclosed and made available to the public in the earlier patent.

Therefore, although the notion that cumulative innovation involves successively complementary innovations teaches us something about improvements broadly writ, it does not help to distinguish classic and overlooked improvements.

b) Successively Invented Things as Complements or Substitutes

Rather than looking to the process through which cumulative innovation occurs and identifying earlier boosting innovations and later boosted innovations as complements, it is also possible to focus on the things produced by earlier and later innovators and to label them as either complements or substitutes. Things that are either complements or substitutes are often invented in succession. Because patent rewards are market-based and filtered through willingness to pay, the successive invention of complement and substitute things has important ramifications for the private value of patents over time. Even if the set of things encompassed within a patent remains rigidly fixed and the later-developed thing falls outside of the scope of the earlier-filed patent, a later-developed substitute decreases an earlier patentee's profits, whereas a later-developed complement may increase an earlier patentee's profits.<sup>268</sup>

When the later-developed thing is a complement for the earlier-patented thing, the private value of the earlier patent can increase when the later-developed thing is marketed.<sup>269</sup> For example, assume that an earlier inventor invents and patents the hammer and that a later inventor invents an improved nail that does not bend as easily. The later invention of the improved nail increases the utility of hammers to consumers. For many consumers, the value of a hammer is determined by the fact that the hammer plays a role in the process of pounding nails into wood. When improved nails become available, the value of a hammer increases as it now plays a role in a process that is more valuable to consumers because the pounding of nails into wood is easier to accomplish and involves fewer bruised thumbs and less waste (in the form of fewer bent nails). A shift in the availability of technology beyond the scope of a patent makes the patented technology

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268. For simplicity, the following discussion assumes that a patentee is initially able to exercise some monopoly power or enjoy some supra-competitive profits. *But cf.* Kenneth W. Dam, *The Economic Underpinnings of Patent Law*, 23 J. LEGAL STUD. 247, 249–51, 268–70 (1994) (noting that a patent does not allow its owner to exercise monopoly power or charge supra-competitive prices if consumers are indifferent between patented and unpatented technologies).

269. *See* Shapiro, *supra* note 201, at 122–25 (defining the concept of technical complementarity as the social value of the combination being greater than the social values of the two inventions considered separately).

more valuable to consumers.<sup>270</sup> In a regime in which rewards are determined by a market for embodied ideas and willingness to pay,<sup>271</sup> this increase is an expected change in the value of patent rights over time.

In contrast, when the later-developed thing is a substitute for the thing disclosed and claimed by the earlier patent, the private value of the earlier patent is diminished when the later-invented thing is marketed.<sup>272</sup> The profit that a patentee can realize from a patent cannot be determined simply by understanding intrinsic value or utility of the technology that falls within the scope of the patent to a consumer. For example, assume that an earlier inventor patented the nail, that a later inventor invents an industrial-strength glue, and that, at least for some purposes, consumers are indifferent as to which product they prefer. Also assume that the owner of the nail patent enjoyed some monopoly power before the invention of the industrial-strength glue. When the industrial strength glue reaches the market, the value of nails to consumers does not change. Nails are still capable of doing what they did before the invention of the glue. However, because nails and the glue are substitutes, the owner of the nail must compete on the basis of price with the glue producers, so the later-developed substitute decreases the private value of patent rights on the earlier-invented thing.<sup>273</sup> Again, in a regime in which rewards are determined by a market for embodied ideas and

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270. The portion of this increase in social welfare that occurs upon the later development of a complement that an earlier patent owner can internalize depends, in part, on whether the later-developed complement is patented. See Michael Kremer, *Patent Buyouts: A Mechanism for Encouraging Innovation*, 113 Q.J. ECON. 1137, 1156 (1998) (noting that the value of a patent is higher if a non-infringing complementary good is not patented and is instead in the public domain).

271. See *supra* Section VII.A.

272. PINDYCK & RUBINFELD, *supra* note 252, at 434–35 (noting that firms with some monopoly power face more elastic demand curves, and earn smaller profits, when there are more and closer substitutes); SCOTCHMER, *supra* note 24, at 103–07 (“The demand curve [for a patented technology] will be more elastic, and generally lower, if close [non-infringing] substitutes are allowed in the market.”). It is for this reason that some economists model the “leading breadth” of a claim that sets the reach of a patent right into improvements as a measure of the effective term of a patent. See *supra* notes 24–26 and accompanying text (discussing a “quality ladder” model of improvement). The profit-reducing effect of the entry into the market of substitute, non-infringing goods is a core tenet of models of monopolistic competition. See Christopher S. Yoo, *Copyright and Product Differentiation*, 79 N.Y.U. L. REV. 212, 238–39 (2004) (describing the effect of the entry of a new, substitute work into the market as a “backwards” shift in the demand curve).

273. How robust that competition will be is dependent upon whether the glue, too, is patented. See Kremer, *supra* note 270, at 1154 (noting that a patent on Prozac is worth less if the patent on Zoloft is made available to all comers at no price).

willingness to pay,<sup>274</sup> this decrease is an expected change in the value of patent rights over time.<sup>275</sup>

Improvements of all types are usually substitutes for the things that were disclosed and made available to the public at the time of the filing of the earlier patents.<sup>276</sup> More importantly, both classic and overlooked improvements are usually substitutes in this manner. Both Curtiss's improved airplane (a classic improvement) and the improved-canvas airplane (an

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274. See *supra* Section VII.A.

275. Because later innovators can obtain rents by designing around an earlier patent and transforming a monopoly (presuming it exists) into a duopoly, patent law creates an incentive to design around existing patents, whether through the creation of improvements or the exploitation of gaps in poorly drafted claims. Whether this incentive to design around is socially beneficial is the subject of a robust debate. Courts generally view the incentive as beneficial. See *State Indus. Inc. v. A.O. Smith Corp.*, 751 F.2d 1226, 1236 (Fed. Cir. 1985). The scholarly opinion is mixed. Compare, e.g., Bessen & Maskin, *supra* note 2, at 613 (“[A]n important role of patents is to encourage innovative activity on the part of others who would otherwise be inclined merely to imitate.”), with Michael Abramowicz, *The Uneasy Case for Patent Races over Auctions*, 60 STAN. L. REV. 803, 827 (2007) (emphasizing the duplicative, wasteful efforts entailed in design around).

