ESSENTIAL CAUSATION AND THE METAPHYSICS OF PATENT LAW'S ABSTRACT-IDEAS EXCLUSION

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I. PROLOGUE: TAKING *BILSKI* SERIOUSLY

> *This court labors for page after page, paragraph after paragraph, explanation after explanation to say what could have been said in a single sentence: "Because Bilski claims merely an abstract idea, this court affirms the Board's rejection."*
>
> — Federal Circuit Judge Randall R. Rader[1]

> *The patent application here can be rejected under our precedents on the unpatentability of abstract ideas. The Court, therefore, need not define further what constitutes a patentable "process," beyond pointing to the definition of that term provided in § 100(b) and looking to the guideposts in* Benson, Flook, *and* Diehr.
>
> — Justice Anthony M. Kennedy[2]

> *The Court, in sum, never provides a satisfying account of what constitutes an unpatentable abstract idea.*
>
> — Justice John P. Stevens[3]

Throughout its thirteen-year odyssey from the Patent Office to the Supreme Court,[4] Bernard L. Bilski and Rand Warsaw's ("Bilski's") patent

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[1] In re Bilski, 545 F.3d 943, 1011 (en banc) (Fed. Cir. 2008) (Rader, J., dissenting).

[2] Bilski v. Kappos, 561 U.S. ___, ___ (2010).

[3] 561 U.S. at ____ (Stevens, J., concurring).

[4] *See* Bilski v. Kappos, 561 U.S. ___ (2010); In re Bilski, 545 F.3d 945 (Fed. Cir. 2008) (en banc); Ex Parte Bilski, No. 2002-2257, 2006 WL 5738364 (B.P.A.I. Sept. 26, 2006).

application,[5] claiming methods of hedging commodities trading risks, met with nearly unanimous disapproval. All but one[6] of the twenty-six Supreme Court, Federal Circuit, and administrative patent judges found Bilski's invention to be nonstatutory subject matter under 35 U.S.C. § 101. The judges divided more sharply, however, in their reasoning. Majorities of the Federal Circuit and the Board of Patent Appeals and Interferences held that a patentable process must either be tied to a particular machine or transform an article,[7] and found Bilski's claims to fail both prongs of this "machine-or-transformation" test.[8] Four Supreme Court justices (including Justice Stevens) and three Federal Circuit judges opined that methods of doing business should be held nonstatutory[9] — at least those that do not involve manufactures, machines or compositions of matter.[10] A five-justice Supreme Court majority, however, held that neither a mandatory "machine-or-transformation" test nor the so-called "business method" exclusion was warranted by precedent[11] or necessary to invalidate Bilski's claims as directed to an unpatentable abstract idea.[12] The nine justices did all agree that the "machine-or-transformation" test remains "a useful and important clue" to the patent-eligibility of a claimed process.[13]

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[5] U.S. Patent Application Serial No. 08/833,892 (filed Apr. 10, 1997).

[6] *See* In re Bilski, 545 F.3d at 997 (Newman, J., dissenting) (finding Bilski's claimed process to be "neither a fundamental truth nor an abstraction").

[7] *See id.* at 954 (citations omitted) ("A claimed process is surely patent-eligible under § 101 if: (1) it is tied to a particular machine or apparatus; or (2) it transforms a particular article into a different state or thing."); Ex Parte Bilski, 2006 WL 5738364 at *18 (holding that a claim that does not recite a specific apparatus may be directed to patentable subject matter "if there is a transformation of physical subject matter from one state to another"); *see also id.* at *14 (noting that "[i]t is possible that a non-machine-implemented method may be nonstatutory subject matter if it does not perform a transformation of physical subject matter even though it contains physical steps that might prevent i[t] from being labeled an 'abstract idea.'").

[8] *See* In re Bilski, 545 F.3d at 962 (finding "the machine implementation part of the test" inapplicable to Bilski's claims); *id.* at 963 (holding that Bilski's claims do not transform any article to a different state or thing); Ex Parte Bilski, 2006 WL 5738364 at *2 (noting that Bilski's claims are "non-machine-implemented"); *id.* at *18-*20 (holding that none of Bilski's claims involve a physical transformation).

[9] See Bilski v. Kappos, 561 U.S. at ___ (Stevens, J., concurring); In re Bilski, 545 F.3d at 998 (Mayer, J., dissenting).

[10] *See* In re Bilski, 545 F.3d at 974 (Dyk, J., concurring).

[11] *See* Bilski v. Kappos, 561 U.S. at ____ ("The 'machine-or-transformation' test is not the sole test for deciding whether an invention is a patent-eligible 'process.'"); *id.* at ____ ("Section 101 similarly precludes the broad contention that the term 'process' categorically excludes business methods.").

[12] *See id.* at __ ("Allowing petitioners to patent risk hedging would preempt use of this approach in all fields, and would effectively grant a monopoly over an abstract idea.").