276. See Green & Scotchmer, *supra* note 2, at 20 (“[C]ompetition from improved products could undermine the original innovator’s profit.”); O’Donoghue et al., *supra* note 2, at 2 (noting that design-around shortens the effective, but not legal, term of a patent because improvements are substitutes for the earlier-patented things). Some scholarship on cumulative innovation assumes that improvements increase the value of earlier-patented things and therefore increase an earlier patentee’s profits, but this scholarship seems to use a broader definition of improvement than this Article does. See *supra* Section III.A (defining an improvement). For example, a second-stage innovation that produces a new application of a first-stage innovation that serves a market unrelated to the market served by the first-stage innovation is not an after-arising substitute. See Green & Scotchmer, *supra* note 2, at 20. This second stage innovation seems to presume a later-discovered use for an earlier-patented thing, and this type of cumulative innovation does not entail improvement. See *supra* note 113 and accompanying text. Similarly, a second-stage innovation can be thought of as an improvement that enhances, but does not compete with, the earlier innovation. Bessen & Maskin, *supra* note 2, at 620. The facts that most closely fit this model seem to be the discovery of an after-arising complement that has no use except when used together with the earlier-patented and earlier-disclosed things. See *supra* notes 111–12 and accompanying text. Nonetheless, even following the narrow definition of an improvement that structures this Article, not all improvements will be substitutes for the things made available by earlier patents. For example, consider an earlier patent on a slow-release technology for pharmaceuticals. See *supra* text accompanying note 74. If the earlier patent claim describes a “pill” or “drug,” a pill with an after-arising active ingredient is an improvement: the after-arising pill is a thing; the earlier patent did not disclose or make available the after-arising pill to the public; the after-arising pill still possesses a property that was invented by the earlier inventor. See *supra* Section III.A. Yet, the after-arising drug in its slow-release formulation may be a substitute for some slow-release drugs that were disclosed by the patent, a complement for others, and neither a complement nor a substitute for yet others. For simplicity, this Section addresses only later improvements that are substitutes for the things disclosed by the earlier patent.

overlooked improvement) are substitutes for the airplanes that the Wright Brothers taught the public how to make.<sup>277</sup> Both Bernard’s mousetrap (a classic improvement) and Bob’s mousetrap (an overlooked improvement) are substitutes for the mousetraps disclosed by Abby’s patent at the time it was filed.<sup>278</sup> Thus, looking at successively invented things as complements or substitutes does not allow any distinction between classic and overlooked improvements to be drawn.

c) Patent Rights as Complements or Substitutes

Finally, in the analysis of the pro- or anticompetitive effects of a patent cross-licensing or pooling agreement, legal doctrine and economic scholarship identify patent rights as either complements or substitutes.<sup>279</sup> If the patent rights are substitutes, then an exclusive agreement to cross-license the patents, or to pool the patent rights together, may in effect be an anticompetitive agreement between natural competitors not to compete on price. Consumers want to use either one patented technology or the other, so taking away the competition between the patent owners can be problematic. However, if the patent rights are complements, patent licenses may well be procompetitive because they eliminate Cournot-complement or thicket problems.<sup>280</sup> Consumers want to use both sets of patented technologies together, so one-stop shopping at the least reduces the transaction costs of patent licensing.

Courts identify patent rights as either complements or substitutes through two distinct layers of analysis. If the two patents overlap in the sense that they both describe the self-same, indivisible thing, the rights are complements.<sup>281</sup> To practice the technology that is in the overlap, both rights

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277. See *supra* text accompanying notes 29–32, 40 (discussing these inventions).

278. See *supra* Part IV and Section V.A (presenting and analyzing the hypothetical inventions of Abby, Bernard, and Bob).

279. See 2 HERBERT HOVENKAMP ET AL., IP AND ANTITRUST: AN ANALYSIS OF ANTITRUST PRINCIPLES APPLIED TO INTELLECTUAL PROPERTY LAW § 34.2c, at 34-6 to -10 (2d ed. 2004); U.S. DEP’T OF JUSTICE (DOJ) & FED. TRADE COMM’N (FTC), ANTITRUST GUIDELINES FOR THE LICENSING OF INTELLECTUAL PROPERTY § 5.5 (1995), available at [www.usdoj.gov/atr/public/guidelines/0558.htm](http://www.usdoj.gov/atr/public/guidelines/0558.htm) (discussing the anticompetitive and procompetitive effects of cross-licensing and patent pooling arrangements); Shapiro, *supra* note 213, at 119.

280. DOJ & FTC, *supra* note 279, § 5.5 (noting that cross-licensing and pooling arrangements “may provide procompetitive benefits by integrating complementary technologies, reducing transaction costs, clearing blocking positions, and avoiding costly infringement litigation”). On Cournot complements, see SCOTCHMER, *supra* note 24, at 144–46; Shapiro, *supra* note 213, at 122–26.

281. Two patents that both describe the self-same, indivisible thing are overlapping blocking patents. See *infra* note 297 (defining overlapping and economic blocking patents).

must be obtained. If the patents do not overlap in this manner, then the status of the patent rights as complements or substitutes turns on whether the distinct things described by the patents are complements or substitutes. For example, if the two patents claim hammers and nails, respectively, then the patent rights are complements.<sup>282</sup> However, if the two patents claim a nail and an industrial-strength glue, then the patent rights are substitutes.

The antitrust analysis of patent rights as complements or substitutes offers no insight into the optimal depth of patent rights when improvements are the contested margin. Whether the patents owned by the earlier and later inventors are complements or substitutes hinges on a court's decision to allow the earlier-issued patent to encompass the improvement. If the earlier patent does not encompass the improvement, the patent rights are substitutes. The patents do not overlap to describe the self-same, indivisible thing, and the distinct things claimed by each patent are substitutes. However, if the earlier patent does encompass the improvement, then the patent rights are complements because the earlier and later patents do overlap and describe the self-same, indivisible thing.<sup>283</sup> In sum, trying to use the antitrust analysis of complementary and substitute patents to craft claim scope requires putting the cart before the horse. A court's decision on how to craft claim scope is a necessary input. It must be taken as a given to avoid circular reasoning.

### 3. *Successively Invented Properties as Complements and Substitutes*

The three frames in contemporary scholarship for identifying complements and substitutes in sequential innovation neither help courts to distinguish classic and overlooked improvements nor provide insight into the optimal reach of a patent on an earlier-developed technology into later-developed improvements.<sup>284</sup> This Article has developed a fourth frame: the properties of things invented by successive innovators can be identified as complements, substitutes, or a mixture of the two. When properties are the relevant goods, a systematic distinction between contested classic

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282. Although two patents describing distinct sets of complementary things do not overlap, they are nonetheless blocking patents of a sort. See *infra* note 297 (defining overlapping and economic blocking patents).

283. Improvement scenarios are commonly described as giving rise to complementary patents, despite the fact that improved things are often substitutes for the earlier-developed and earlier-patented things. See John F. Duffy, *The Marginal Cost Controversy in Intellectual Property*, 71 U. CHI. L. REV. 37, 48–49 (2004); Kremer, *supra* note 270, at 1156–57. This characterization is only correct if the scope of the earlier patent encompasses the later-developed improvement.

284. See *supra* Section VII.C.2.



improvements and “easy” overlooked improvements can be discerned, and the concepts of complements and substitutes can be operationalized in patent doctrine so as to help courts craft optimal claim scope.