[13] *See id.* at ___ (Kennedy, J.) ("This Court's precedents establish that the machine-or-

In finding Bilski's claims impermissibly abstract, Justice Kennedy's majority opinion not only quoted Judge Rader's dissenting opinion with approval, but appeared to follow his suggestion.[14] Though longer than one sentence, the Court's elaboration of the abstract-idea exclusion was terse — to a fault, at least in Justice Stevens's view.[15]

Justice Stevens was not alone. In a recent *Stanford Law Review* article,[16] Mark Lemley, Michael Risch, Ted Sichelman and Polk Wagner find that the *Bilski* Court's lack of guidance has left the Patent Office and the lower courts continuing to rely on the machine-or-transformation test

> no longer as a mandatory rule, to be sure, but as a presumptive rule that threatens to effectively become mandatory. Put simply, the problem is that no one seems to understand what makes an idea "abstract" and hence ineligible for patent protection, so they fall back on the one test that has been articulated.[17]

Lemley *et al.* are dissatisfied with this state of affairs, since the machine-or-transformation test "contains a number of ambiguities, leads to some bizarre results, and poorly tracks the stated goal of preventing the patenting of abstract ideas."[18] In response, the authors propose a radical change to the "traditional view" of patentable subject matter doctrines as gatekeepers that exclude certain types of inventions entirely from the patent system. They envision the abstract ideas exclusion as an open-ended, multi-factor test to determine whether the "scope of the patentee's claims is commensurate with a practical, real world contribution the patentee has made."[19] Relevant factors would include the potential generativity of the claimed invention, reliance in the industry on cumulative invention, the pace of change in the technological field, the breadth of the claim relative to the disclosed embodiments, and the importance of the inventive contribution.[20] Instead

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transformation test is a useful and important clue, an investigative tool, for determining whether some claimed inventions are processes under §101."); *id.* at ___ (Stevens, J., concurring) ("The Court correctly holds that the machine-ortransformation test is not the sole test for what constitutes a patentable process; rather, it is a critical clue."); *id.* at __ (Breyer, J., concurring) (noting Court's substantial agreement on the point that "while the machine-or-transformation test has always been a 'useful and important clue,' it has never been the 'sole test' for determining patentability.").

[14] *See id.* at ___ (citing In re Bilski, 545 F.3d at 1013 (Rader, J., dissenting)).

[15] *See id.* at ____ (Stevens, J., concurring).

[16] Mark A. Lemley *et al.*, *Life After Bilski*, 63 STAN. L. REV. ___ (2011).

[17] Id. at ___.

[18] Id. at ___.

[19] Id. at ___.

[20] See id. at ___.

of a rule-based gatekeeper, this policy-based evaluation would serve "as a backstop after all other validity doctrines have been exhausted."[21]

The *Bilski* Court expressly left the Federal Circuit free to develop "other limiting criteria [for patent-eligibility] that further the purposes of the Patent Act and are not inconsistent with its text,"[22] but it is hard to imagine the Court had anything like Lemley et al.'s proposal in mind. Nothing in the Court's opinion suggests that lower courts should disrupt the historically categorical approach to patentable subject matter or shift the subject matter inquiry from first to last in the sequence of patentability doctrines.

To the contrary, the one Federal Circuit opinion cited with approval by the Court — Judge Rader's *Bilski* dissent — categorically characterizes abstract claims as analytically incompatible with prior art, precluding examination for novelty and nonobviousness:

> When considering the eligibility of "processes," this court should focus on the potential for an abstract claim. Such an abstract claim would appear in a form that is not even susceptible to examination against prior art under the traditional tests for patentability. Thus this court would wish to ensure that the claim supplied some concrete, tangible technology for examination.[23]

This is an essentially metaphysical approach to the abstract-ideas exclusion. To use a term of art, Judge Rader would hold that abstract claims are "not even susceptible to examination against prior art" because to perform such an examination would entail the *category error* of treating an abstract idea as if it were "concrete, tangible technology."[24] The ontological mismatch[25] between an abstract claim and the "useful Arts"[26] would reveal itself in the

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[21] Id. at ___.

[22] Bilski, 561 U.S. at ___.

[23] In re Bilski, 545 F.3d at 1013 (Rader, J., dissenting).

[24] *See* THE CAMBRIDGE DICTIONARY OF PHILOSOPHY 123 (Robert Audi ed., 2d ed. 1999) (defining "category mistake" as "the placing of an entity in the wrong category" or "the attribution to an entity of a property which that entity cannot have"); JONATHAN C. SMITH, PSEUDOSCIENCE AND EXTRAORDINARY CLAIMS OF THE PARANORMAL: A CRITICAL THINKER'S TOOLKIT 81 (2010) ("Reification is a category error that involves taking an abstraction, belief, or hypothetical construct, and treating it as if it were a concrete entity, something real.").

[25] *See, e.g.*, David S. Oderberg, *Hylemorphic Dualism*, 22 SOCIAL PHIL. & POL'Y 70, 89 (2005) ("[T]here is an essential ontological mismatch between the proper objects of intellectual activity … and any kind of potential physical embodiment of them…. Concepts, propositions, and arguments are abstract; potential material loci for these items are concrete.").

[26] *See* Diamond v. Chakrabarty, 447 U.S. 303, 315 (1980) (explaining that the Patent Act's subject matter provisions "have been cast in broad terms to fulfill the constitutional

patent system's practice of examining the claim against prior art.