The properties of things can be identified as either complements or substitutes, just like things can. The standard intuitive and economic definitions apply.<sup>285</sup> Two properties are complements if consumers desire both of them together in a single thing.<sup>286</sup> The properties of *containing pharmaceutical Z* and *being enteric coated* are complementary properties if consumers want pills that both contain chemical Z and have an enteric coating. When consumers desire the two properties bundled together in a single thing, an increase in the price of the right to use one property leads to a higher price for the bundle and a decrease in demand for the other property.<sup>287</sup> In contrast, two properties are substitutes if consumers desire either a thing with one property or a thing with the other property, but not a thing with both. The properties *containing pharmaceutical compound X* and *containing pharmaceutical compound Y* are substitute properties if consumers desire either compound X or compound Y to combat an illness, but not both at the same time or in combination. When consumers desire either a thing with one property or a thing with the other, an increase in the price of the right to use one property leads to an increase in the demand for the other property.

Once established, the concepts of complementary and substitute properties provide a new way of describing the distinction between overlooked and classic improvements. The very concepts of properties that compound with and supplant each other that were employed to differentiate classic and overlooked improvements translate directly into the concepts of properties that are complements and substitutes, respectively. In an

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285. *See supra* Section VII.C.1 (offering both intuitive and economic definitions of complements and substitutes).

286. Technically, properties can also be complements if consumers desire both of them together and each property is embodied in a distinct thing. However, the issue of improvements centers on complementary properties of a single, indivisible thing.

287. In order to talk about properties as complementary and substitute goods, it is necessary to imagine a hypothetical patent regime in which patent rights encompass all things that possess the property. Complements and substitutes are identified by the cross-price elasticity of demand of two goods—an idea that is hard to interpret if one does not have to pay to use the goods. This hypothetical patent regime that enables discussions of properties as complements or substitutes is different from the actual patent regime in that the scope of actual patent rights does not track the presence of all properties infinitely far into after-arising technology. *See supra* notes 242–48 and accompanying text (noting that the persistence of properties defined at high levels of generality does not necessarily mean that an earlier-filed patent should encompass a later-developed improvement).

overlooked improvement, the properties that instantiate the advances of the successive inventors are pure complements. The successively invented properties simply compound with each other, making the improvement a single, indivisible thing that naturally bundles together the properties that instantiate the earlier and later advances.<sup>288</sup> Consumer demand for the improvement is demand for the bundle of the earlier- and later-developed properties, and it is sensitive to the total cost of the rights to use both properties. An increase in the price of the right to use one property increases the price of the bundle as a whole, and it thereby decreases the consumption of the other property. The later invention of a metal from which one can make longer-lasting springs (Bob's invention) makes the invention of a mechanical design for a spring-loaded mousetrap (Abby's invention) more valuable to society.<sup>289</sup> In other words, Bob's property *being made of an after-arising alloy* complements all of Abby's innovative properties that pertain to the mechanical arrangements of the components. In contrast, in the process of refinement that gives rise to a classic improvement, the properties that instantiate the advances of the successive inventors are a mixture. They are part complement and part substitute.<sup>290</sup> The properties that instantiate the later advance in the improvement compound with, and thus complement, the properties that instantiate the earlier inventor's more general properties. The later invention of a better way to use a spring in a spring-loaded mousetrap (Bernard's invention) makes the earlier invention of the notion of a spring-loaded mousetrap itself (Abby's most general invention) more valuable to society. In other words, the specific property *being made of a wire that can move in an arc in relation to a fixed base* complements the property *being a device in which the jostling motion of a mouse transforms the potential energy stored in a spring into the kinetic energy required to catch a mouse*. These same later-developed properties supplant, and thus substitute for, the properties that instantiate the earlier inventor's more specific properties. The later invention of a better way to use a spring in a spring-loaded mousetrap (Bernard's invention) can swap in for the earlier invention of the notion of a sliding-plate mousetrap (Abby's more specific invention). In other words, the specific property *being made of a wire*

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288. See *supra* Part IV. This bundling is visually apparent in Figure 4, *supra*. In an overlooked improvement, the later-invented property supplants, and thus is a substitute for, a property of the earlier-patented things that is not one of the earlier patentee's innovative properties.

289. If things rather than properties are the primitives of invention, the overlooked improvement cannot be viewed as a bundle of the two inventions. Successively invented properties can be complements even though the things are actually produced by subsequent inventors.

290. See *supra* Section V.A. The mixture is visually apparent in Figure 3.

*that can move in an arc in relation to a fixed base* is a substitute for the property *being made of sliding plates*. In sum, the concepts of properties that compound with and supplant each other that were employed to differentiate classic and overlooked improvements translate directly into the notions of properties that are complements and substitutes, respectively.<sup>291</sup>

The true payoff of being able to identify successively invented complementary and substitute properties is a retooled normative explanation of why claim scope should be sculpted (as it is today, albeit without any recognition of this fact) so that overlooked improvements give rise to “easy” cases and classic improvements give rise to contested cases. There is no economically meaningful distinction between the earlier and later inventors of complementary distinct things such as a hammer and an improved nail, on the one hand, and the earlier and later inventors in an overlooked-improvement case, on the other. The former may have invented distinct complementary things and the latter complementary properties that are possessed by a single, indivisible thing, but this is not a difference that should matter. The later development of a complementary property for an earlier-invented property makes the earlier-invented property more desirable to consumers in the exact same way that the later development of a complementary thing for an earlier-invented thing makes the earlier-invented thing more valuable to consumers.<sup>292</sup> For example, in the Abby-Bob hypothetical,<sup>293</sup> Bob’s later discovery of a better metal for making springs only increases the utility of the mechanical design for a mousetrap invented by Abby to consumers. The inventive property *being made of sliding plates* (Abby) is made more valuable by the later invention of the property *being made of a particular metal* (Bob). In a patent regime in which rewards are

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291. The possibility of purely substitute innovative properties is not relevant to a discussion of improvements. Successive inventors who generate properties that are purely substitutes do not produce improvements. If the later inventor’s advances completely supplant the earlier inventor’s advances in the later-produced thing, then the later-produced thing no longer embodies the earlier inventor’s ideas and it is not an improvement. *See supra* Section III.A.3. For example, imagine a variant of the Abby-Bernard hypothetical, *see supra* Part IV, in which spring-loaded mousetraps are already well-known in the art. In this world, Abby’s mousetrap might still be patentable, but the only properties that instantiate Abby’s ideas in the claimed mousetraps would be the more specific properties like *being made of sliding plates*. If Bernard invents his mousetrap after Abby does, Bernard’s mousetrap would not be an improvement. The properties that a mousetrap must possess to instantiate Bernard’s inventive ideas—properties like *being made of a wire that can move in an arc in relation to a fixed base*—cannot coexist with the properties that instantiate Abby’s ideas in a single, indivisible, and functional mousetrap.

292. *See supra* notes 269–71 and accompanying text (discussing the effect of a later-developed complement on the value of an earlier patent).