All that is needed, then, to give a complete and "satisfying account of what constitutes an unpatentable abstract idea" (about which the "machine-or-transformation" test provides only a "clue") is an explicit account of the patent system's implicit ontological commitments; i.e., an identification of those entities whose existence is metaphysically presupposed by settled patent doctrine.[27] If we are to take seriously the *Bilski* Court's instruction to the Federal Circuit and its apparent endorsement of Judge Rader's approach, the doctrinal path of the abstract-ideas exclusion should find its "guideposts" in the metaphysics of "useful Arts" as revealed by precedent and practice. Describing and interpreting this metaphysics is the project of this Article, a project at once old and new.

II. INTRODUCTION AND METHODOLOGY

A. Patent Law's Metaphysical Foundations

Even though the Supreme Court long ago recognized patent law as the "most metaphysical branch of modern law,"[28] the bench, bar and academy

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and statutory goal of promoting 'the Progress of Science and the useful Arts'"); In re Comiskey, 554 F.3d 967, 997 (Fed. Cir. 2009) (quoting Graham v. John Deere Co., 383 U.S. 1, 6 (1966)) (explaining that in enacting statutory limitations on patentable subject matter, "Congress [] responded to the bidding of the Constitution" to promote the progress of "useful Arts").

[27] *See* THE CAMBRIDGE DICTIONARY OF PHILOSOPHY, *supra* note 24, at 409 (defining "hypostasis" and noting that the issue of whether reification is fallacious "turns largely on criteria of ontological commitment"); CYNTHIA MACDONALD, VARIETIES OF THINGS 25 (2005) (defining a criterion of ontological commitment as "a principle for determining just what objects or entities a theory says there are (or what entities must exist in order for a theory to be true).").

[28] Hogg v. Emerson, 47 U.S. 437, 485-86 (1848); *see also* Rohm & Haas Co. v. Dawson Chemical Co., 599 F.2d 685, 706 (5th Cir. 1979) (citing Judge Rich's comment that "patent law is 'the metaphysics' of the law"); Folsom v. Marsh, 9 F. Cas. 342, 344 (C.C. Mass. 1841) (Story, J.) ("Patents and copyrights approach, nearer than any other class of cases belonging to forensic discussions, to what may be called the metaphysics of the law, where the distinctions are, or at least may be, very [subtle] and refined, and, sometimes, almost evanescent."); Giles S. Rich, *The Relation Between Patent Practices and the Anti-Monopoly Laws*, 14 FED. CIRCUIT B.J. 87, 92 (2004) (describing patent law as a "metaphysical branch of the law" and "the invisible, intangible, incorporeal patent right" as "one of the most elusive of all legal concepts"); *cf.* Ariel Simon, *Reinventing Discovery: Patent Law's Characterizations of and Interventions Upon Science*, 157 U. PA. L. REV. 2175, 2197 (2009) (noting that "the metaphysics of patent law" is "foundational to doctrines of patentable subject matter" but suggesting that "abstract questions of reality otherwise play little to no role in patent law").

to date have shown remarkably little interest in articulating, stabilizing and building on the essential metaphysical foundations of the patent system.[29] Courts in patent cases have tended instead to attach the term "metaphysical" pejoratively to considerations deemed too theoretical to guide practical jurisprudence.[30] Practitioners, scholars and other commentators have generally followed suit, criticizing metaphysical approaches to patent doctrine as exceeding the competence of the Patent Office and the judiciary,[31] clashing with scientific methods and teachings,[32] and ignoring

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[29] *Cf.* Darren Hudson Hick, *Making Sense of the Copyrightability of Plots: A Case Study in the Ontology of Art*, 67 J. AESTHETICS & ART CRITICISM 399, 399 (2009) (observing that "while copyright law assumes *some* metaphysical basis to its objects, this basis tends to go largely uninvestigated.") (emphasis in original).