293. *See supra* Section V.A.

determined by the market value of embodied ideas and willingness to pay,<sup>294</sup> Abby's patent rights should become more valuable (or, at the least, remain unchanged) because of Bob's invention. However, if Abby's patent rights were to not encompass the overlooked improvement, then Bob's invention would decrease the value of Abby's patent because Bob's mousetrap, viewed as a thing, is a substitute for the mousetraps disclosed by Abby, and Abby must compete on price with Bob's mousetrap.<sup>295</sup> This outcome would add insult to injury: the development of the overlooked improvement increases the value of the set of things that embody an inventor's ideas, but it would trigger a radical decrease in the patentee's profit.

The successive inventors in an overlooked improvement scenario should have rights that mimic the rights given to the earlier inventor of a hammer and a later inventor of an improved nail. In order to achieve this parity, earlier-issued patents must routinely encompass overlooked improvements. The earlier inventor of a hammer and a later inventor of an improved nail can obtain patents that block the hammer-and-improved-nail bundle. For Abby and Bob to have blocking patents with respect to the bundle of their innovative properties, the scope of Abby's earlier-filed patent must be construed so as to encompass Bob's later-developed improvement.<sup>296</sup> It is true that the creation of blocking patents in an overlooked improvement scenario requires the scope of the earlier-filed patent to grow over time as an earlier-filed patent must describe the self-same thing that an improver invents only at a later point in time. In contrast, patents that block the purchase of a bundle of distinct things can come to pass without any post-filing shifts in the set of things that fall within claim scope.<sup>297</sup> However, to forbid the

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294. See *supra* Section VII.A.

295. See *supra* notes 272–75 and accompanying text (discussing the effect of a later-developed substitute on the value of an earlier patent).

296. The recognition of overlooked-improvement cases as cases involving successively invented complements—or, more precisely, the “easy” nature of overlooked improvement cases that follows from this recognition—does have the potential to aggravate the royalty stacking problem that exists when goods consumed by consumers include many distinct patented technologies. See *supra* note 116. However, in most situations this is a necessary cost of ensuring that patents structure a market for embodied ideas.

297. The distinction between successively invented complementary things and overlooked improvements leads to a distinction between two types of blocking patents. Cf. Collins, *supra* note 66, at 510 n.66 (distinguishing overlapping and economic blocking patents). The blocking patents involved in overlooked-improvement cases are *overlapping* blocking patents as the patents overlap and the self-same, indivisible thing falls within the scope of both patents. For overlapping blocking patents to exist in improvement scenarios, the set of things described by the earlier-filed patent must grow over time. In contrast, the blocking patents at issue when there are successively invented complementary things are *economic* blocking patents because, although the patents do not overlap and encompass the

earlier-filed patent in an overlooked-improvement scenario from growing over time would be to allow a formalistic notion that peripheral claims are “fixed” to triumph over the economic reasoning.<sup>298</sup> Failing to allow an earlier-filed patent to encompass an overlooked improvement would be economically akin to holding that the use of an earlier-patented hammer to pound on an after-arising nail is a non-infringing use of the hammer with which the owner of the hammer patent must compete on price. It would distort the proportionality of contribution and reward to an unacceptable extent.<sup>299</sup> It would be a nonsensical economic result in which a formalism about patents protecting only the things that a patentee actually disclosed and made available to the public at the time of filing eviscerates the ability of the patent regime to structure a market for embodied ideas.<sup>300</sup>

In contrast to overlooked improvements and their purely complementary, successively invented properties, classic improvements and their part-complement, part-substitute properties have no simple, intuitive parallel in terms of complements and substitutes in the world of successively invented things. To the extent that the later inventors’ properties compound with and complement the earlier inventors’ more general properties, the private value of the earlier inventor’s patent should increase upon the later invention of the improvement. To achieve this end, the successive inventors

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self-same thing, consumers experience the patents as blocking because each one reads on one of two things that consumers want to consume together. If there is a first patent that encompasses A and a second patent that encompasses B, the technology bundle A+B is subject to economic blocking patents. *See* Lemley, *supra* note 2, at 1010 n.87 (noting that patents on distinct complementary goods are a form of blocking patents).

298. *Cf. infra* notes 308–11 and accompanying text (discussing the strong fixation theory of literal claim scope).

299. Couched in the rhetoric of the rules-standards debate, the rule-like option of examining only innovative things and ignoring the more particular properties that make those things innovative would make the rule unacceptably over- and under-inclusive with respect to the justified outcome. *See supra* notes 67–68 and accompanying text (framing the choice between things and properties as the locus of invention in terms of the rules-standards debate).

300. In fact, if one pushes on the distinction between overlapping and economic blocking patents, *see supra* note 297, the distinction often falls apart because inventions can be claimed with differing amounts of matter included within the description. *See supra* Section V.B.3 (discussing claims with limitations that describe the prior art). The hypothetical involving the hammer and improved nail intuitively seems like the successive invention of distinct complementary goods. Provided that the earlier patent claims a hammer and the later patent claims the improved nail, the patents at issue are economic blocking patents. However, if the earlier hammer inventor files a dependent claim in his patent that recites both a hammer and a nail as limitations, then a later claim by the inventor of an improved nail gives rise to overlapping blocking patents, as both patents read on the hammer-and-improved-nail bundle.

should have rights that mirror the rights of the successive inventors of distinct complementary things, and the earlier-filed patent must encompass the improvement. However, to the extent that the later inventors' properties supplant and thus substitute for the earlier inventors' more specific properties, the private value of the earlier inventor's patent should decrease upon the later invention of the improvement. To achieve this end, the successive inventors should have rights that mirror the rights of the successive inventors of distinct substitute things, and the earlier-filed patent must not encompass the improvement. Patent protection in the intuitive realm of successively invented distinct things offers no halfway house to match the in-between, part-complement and part-substitute status of a classic improvement.<sup>301</sup> The issue in play in classic-improvement cases is whether the complementary or substitute nature of the successively-invented properties should be given greater weight, as there is no middle ground.<sup>302</sup> It is the need to simply ignore either the part-complement or the part-substitute nature of the successive inventions, and to treat successive inventors as though they invented either pure complements (which should give rise to blocking patents) or substitutes (which should not), which makes classic-improvement cases legitimately contested.<sup>303</sup>

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301. The part-complement, part-substitute mixture is not the same phenomenon as imperfect complements and substitutes. *See supra* note 257. A possible analogy might involve an earlier patent that discloses compound A and the later discovery of an improvement A' that is capable of both increasing the efficacy of A (being a complement) and being taken instead of A (being a substitute). In this scenario, however, each individual consumer experiences A and A' as either complements or substitutes. In the classic improvement, the properties consumed by each consumer are a part-complement, part-substitute mixture of the earlier- and later-invented properties.

302. Patent regimes in many foreign countries include a "dependency license" provision under which later improvers can obtain a compulsory license to practice earlier inventions. John H. Barton, *Patents and Antitrust: A Rethinking in Light of Patent Breadth and Sequential Innovation*, 65 ANTITRUST L.J. 449, 457–58 (1997); Merges, *supra* note 2, at 102–05. If a court is competent to assess the value of successive improvers' contributions to the overlooked improvement, this solution may provide a middle ground for classic-improvement cases.