[30] *See, e.g.*, In re Nuijten, 500 F.3d 1346, 1367 (Fed. Cir. 2007) (en banc) (Linn, J., concurring-in-part and dissenting-in-part) ("[T]he outer limits of statutory subject matter should not depend on metaphysical distinctions such as those between hardware and software or matter and energy, but rather with the requirements of the patent statute. . ."); Sarkisian v. Winn-Proof Corp., 697 F.2d 1313, 1325 (9th Cir. 1983) (contrasting the courts' earlier "metaphysical and semantic" approach to double patenting with the "specific, workable criteria" used in the current test); Kalamazoo Loose Leaf Binder Co. v. Wilson Jones Loose Leaf Co., 286 F. 715, 720 (S.D.N.Y.1920) (Hand, J.) (dismissing "the metaphysical question whether [a binder and rack] form a 'combination' or an 'aggregation'"); Wilson v. Singer, 30 F. Cas. 217, 220 (C.C.D.C. 1860) (rejecting alternative interpretation of joint inventorship law as "too refined and metaphysical for the practical business of life"); *see also* Earle v. Sawyer, 8 F. Cas. 254 (C.C. Mass. 1825) (Story, J.) ("It did not appear to me at the trial, and does not appear to me now, that this mode of reasoning upon the metaphysical nature, or the abstract definition of an invention, can justly be applied to cases under the patent act. That act proceeds upon the language of common sense and common life, and has nothing mysterious or equivocal in it."); Neil A. Smith, *Remembrances and Memorial: Judge Giles Sutherland Rich, 1904-1999*, 9 FED. CIR. B.J. 87, 92 (1999) (noting that one of Judge Rich's stated intentions in drafting § 103 of the Patent Act was "to release the courts from all the metaphysical law of the cases about this concept of 'invention' and to make it clear that not all inventions, only unobvious inventions, are patentable."); *cf.* Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 134-35 (1948) (Frankfurter, J., concurring) (arguing that majority's exclusion of "manifestations of laws of nature" from patentable subject matter relies on "vague and malleable terms infected with too much ambiguity and equivocation"); Rohm & Haas Co., 599 F.2d at 706 (noting "the difficulty of the subject matter" of 35 U.S.C. § 271, which Judge Rich referred to as "the metaphysics of patent law"); Jamesbury Corp. v. U.S., 518 F.2d 1384, 1396 (Ct. Cl. 1975) (quoting Mueller Brass Co. v. Reading Indus., 352 F. Supp. 1357, 1372 (E.D. Pa. 1972)) (describing joint inventorship as "one of the muddiest concepts in the muddy metaphysics of patent law").

[31] *See, e.g.*, William Michael Schuster, *Predictability and Patentable Processes: The Federal Circuit's In Re Bilski Decision and Its Effect on the Incentive to Invent*, 11 COLUM. SCI. & TECH. L. REV. 1 (2009) ("[I]nherently difficult metaphysical questions such as 'What is an abstract idea?' or 'What is the claimed invention?' are not the expertise of judges or patent examiners but rather philosophers."); John R. Thomas, *Formalism at the Federal Circuit*, 52 AM. U. L. REV. 771, 804 (2003) (noting that *State Street Bank*'s

normative economic considerations.[33]

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relatively simple test for patent-eligibility held the promise of "decreas[ing] Patent Office workload by allowing examiners to avoid the metaphysical inquires that sometimes accompanied" previous tests, though increased filings have swamped any such effect); Todd R. Geremia, *Protecting the Right to Copy: Trade Dress Claims for Configurations in Expired Utility Patents*, 92 NW. U. L. REV. 779, 814 (1998) ("[T]o ask courts to make the metaphysical determination of exactly what constitutes the 'true,' 'essential,' or 'significant' inventive components of a formerly patented invention is to invite chaos and unpredictability."); Dennis S. Karjala, *The Relative Roles Of Patent and Copyright in the Protection of Computer Programs*, 17 J. MARSHALL J. COMPUTER & INFO. L. 41, 43 (1998) (criticizing "some 20 years of § 101 subject matter metaphysics" during which judges and the Patent Office "had great difficulty extricating themselves from the form in which [software] technology appeared"); John A. Kidwell, *Software and Semiconductors: Why Are We Confused?*, 70 MINN. L. REV. 533, 566 (1985) ("The norms of patent law generally create problems in their administration because patent law is notorious for asking judges to apply criteria that are almost metaphysical in character."); *cf.* Douglas A. Applegate, *Patenting Improvements: The Costs of Making Patents Easily Available*, 8 SANTA CLARA COMPUTER & HIGH TECH. L.J. 429, 442 (1992) (suggesting that the Supreme Court's approach to combination patents in the wake of Graham v. John Deere Co., 383 U.S. 1 (1966) unhelpfully "wreaked confusion in the patent bar, and rekindled judicial inquiries into the metaphysics of patentable invention"); *but see* Craig Allen Nard, *Legal Forms and the Common Law of Patents*, 90 BOSTON U. L. REV. 51, 57-58 (2010) (citing *Jamesbury*) ("[M]ore than two centuries of experience has taught us that the common law has handled its responsibility relatively well when engaging 'the muddy metaphysics of the patent law.'"); *but cf.* John R. Thomas, *Of Text, Technique, and the Tangible: Drafting Patent Claims Around Patent Rules*, 17 J. MARSHALL J. COMPUTER & INFO. L. 219, 266-67 (1998) (arguing that "jurists, PTO officials, and commentators concerned with the patent system have not been particularly articulate in describing [the] ontological task" of identifying the invention that is the subject of an artfully drafted patent claim, but proposing that the courts and the PTO employ "the philosophical discipline of phenomenology").

[32] *See, e.g.*, Simon, *supra* note 28, at 2192 ("[P]atentable-subject-matter jurisprudence is filled with metaphysical curiosities that bear little resemblance to how historians of science, philosophers, or even scientists think about science."); Andrew W. Torrance, *Metaphysics and Patenting Life*, 76 UMKC L. REV. 363, 395 (2007) (criticizing the Canadian Supreme Court's appeal to "metaphysical phenomena, such as souls and spirits," in delineating the patentability of life forms, as being "outside the analytical reach of the scientific method"); *cf.* DAVID R. KOEPSELL, THE ONTOLOGY OF CYBERSPACE: LAW, PHILOSOPHY AND THE FUTURE OF INTELLECTUAL PROPERTY 102-04, 111 & 121-24 (2000) (arguing that the current "legal ontology" of information technology draws distinctions among media of expression that computer science shows to be false, and advocating legal reform based on "correct ontologies," including the abolition of software patents).