303. At first glance, the proposal that patents should reach into improvements with later-developed complementary properties seems to contradict the common understanding of the implications of complements in the fair use analysis in copyright law. In *Ty, Inc. v. Publications International*, the Seventh Circuit stated a general rule that "copying that is complementary to the copyrighted work (in the sense that nails are complements of hammers) is fair use, but copying that is a substitute for the copyrighted work (in the sense that nails are substitutes for pegs or screws) . . . is not fair use." 292 F.3d 512, 517 (7th Cir. 2002). Thus, under the fair use doctrine of copyright law, later-developed complements are less—not more—likely to wind up within the rights of the earlier author. The seemingly opposed nature of the conclusions on complements drawn in the improvements analysis in this Section and the fair use analysis in copyright can be explained by recognizing that the good at issue is being framed differently in each situation. In the improvements context, it is

### VIII. CODA: RETHINKING THE “PERIPHERAL” IN PERIPHERAL CLAIMS

This Part illustrates the compatibility of a conceptual framework in which properties are the locus of invention in improvement cases and the contemporary peripheral claiming regime. Upon first impression, such a framework may appear to be incompatible with a peripheral claiming regime, and to mandate instead a central claiming regime, because of its invocation of the “spirit” of a set of claimed things and the attention that it pays to the point of novelty of a patented invention.<sup>304</sup> This Part argues that a focus on properties as the locus of invention in improvement cases is compatible with a peripheral claiming regime, although it does require some common misconceptions about the nature of peripheral claims to be recognized and abandoned. One of the principal goals of this Article is to argue that a conceptual shift is needed to reduce the gap between patent theory and the reality of patent protection.<sup>305</sup> A similar conceptual shift in the theory of what constitutes a peripheral claim is needed if the theory of peripheral claims is to map onto the contemporary reality of peripheral claims. A focus on properties as the locus of invention is compatible with peripheral claims, but peripheral claims turn out not to be what they are commonly presumed to be.

Today’s patent claims are commonly described as peripheral because they describe the full set of things that are literally encompassed within a patent claim, right out to its periphery or outer boundaries.<sup>306</sup> Historically, patent

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the set of properties contributed by the later actor that is at issue. In the fair use context, it is the allegedly infringing work as a whole that is at issue. Translated into the patent context, this latter framing would require analysis of the later-developed things as complements to or substitutes for the earlier-disclosed and earlier-claimed things. *See supra* Section VII.C.2.b. The later development of a non-infringing complementary thing will increase the private value of the earlier patent or copyright, suggesting that the harm from allowing later-developed complementary things to be non-infringing will not be significant. In contrast, the later development of a non-infringing substitute thing can undermine the ability of the owner of either a patent or a copyright to obtain rents on the things that he actually did invent or author, and this result should be allowed only when the later actor has outmoded the earlier inventor’s or author’s contribution. When framed as things, patent improvements are usually substitutes for the earlier-disclosed and earlier-claimed things. *See supra* notes 276–78 and accompanying text. Therefore, the concern that motivates differential treatment of complements and substitutes in the fair use analysis does not come into play when addressing complementary and substitute properties in improvements under patent law.

304. *See supra* notes 64–68 and accompanying text.

305. *See supra* text accompanying note 11.

306. *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 27 n.4 (1997). *But cf. supra* note 139 (noting that the DOE expands a patentee’s interest beyond the outer boundaries of a peripheral claim).

claims were not always administered through the demarcation of a periphery. In the first part of the nineteenth century, patent claims were “central” claims.<sup>307</sup> Central claims publicize only an archetypal example of a patented invention, leaving the outer bounds of the claim undefined. In a central claiming regime, infringement determinations are made by comparing an allegedly infringing technology to the publicized example and assessing whether the two are more or less similar than a legal threshold of similarity that determines the scope of the patentee’s rights. The outer boundary of the claim is never specified.

Two themes echo through many contemporary discussions of peripheral claims. Both mistakenly presume that peripheral and central claiming must be a strict dichotomy, and both define peripheral claims by the absence of the primary qualities of central claims.

The first theme is fixation. It is black-letter law that the scope of a peripheral claim is fixed *ex ante* in the sense that the meaning of claim terms to the PHOSITA must be rooted in time on the date on which the claim is filed.<sup>308</sup> Commonly, this black-letter requirement for fixation is interpreted in a strong fashion to mandate fixing the set of claimed things to the set of things made available to the public on that date and, inversely, the exclusion of after-arising technologies from claim scope.<sup>309</sup> This strong interpretation of the fixation requirements treats the distinction between central and peripheral claims as a true dichotomy: central claims do not allow the PHOSITA to identify the full set of claimed things *ex ante*, but peripheral claims do. Two normative arguments are often made to defend this strong, thing-centric notion of fixation. First, fixation of the set of claimed things is a means to the end of ensuring effective public notice. The post-filing shift in the scope of a claim that is required for a claim to encompass after-arising technology of any kind, it is argued, destabilizes the meaning of a claim and undermines the public-notice benefits of peripheral claims.<sup>310</sup> Second,

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307. For extended, and in some respects divergent, discussions of the distinction between central and peripheral claims, see Dan L. Burk & Mark A. Lemley, *Fence Posts or Sign Posts? Rethinking Patent Claim Construction*, 157 U. PA. L. REV. 1743 (2009); Jeanne C. Fromer, *Claiming Intellectual Property*, 76 U. CHI. L. REV. 719 (2009).

308. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) (en banc).

309. Collins, *supra* note 66, at 501–10 (discussing the strong fixation theory of literal claim scope). For scholarly commentary favoring the strong fixation theory in principle, but not in name, see Charles W. Adams, *Allocating Patent Rights Between Earlier and Later Inventions*, 54 ST. LOUIS U. L.J. 55 (2009); Christopher A. Cotropia, “*After-Arising*” *Technologies and Tailoring Patent Scope*, 61 N.Y.U. ANN. SURV. AM. L. 151 (2005); Holbrook, *supra* note 156; Timothy R. Holbrook, *Possession in Patent Law*, 59 SMU L. REV. 123 (2006).