[33] *See, e.g.*, 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, 554-58 (2008) (arguing that metaphysical approaches to after-arising technologies will lead courts "to dole out identical treatment for pairings of patentees and alleged infringers who are distinct from a normative perspective"); A. Samuel Oddi, *Contributory Infringement/Patent Misuse: Metaphysics and Metamorphosis*, 44 U. PITT. L. REV. 73, 127-30 (1982) (arguing that the Supreme Court's metaphysical approach in

These concerns should of course be taken seriously. It would indeed be foolish to expect the Patent Office or the courts to resolve long-contested metaphysical questions in the course of administering, enforcing, applying, and developing the patent laws. It would be equally unwise for patent law and policy to abandon sound science and economics for the sake of mere metaphysical line-drawing.

At the same time, the patent system's metaphysical commitments also need to be taken seriously. As Steven Smith persuasively argues in *Law's Quandary*,[34] metaphysical commitments "pervade and inform the ways that lawyers talk and argue and predict and that judges decide and justify."[35] Legal scholars have long recognized the involvement of the metaphysics of causation in accounts of legal responsibility, particularly in the areas of criminal and tort law.[36] In the patent system, inventors, examiners, lawyers and judges are tasked with drafting and reviewing statements about the capacities of objects and processes to cause beneficial effects in the world.[37] Patent claims (the patent system's stock in trade[38]) are essentially *ad hoc* ontological categories[39] (the metaphysician's stock in trade[40]). It is not hard

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Dawson Chemical Co. v. Rohm & Haas Co., 448 U.S. 176 (1980), led to a result that creates uneven incentives for inventive activity).

[34] Steven Douglas Smith, LAW'S QUANDARY (2004).

[35] *See* Steven D. Smith, *Metaphysical Perplexity?*, 55 CATH. U. L. REV. 639, 644-45 (2006) (summarizing a central thesis of LAW'S QUANDARY for a symposium on the book).

[36] *See, e.g.*, MICHAEL S. MOORE, CAUSATION & RESPONSIBILITY (2009); H.L.A. HART & TONY HONORÉ, CAUSATION IN THE LAW (2d ed. 1985); Marcelo Ferrante, *Causation in Criminal Responsibility*, 11 NEW CRIM. L. REV. 470 (2008); Michael Moore, *For What Must We Pay? Causation and Counterfactual Baselines*, 40 SAN DIEGO L. REV. 1181 (2003); Michael S. Moore, *The Metaphysics of Causal Intervention*, 88 CAL. L. REV. 827 (2000); Stephen J. Morse, *The Moral Metaphysics of Causation and Results*, 88 CAL. L. REV. 879 (2000); Jane Stapleton, *Choosing What We Mean By "Causation" in the Law*, 73 MO. L. REV. 433 (2008); Richard W. Wright, *Causation in Tort Law*, 73 CAL. L. REV. 1735 (1985).

[37] *See* 35 U.S.C. § 101 ("Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title."); Diamond v. Diehr, 450 U.S. 175, 182 (1981) (quoting Corning v. Burden, 56 U.S. 252, 268 (1853)) ("It is for the discovery or invention of some practical method or means of producing a beneficial result or effect, that a patent is granted. . . .").

[38] *See, e.g.*, Giles S. Rich, *The Extent of the Protection and Interpretation of Claims: American Perspectives*, 21 INT'L REV. INDUS. PROP. & COPYRIGHT L., 497, 499 (1990) ("To coin a phrase, the name of the game is the claim.").

[39] *See* Jeffrey A. Lefstin, *The Formal Structure of Patent Law and the Limits of Enablement*, 23 BERKELEY TECH. L.J. 1141, 1168 (2008) (noting "the ontological nature of patent claims").

[40] *See* Jan Westerhoff, *The Construction of Ontological Categories*, 82 AUSTRALASIAN J. PHILOSOPHY 595, 595 (2004) ("[T]he notion of an ontological category . . . is central to

to imagine that metaphysical commitments might attach to legal accounts of patent acquisition, validity, and infringement, even if only tacitly.

This Article departs methodologically from previous legal scholarship in its focused search for, and reliance on, the patent system's metaphysical commitments. Scholars who have previously attributed particular metaphysical stances to the patent system have generally done so in order to reject those stances, thereby clearing the way for proposed policy or doctrinal reforms.[41] A common characteristic of this literature is that modern philosophy supplies much of the artillery against the accused stances, but few fortifications in support of the proposed changes; thus potentially powerful metaphysical insights ultimately serve only as adjuncts to normative appeals for reform. In contrast, the aim of this Article is to demonstrate that an explicit recognition of, and reliance on, the patent

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ontology and metaphysics (it is, after all, what these disciplines are about)").

It should be noted that Westerhoff's highly abstract notion of an ontological category excludes "categories as specific as kni[v]es and forks, tables and chairs, or chairs and palaces," *see id.* at 596, and presumably would also exclude typical patent claims. Neither do patent claims appear to provide a general ontological account of the relation between artifacts as "higher-order objects and their material basis." *See* Wybo Houkes & Anthonie Meijers, *The Ontology of Artefacts: The Hard Problem*, 37 STUD. HIST. PHIL. SCI. 118, 119 (2006) (concluding that describing such a relation is "a hard problem in metaphysics"). Patent claim drafting's *ad hoc* approach is more closely related to the recent use of ontological categories in information science and biomedicine to organize domain-specific knowledge. *See* Katherine Munn, *What is Ontology For?*, in APPLIED ONTOLOGY: AN INTRODUCTION 7, 10-12 (Katherine Munn & Barry Smith eds., 2009) (discussing the need for an information system to "have a categorial structure readymade for slotting each piece of information programmed into it under the appropriate heading" and to organize domain-specific human knowledge about reality); The Open Biological and Biomedical Ontologies <http://www.obofoundry.org/> (visited January 3, 2011) (providing open-source ontologies for further research and development in various fields of biology and biomedical research).

While longstanding patent doctrine entitles inventor-applicants to devise their own ontologies within the scope of the prosecution history, *see, e.g.*, Process Control Corp. v. HydReclaim Corp., 190 F.3d 1350 (Fed. Cir. 1999) ("[W]e have held many times that a patentee can act as his own lexicographer to specifically define terms of a claim contrary to their ordinary meaning"), at least one information science researcher questions the necessity of this *ad hoc* approach. Jeffrey Gower, a graduate student at University at Buffalo-SUNY, has embarked on a massive computer-driven effort to unify the ontology of patent claims around "a structured and controlled vocabulary." *See* 3TU Center for Ethics and Technology, *Towards an Ontology of Patent Claims* <http://www.ethicsandtechnology.eu/news/comments/towards_an_ontology_of_patent_claims/> (visited July 8, 2010) (abstract for Gower's Apr. 29, 2010 presentation).

[41] *See, e.g.*, Dan L. Burk, *Feminism and Dualism in Intellectual Property*, 15 AM. U. J. GENDER SOC. POL'Y & L. 183, 186 (2007) (arguing that the conception-focused inventorship doctrine exemplifies a "striking pattern of dualism" in the patent system that is subject to critique); Simon, *supra* note 28, at 2192-97 (arguing that modern metaphysics has undermined patent law's characterization of laws of nature as fundamental truths).

system's core metaphysical commitments would be not only jurisprudentially defensible, but also instrumental in illuminating the form and nature of the project of "promot[ing] the Progress of . . . useful Arts"[42] and in aligning patent laws and institutions with that constitutional purpose. Doctrines arising from such an analysis would be warranted not only as substantive policy reforms, but also, importantly, as metaphysically necessary consequences of existing precedents.

The judicial precedents excluding "laws of nature, physical phenomena, and abstract ideas" from patentable subject matter[43] are metaphysical at their core.[44] An analysis of patent law's metaphysical commitments is therefore an apt approach to delineating each of the excluded categories. In particular, *Bilski*'s crucial question, "what constitutes an unpatentable abstract idea," interrogates the ontological boundary between products and processes (which the patent system recognizes as existent within the ontology of "useful Arts") and abstractions (which are denied such recognition). A precise definition of this boundary will require a careful analysis of the patent system's ontological commitments in virtue of its legal construction of the "useful Arts." In this Article, I will attempt to provide such an analysis and define such a boundary.

B. Thomas's Appeal to "Mainstream" Philosophy

A project with similar aspirations but a different analytical methodology was undertaken by John R. ("Jay") Thomas in his influential 1999 article *The Patenting of the Liberal Professions*.[45] Written in the wake of the Federal Circuit's *State Street Bank* decision[46] discarding the so-called "business method" exception to patentable subject matter,[47] Thomas's article aims "to develop an articulation of those aspects of human endeavor we may fairly call technological"[48] and advocates restricting patent-

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[42] U.S. CONST. art. I, § 8, cl. 8.

[43] *See* Bilski v. Kappos, 561 U.S. ___, ___ (2010) (quoting Diamond v. Chakrabarty, 447 U.S. 303, 309 (1980)).

[44] *See, e.g.*, Simon, *supra* note 28, at 2197 (describing metaphysics as "foundational to doctrines of patentable subject matter").

[45] John R. Thomas, *The Patenting of the Liberal Professsions*, 40 B.C. L. REV. 1139 (1999). This article and an earlier symposium version, *see* John R. Thomas, *The Post-Industrial Patent System*, 10 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 3 (1999), have been cited in a total of 140 law review articles, according to a search of Westlaw's JLR database (visited Jan. 5, 2011).

[46] State Street Bank & Trust Co. v. Signature Financial Group, Inc., 149 F.3d 1368 (Fed. Cir. 1998) (abrogated on other grounds).

[47] *See id.* at 1375-77.