310. See Mark A. Lemley, *The Changing Meaning of Patent Claim Terms*, 104 MICH. L. REV. 101, 112–22 (2005).



fixation of the set of things is viewed as necessary to create a market for ideas and to limit the patentee’s reward so that it is proportional to his contribution to technological progress. As expressed in a recent Federal Circuit opinion on claim construction, allowing a claim to encompass later-developed technology “compromises two fundamental tenets of the patent system: first, that the applicant must be the ‘inventor’ of the things covered by the patent claims, and second, that the right to exclude will be no broader than the inventor’s enabling disclosure.”<sup>311</sup>

The second theme is what can be called the self-sufficiency of peripheral claims. The “spirit” of an invention—that is, the features of the invention that differentiate it from the prior art—is taken to be irrelevant to the doctrinal mechanics of the infringement and validity analyses in a peripheral claiming regime, making the language of the claim alone sufficient to communicate the information to the public that is required for the public to have notice of the claim’s scope.<sup>312</sup> Identifying precisely how and why a patent is different from the prior art requires an information-intensive and contested comparative analysis. By defining the outer boundaries of an invention through a descriptive text, a peripheral claim is presumed to avoid this comparative analysis and thereby make patent rights less costly and more certain. The limitations of a claim become a simple checklist. If all of the claim limitations are present in an accused device, the device infringes; if all of the claim limitations are present in a prior-art technology, the claim is invalid as anticipated.<sup>313</sup> To the extent that it holds true, this self-sufficiency theme starkly distinguishes peripheral claims from central claims. The similarity analysis in a central claiming regime is necessarily performed in

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311. *Superguide Corp. v. DirecTV Enters.*, 358 F.3d 870, 898 (Fed. Cir. 2004) (Michel, J., concurring). The strong, thing-centric fixation argument is also voiced during analyses of the enablement and written description that require the “full scope” of the claim to be enabled or possessed, respectively. Collins, *supra* note 58, at 1088 (discussing “full scope” rhetoric in enablement cases).

312. *Ormco Corp. v. Align Tech., Inc.*, 498 F.3d 1307, 1322–23 (Fed. Cir. 2007) (“This court . . . has rejected a claim construction process based on the ‘essence’ of an invention.”). Of course, claim language is not truly self-sufficient because many interpretive sources, including the patent disclosure, can be called upon to determine the meaning of patent claims. *Phillips*, 415 F.3d at 1311–19. The self-sufficiency theme more narrowly assumes that the point of novelty of a claim is irrelevant and that the rules of claim construction do not require a claim to be construed in light of the “spirit” of the invention. The patented technology clearly must be different from the prior art to survive the validity analyses under § 102 and § 103, but the way or ways in which a patented technology differs from the prior art broadly writ need never be isolated, identified, and catalogued.

313. This “all elements” rule of infringement (and anticipation) is part of the bedrock of contemporary patent law. *See, e.g., TechSearch, L.L.C. v. Intel Corp.*, 286 F.3d 1360, 1374–75 (Fed. Cir. 2002).

light of the “spirit” of the invention. To infringe in a central claiming regime, the allegedly infringing technology must be similar to the features of the disclosed, archetypal embodiment that distinguish it from the prior art.<sup>314</sup>

These peripheral claim themes shore up both the notion that innovative things should be viewed as the primitives of what an inventor invents and its corollary, the refusal to countenance inventive properties of things as the locus of invention. However, a conceptual framework in which innovative properties are the locus of invention is compatible with a peripheral claiming regime. On a conceptual level, peripheral claims are not only compatible with a focus on the properties of things, but, more strongly, they rely on the properties of things to perform their boundary-drawing function. The descriptive language of a peripheral claim defines the set of things encompassed within the claim by describing particular properties that things must possess to be included within the claimed set.<sup>315</sup> More pragmatically, the best proof of the compatibility of a focus on properties as the locus of invention and peripheral claims is in the pudding of contemporary patent protection. The contemporary claiming regime is widely regarded as a peripheral claiming regime—especially when the default rules of claim construction and literal infringement apply<sup>316</sup>—yet the brunt of the work in this Article performed by the conceptual framework in which properties are the locus of invention is descriptive. The framework simply explains what the contemporary patent regime is already doing in classic- and overlooked-improvement cases.<sup>317</sup> Unless one argues that contemporary claims are not in fact peripheral (or that classic and overlooked improvements do not receive differential treatment), then it is problematic to argue that peripheral claiming and a focus on properties as the locus of invention are incompatible. What paying attention to properties as the locus of invention does illustrate, however, is that the dominant conceptual paradigm of what it means for a claim to be peripheral is sorely in need of revision. Peripheral claims cannot be defined in sharp contradistinction to central claims; a workable peripheral claiming regime is not everything that a central claiming regime is not.<sup>318</sup> The

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314. See Burk & Lemley, *supra* note 307, at 1746.

315. Lefstin, *supra* note 63, at 1145 (“[Peripheral claims] recite a set of characteristics, or properties, that define the subject matter encompassed by the patent.”).

316. The contemporary patent regime does include rule sets other than this default—such as the rules of means-plus-function claiming and the doctrine of equivalents—that are based on the principles of central claiming. See *infra* note 318.

317. See *supra* notes 84–85 and accompanying text.

318. Recent scholarship on patent claims has highlighted that the contemporary claiming regime is in fact a hybrid, part-peripheral-and-part-central regime. Burk & Lemley, *supra* note 307, at 1771–78; Fromer, *supra* note 307, at 735–41. By arguing that contemporary

two themes that run through contemporary discussions of peripheral claims need to be recognized as misleading and abandoned. To the extent that judicial rhetoric defines peripheral claims by the strict fixation of the claimed set of things on the date of filing or the irrelevance of the point of novelty in the determination of claim scope, there is a significant gap between what courts are saying and what they are doing.

The very existence of the “easy” overlooked-improvement cases is an Achilles heel of the strong variant of the fixation theme, under which peripheral claims fix the set of things that falls within the scope of a claim on the date the claim is filed. These cases definitively disprove this strong theory of fixation as a descriptive matter, demonstrating that literal claim scope already grows over time to encompass after-arising technology on a routine basis.<sup>319</sup> Furthermore, the two policy reasons often given for adhering to a strong variant of the fixation theory and preventing claim expansion over time are not persuasive.<sup>320</sup> First, as I have explored at length elsewhere, the fixation of meaning that is required to ensure reasonable public notice of claim scope does not entail limiting the set of things encompassed within the claim to the set of things of which the PHOSITA was aware on the date the

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peripheral claims cannot be defined in sharp contradistinction to central claims, this Part reinforces the notion that the contemporary claiming regime is already a hybrid of sorts. However, the nature of the hybridity unveiled here is new. The hybridity at issue is turned from an either-or hybridity into a both-and hybridity. The argument in recent scholarship is that the patent regime contains many rule sets and that some of these rule sets (other than the default rules that govern literal claim construction) employ the principles of central claiming. In this Article, the argument is that peripheral claiming, even at its most peripheral when the default rules of claim construction and literal infringement apply, is not what it is commonly presumed to be. In other words, even when the “all elements” rule applies, *see supra* note 313, the set of things literally described by a claim can grow over time and the “spirit” of an invention is relevant to determinations of claim scope and infringement.

319. Advocates of a strong fixation theory of literal claim scope often suggest that the DOE provides the necessary protection for later-developed improvements. *See* Cotropia, *supra* note 309, at 185–201; Holbrook, *supra* note 156, at 36–45. However, as an empirical matter, the DOE does not seem to be performing this function. The recent decline of the DOE has been well-documented, and the doctrine is today rarely dispositive of infringement. John R. Allison & Mark A. Lemley, *The (Unnoticed) Demise of the Doctrine of Equivalents*, 59 STAN. L. REV. 955 (2007); David L. Schwartz, *Explaining the Demise of the Doctrine of Equivalents*, 26 BERKELEY TECH. L.J. 1157 (2011). It is therefore difficult to argue as a descriptive matter that the DOE shoulders the entire burden of protecting a patentee’s interests in after-arising technology. Furthermore, the examples of courts treating overlooked improvements as “easy” cases, *see supra* Sections V.B.1 and V.B.2, all involve later-developed improvements that, today, are presumed to fall within the literal scope of earlier-filed claims.