[48] Thomas, *supra* note 45, at 1142.

eligibility according to "an essentialist, legally apt definition of the technological"[49] so as to "restore a sense of patentable subject matter that matches our sensibilities."[50]

Thomas describes philosophers of technology as falling into two camps: those who have adopted "exceptionally broad" definitions of technology that embrace all "artifacts" or "practical implementations of intelligence," whether tangible or intangible,[51] and others who have found technology to be "an endeavor that both intuition and sustained analysis would distinguish from other aspects of human society."[52] Siding with the latter, more limited view, he determines that "technological activities are concerned with the production or transformation of artifacts through the systematic manipulation of physical forces."[53]

Thomas goes on to suggest legislation limiting patentability to inventions "susceptible to so-called 'industrial application.'"[54] He finds that the European and Japanese Patent Offices already implement this industrial application requirement[55] by recognizing the "distinguishing traits" of the more limited view of technology: "production or transformation of artifacts; interaction with the external environment; systematic manipulation of physical forces; and focus upon design."[56] Significantly, Thomas's proposed legislation would effectively preclude patenting of business methods, because "[t]hey do not manipulate physical forces to achieve the production or transformation of material objects" and they "engage economic principles rather than the laws of physics, chemistry or biology."[57]

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[49] Id. As Thomas explains, the Federal Circuit has taken the term "technology" to be synonymous with the "useful Arts." *See id.* at 1140 n. 12 (citing Paulik v. Rizkalla, 760 F.2d 1270, 1276 (Fed. Cir. 1985)); *but see infra* Section C (questioning the assumption that ontological theories of "technology" necessarily track doctrinal conceptions of the "useful Arts").

[50] Id. at 1143.

[51] *See id.* at 1168-69.

[52] *See id.* at 1175.

[53] Id. at 1142.

[54] Id. at 1178.

[55] As Thomas notes, such a restriction on patentable subject matter is expressly permitted by the TRIPS Agreement. *See id.* at 1184 & n. 303 *citing* Agreement on Trade-Related Aspects of Intellectual Property Rights art. 27(1), Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, Legal Instruments—Results of the Uruguay Round vol. 31; 33 I.L.M. 81 (1994) ("[P]atents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application.").

[56] Id. at 1180.

[57] Id. at 1181.

A different result in *Bilski* might well have obviated such legislation. Both Justice John P. Stevens's concurrence and Judge H. Robert Mayer's dissent cite Thomas's article in support of their view that business methods should be deemed ineligible for patent protection.[58] The majority opinions of the Supreme Court and the Federal Circuit, however, both found a lack of precedential support for a business method exception to patentable subject matter.[59] Thomas himself conceded that absent legislation, the U.S. patent system would probably not sustain the importation of a European-style industrial application requirement.[60] With the Supreme Court's definitive rejection of a business method exception in *Bilski*,[61] Thomas's hopes for cabining the patent system within a more limited view of technology now rest solely with Congress, where the agenda seems more likely to be set by public opinion than by philosophy.[62]

Even if Congress cared about such discourse, analytic philosophy is not in a position to offer a definitive view on "the ontic dimension of technology," as Thomas acknowledges.[63] Thomas does his best to champion the four philosophers in the limited-technology camp,[64] labeling their scholarship "contemporary"[65] and "sustained"[66] and their perspectives

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[58] *See* Bilski v. Kappos, 561 U.S. at _____ (Stevens, J., concurring); In re Bilski, 545 F.3d 943, 1003 (Fed. Cir. 2008) (en banc) (Mayer, J., dissenting).

[59] *See* Bilski v. Kappos, 561 U.S. at ____; In re Bilski, 545 F.3d at 960.

[60] *See* Thomas, *supra* note 45, at 1183-84 (noting similarities between the Patent Office's Software Guidelines and the European approach, but "[t]he fact remains that the Patent Office . . . following *State Street*, appears obliged to allow [applications claiming business methods] to mature into allowed patents.").

[61] *See* Bilski v. Kappos, 561 U.S. at ____.

[62] Moreover, as the *Bilski* majority noted, Congress in enacting § 273 of the Patent Act has already "explicitly contemplate[d] the existence of at least some business method patents." *See id.* at ___ (citing 35 U.S.C. § 273(b)(1)).

Some observers of Congress would regard lobbying rather than public opinion as the primary determinant of the legislative agenda in this area. *See, e.g.*, Emir Aly Crowne Mohammed, *What is an Invention? A Review of the Literature on Patentable Subject Matter*, 15 RICH. J.L. & TECH. 2 (2008) ("It may well be that business methods are now considered a protected form of knowledge — whereas traditional knowledge is not — chiefly because of the extensive lobbying and commercial interests at play.").

[63] *See* Thomas, *supra* note 45, at 1142 ("Identifying the ontic dimension of technology has perplexed not only the courts, but epistemologists and the most accomplished of technological observers as well.").

[64] *See id.* at 1170-75 (discussing the work of Robert McGinn, N. Bruce Hannay, Paul W. DeVore and Carl Mitcham).

[65] *See id.* at 1180 ("[T]he industrial application standard appears very much in keeping with the characterizations of technology offered by contemporary technological thinking.").

[66] *See id.* at 1175 ("[T]echnology is an endeavor that both intuition and sustained analysis would distinguish from other aspects of human society.").