320. *See supra* notes 310–11 and accompanying text (presenting these two arguments).

claim was filed.<sup>321</sup> It is possible to fix a stable periphery with language even without complete knowledge of the set of things that, after the expiration of a twenty-year patent term, may populate that set. The meaning of whatever claim language Abby uses to claim her invention does not have to shift from its filing-date meaning in order to be capable of describing Bernard's and Bob's improvements that are not invented until after Abby's filing date.

Second, while it is true that patents should structure a market for embodied ideas and limit inventors' rewards so that they are proportional to their contributions to technological progress, it is counterproductive to measure a patentee's contribution solely by looking at the innovative things that he made available to the public at the time of filing.<sup>322</sup> Even if patent protection is to be trimmed back to what a patent-minimalist would likely prefer, adopting the line between technologies that are known on the date a claim is filed and after-arising technologies as the line that defines literal claim scope distorts proportionality to an unacceptable extent. The fine-grained properties of a thing that embody an inventor's ideas may remain steadfast and unchanging even as the coarse-grained things that possess

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321. Provided that courts employ ideational rather than denotational meaning, there can be play between what claim language means to a person (the meaning-scope of a claim) and the set of things to which the claim language refers for that person (the thing-scope of a claim). Collins, *supra* note 66, at 536–53 (distinguishing ideational meaning, which allows this play, from denotational meaning, which does not). Meaning-scope can remain fixed even as thing-scope expands over time. *Id.* For example, the meaning of “bachelor” is determined by the relationship between the word “bachelor” and other words and concepts in the English language, such as “male” and “unmarried.” Thus, the meaning of the term “bachelor” would not be destabilized if a race of extraterrestrials, in which there are also unmarried males, were to be discovered and the set of things known to be described by the term “bachelor” were to be expanded in an unexpected way. For an example from a classic patent case, consider the claim at issue in *In re Hogan*, 559 F.2d 595 (C.C.P.A. 1977), a controversial case implicating the reach of an earlier-filed claim into later-developed improvements. The claim at issue described “[a] normally solid homopolymer of 4-methyl-1-pentene.” *Id.* at 597. The ideational meaning of this language can remain fixed over time, referring to all molecules that are made up of long chains of a single repeated unit (4-methyl-1-pentene) and that are solid under normal conditions. Growth in the set of distinct things that are known to fit this description over time need not entail a shift in the ideational meaning of the claim language. This observation about the stability of language should not be taken to imply that allowing the *Hogan* claim to encompass after-arising homopolymers is optimal patent policy. What it does imply is, more narrowly, that the stability of the meaning of the claim language over time should not be invoked to categorically prevent improvements from falling within literal claim scope.

322. *Cf.* *Superguide Corp. v. DirecTV Enters.*, 358 F.3d 870, 898 (Fed. Cir. 2004) (Michel, J., concurring) (arguing “that the applicant must be the ‘inventor’ of the *things* covered by the patent claims”) (emphasis added).

those properties change over time.<sup>323</sup> Patentees will be rewarded in proportion to the value of their ideas only if improvements that fully possess the innovative properties invented by an earlier inventor fall within the scope of the inventor’s claim.<sup>324</sup> To achieve this result, the set of things within the scope of a claim must sometimes grow over time after a patent has been filed.

Similarly, the distinct treatment afforded to classic and overlooked improvements undermines the self-sufficiency theme and the argument that a peripheral claiming regime always allows decision makers to remain ignorant of the particular inventive features of a patented technology when determining claim scope and validity.<sup>325</sup> The self-sufficiency theme is a useful trope when dealing with technologies that were known at the time a patent is filed. However, knowledge of the particular properties of an earlier-claimed technology that are innovative is critical in defining whether an improvement is a classic or overlooked improvement.<sup>326</sup> Therefore, the claim language, in isolation, does not convey enough information to demonstrate how the claim should grow over time to encompass improvements. A court must look to something that resembles the “spirit” of the invention—an entity that this Article has proposed can be identified by the innovative properties of a claimed set of things. Consider a simple claim to a “plastic widget.” Should this peripheral claim encompass an improvement that possesses the exact mechanical structure of a widget disclosed in the specification but that is made out of an after-arising plastic? The self-sufficiency thesis fails because the answer depends on the point of novelty of the patented invention. If the “spirit” of the plastic-widget invention lies in the properties of the widget that embody the mechanical configuration of the widget, then the claim will and should routinely grow over time to encompass the improvement (as the improvement is an overlooked improvement). However, if the “spirit” of the plastic-widget invention lies in the invention of plastic itself (and the claim is therefore a dependent claim in which the widget design is the added limitation), then the expansion of the claim over time that is needed to

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323. *See supra* Section II.C (arguing that a focus on properties permits a finer-grained analysis than a focus on things does). The coarse-grained thing may change because some of its properties other than those that embody an earlier innovator’s ideas may change.

324. In other words, looking only at the things that an inventor disclosed and made available to the public at the time of filing is an unacceptably crude proxy for the set of things that the inventor should control. *See supra* notes 67–68 and accompanying text (framing the choice between things and properties as the locus of invention in terms of the rules-standards debate).

325. *See supra* notes 312–14 (summarizing the self-sufficiency theme).

326. *See supra* Part IV and Section V.A.

encompass a widget made out of an improved plastic does and should raise a highly contested issue (as the improvement is a classic improvement).<sup>327</sup> In sum, precisely how the claimed set of things grows over time can only be determined by examining the “spirit” or point of novelty of the invention that is disclosed in the specification, even in a peripheral claiming regime.<sup>328</sup>

In sum, a focus on properties as the locus of invention in improvement cases is compatible with a peripheral claiming regime, but, in order to grasp this compatibility, the fixation and self-sufficiency themes that are commonly used to explain the nature of a peripheral claim must be abandoned. Peripheral claims cannot be defined in sharp contradistinction to central claims. Rather, three new themes need to be adopted. First, the fixation of a peripheral claim requires only the stabilization of a linguistic description, not an exhaustive tally of the members of the set of described things.<sup>329</sup> Unexpected or unforeseeable technological developments may produce improvements during the term of a patent, and linguistically stable claim language can describe these improvements without undermining effective public notice.<sup>330</sup> Second, reiterating a theme that has often been explored before, the level of generality at which valid peripheral claims are allowed to be drawn is one of the key policy levers in fine-tuning the incentives created by patents. Concern over the level of generality of a claim meshes seamlessly with a focus on properties as the locus of invention, as peripheral claims define sets of things by listing the properties that things must possess to be members of the claimed set. When classic improvements are at issue, it is the level of generality at which a claim can be drawn that determines how general the least-general naked property of an improvement must become before the

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327. The same exercise can be performed using a claim to a “programmed computer.” The set of after-arising technologies that literally infringe the claim hinges on whether the software or the hardware is the point of novelty. *Cf. supra* Section V.B.2 (discussing overlooked improvements in the computer arts).

328. In a recent case, the Court of Appeals for the Federal Circuit broke from its refusal to recognize the importance of the point of novelty in validity doctrines and stated that the point of novelty of an invention must be fully enabled by the specification. *Automotive Techs. Int’l v. BMW of N. Am., Inc.*, 501 F.3d 1274 (Fed. Cir. 2007) (“Although the knowledge of one skilled in the art is [] relevant [in the enablement analysis], the novel aspect of an invention must be enabled in the patent.”). The “easy” nature of overlooked improvements suggests that the converse is also true: an enabled claim can encompass after-arising technologies that the specification did not teach the PHOSITA how to make and use at the time of filing if the difference between the disclosed and after-arising technologies does not lie at the point of novelty of the patented invention.

329. *See supra* note 321 and accompanying text.

330. The DOE also has a role to play in granting patentees rights to exclude from after-arising technologies. *See supra* note 319. However, it is not a patentee’s sole recourse for patent rights that encompass improvements.

earlier patentee’s claims can no longer encompass the improvement.<sup>331</sup> Third, and perhaps most controversially, the point of novelty of an invention is sometimes relevant when determining claim scope, even in a peripheral claiming regime in which an “all elements” rule applies.<sup>332</sup>

More precisely, the second and third themes are interconnected. An accused device must possess elements that correspond to all of the limitations of a claim, but the point of novelty must be considered when identifying the subset of claim limitations whose level of generality must be policed to prevent the claim from becoming impermissibly abstract. The level of generality at which claim language is drawn is only a concern when the claim language at issue describes an innovative property of the claimed things, i.e., a property that the inventor of the patent at issue invented and that is implicated in differentiating the claimed invention from the prior art so as to make the claimed things novel and nonobvious. If the claim language describes a property of the innovative things that is functionally independent of the properties that embody the inventor’s innovative ideas, then the claim language can be construed in an extremely general manner without over-rewarding the inventor.<sup>333</sup> The “spirit” of an invention or the point of novelty of a claim matters in improvement cases, even in a peripheral claiming regime.<sup>334</sup> It allows courts to pay attention to the claim limitations whose level of generality must be strictly policed, on the one hand, and to ignore the claim terms whose level of generality need not be policed, on the other.

The need for revision in contemporary understandings of the nature of peripheral claims brings us back to where we began. This Article set out to correct a blind spot in contemporary theory. The overlooked improvements were being overlooked; they were hiding in plain sight.<sup>335</sup> Now, it is finally possible to hazard a guess about why they were able to hide in plain sight. The two recurring themes about peripheral claims discussed above<sup>336</sup> demonstrate that there is a dominant conceptual paradigm of peripheral claiming in action today that focuses exclusively on innovative things as the locus of patentable invention. It is precisely the dominance of this conceptual

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331. *See supra* notes 242–48 and accompanying text.

332. *See supra* notes 325–28 and accompanying text.

333. In other words, overlooked improvements should routinely fall within the scope of earlier-issued claims. *See supra* Section VII.B.1.

334. Both claim construction and the disclosure doctrines are implicated in curtailing the permissible level of generality of a claim. *See supra* note 130 and accompanying text. Therefore, both of these areas of patent doctrine must pay attention to the point of novelty in improvement cases.

335. *See supra* text accompanying note 59.

336. *See supra* notes 308–14 and accompanying text.

paradigm that has made the overlooked improvements so easy to overlook. As Thomas Kuhn has argued in the context of scientific progress, facts that do not fit well with the dominant conceptual paradigm are often overlooked during periods of “normal science,” because the conceptual paradigm serves as a mental screen that filters the way in which we see the world:

Closely examined . . . [the] enterprise [of normal science] seems an attempt to force nature into the preformed and relatively inflexible box that the paradigm supplies. No part of the aim of normal science is to call forth new sorts of phenomena; indeed those that will not fit the box are often not seen at all.<sup>337</sup>

The overlooked improvements, and their distinction from classic improvements, are phenomena that do not “fit in the box” of the contemporary paradigms of what constitutes a peripheral claim. “Normal patent theory,” if you will, did not have as its goal the identification or explanation of these phenomena. Once the phenomena are put openly on the table, however, the need for a paradigm shift (in Kuhn’s terminology) becomes self-evident.<sup>338</sup> Bluntly put, it is time to wake up and smell the coffee. The conceptual structures should shift to reflect the facts on the ground, not the other way around. Innovative things can no longer be taken to be the primitives of what an inventor invents. At least when addressing patent protection for improvements, it is the innovative properties of claimed things that must be viewed as the locus of the invention—a proposition that is axiomatic once it is recognized that, first, innovative properties are the entities that instantiate innovative ideas in things<sup>339</sup> and, second, the patent regime strives to structure a market for innovative, embodied ideas.<sup>340</sup>

## IX. CONCLUSION

Scholarship on the reach of patent scope into improvement has been farsighted. It has identified and addressed one type of improvement—what this Article terms a classic improvement—but it has failed to notice another common type of improvement that is close at hand and in plain sight—what this Article terms an overlooked improvement. Unlike classic improvements, overlooked improvements are “easy” to deal with in patent infringement

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337. THOMAS KUHN, *THE STRUCTURE OF SCIENTIFIC REVOLUTIONS* 24 (1962).

338. *See generally id.* (arguing that scientific progress does not proceed through uniform, gradual accretion but rather occurs through periods of normal science separated by disruptive paradigm shifts).

339. *See supra* note 220 and accompanying text.

340. *See supra* Section VII.A.



cases as earlier-filed patents routinely encompass later-developed improvements. The conventional theory on patent protection for improvements cannot explain why the overlooked-improvement cases are “easy” cases. The only way to explain the different treatment doled out to the different types of improvements is to break with the dominant conceptual paradigm which takes things to be the primitives of what an inventor invents. At least in the context of improvements, it is important to get into the “spirit” of innovative things and identify the innovative properties of things that are the locus of invention. This conceptual framework that focuses more finely on innovative properties, rather than more bluntly on innovative things, allows invention to be studied at a higher resolution and a finer granularity. It reveals information that is lost in a lower-resolution analysis when things are taken to be the primitives of invention, and it is this very information that is needed to explain how classic and overlooked improvements are distinct as a descriptive matter and why this distinction is important as a normative matter. When innovative properties are treated as the locus of invention, the successive inventions of an earlier patentee and a later improver can be identified as either pure complements (giving rise to overlooked improvements) or as a part-complement and part-substitute mixture (giving rise to classic improvements). When the issue of patent protection for improvements is viewed through this conceptual lens that focuses on innovative properties and that allows a “spirit” of an invention to be recognized, the concepts of complements and substitutes can, for the first time, be brought to bear to explain how courts should craft claim scope.