"refined"[67] and "structured."[68] Yet the work of those scholars whom he describes as taking a more encompassing view of technology, such as Marshall McLuhan and Frederick Ferré,[69] cannot easily be dismissed as outdated, superficial or crude.

Given these philosophical ambiguities, Thomas's call for congressional action must rely ultimately on a stark appeal to public opinion and "mainstream" thinking.[70] Thomas asserts that interpretations of technology that encompass business methods are unacceptably "extreme" because "few of us would suppose that inventions within the domain of business, law or fine arts constitute technology, much less patentable technology."[71] As the philosophical divide shows, however, what counts as an "extreme" view of technology is in the eye of the beholder.[72] Perhaps the patenting of the liberal professions continues to shock the public conscience,[73] but with the courts' blessing, it is becoming less shocking with every passing year.[74] In *Bilski*'s aftermath, the prospects for Thomas's definitional reform project appear dim and dimming.

Thomas's article remains notable for its groundbreaking engagement of the philosophical literature on the metaphysical boundaries of patentable

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[67] *See id.* at 1170 (describing these philosophers under the section heading "Toward a Refined View of Technology").

[68] See id. ("A review of commentators such as McGinn, DeVore and Mitcham illustrates that we can achieve a structured definition of technology.").

[69] *See id.* at 1168-69 & nn. 217-18 (citing FREDERICK FERRÉ, PHILOSOPHY OF TECHNOLOGY 26 (1988) and MARSHALL MCLUHAN & ERIC MCLUHAN, LAWS OF MEDIA: THE NEW SCIENCE 3 (1998)).

[70] *See id.* at 1169 (rejecting perspectives from the field of cybernetics as falling beyond "mainstream notions of technology").

[71] *See id.*; *see also id.* at 1185 (arguing that the industrial application requirement "comport[s] with our perception of what technology is").

[72] *See supra* text accompanying notes 51-52; *see also* In re Bilski, 545 F.3d at 960 (citation omitted) (explaining that "the contours" of a technological arts test "would be unclear because the meanings of the terms 'technological arts' and 'technology' are both ambiguous and ever-changing").

The years since *State Street Bank* have seen a significant shift in the popular understanding of "technology," not only to embrace information technology, but to marginalize other technological fields. *See* Timothy Noah, *Did Computers Create Inequality?*, SLATE, Sept. 8, 2010 <http://www.slate.com/id/2266025/entry/2266508/> (visited Jan. 5, 2011) ("Contemporary culture is so fixated on the computer revolution that the very word 'technology' has become an informal synonym for 'computers.'").

[73] *See* Bilski, 561 U.S. at ___ (Stevens, J., concurring) (surveying critical literature on business method patents).

[74] *See, e.g.*, Robert P. Merges, *Software and Patent Scope: A Report from the Middle Innings*, 85 TEX. L. REV. 1627, 1628 (2007) (predicting that because of "technological change and widespread capital availability . . . business method patents seem destined to become a regular feature of the commercial landscape in the coming years").

subject matter. Thomas's analysis has had difficulty finding purchase in patent doctrine, however, because he asks too much of the philosophical literature. As much as Thomas might prefer to dismiss opposing viewpoints, the field of analytic philosophy is not committed to a single essentialist characterization of technology that can definitively resolve the constitutional meaning of "useful Arts." Moreover, while the courts may regard "technology" as synonymous with "useful Arts,"[75] nothing in the caselaw bespeaks a commitment to defining the boundaries of patentable subject matter according to the categories and characterizations formulated by philosophers of technology, let alone the particular approaches favored by Thomas: indeed, the caselaw has squarely rejected such boundaries.[76] At the same time, Thomas asks too little of the existing body of patent law, which upon closer examination may be found to entail metaphysical commitments to least some of the limiting principles he advocates.

C. Metaphysics and the Abstract Ideas Exclusion

The core metaphysical commitments of the patent system are textually grounded in the constitutional grant empowering Congress to "promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries."[77] This copyright-patent clause is unique among the enumerated powers of Congress for including a statement of purpose,[78] thereby instilling the "most metaphysical branch of modern law" with an explicit foundational commitment to "promote the Progress of . . . useful Arts."

In this Article, I will argue that the patent system's established legal doctrines and practices commit the patent system to a metaphysical worldview that is internally consistent and entails meaningful limits on patentable subject matter. In particular, as a consequence of this worldview, the patent system's ontology of "useful Arts" extends only to claims whose embodiments have essential causal powers that are employed in use.[79] I

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[75] *See* Paulik v. Rizkalla, 760 F.2d 1270, 1276 (Fed. Cir. 1985) ("The exclusive right, constitutionally derived, was for the national purpose of advancing the useful arts — the process today called technological innovation."); *In re* Waldbaum, 457 F.2d 997, 1003 (C.C.P.A. 1972) (Rich, J., concurring) ("The phrase 'technological arts,' as we have used it, is synonymous with the phrase 'useful arts' as it appears in Article I, Section 8 of the Constitution.").

[76] *See* Bilski, 561 U.S. at ____.

[77] U.S. CONST. art. I, § 8, cl. 8.

[78] *See* Ralph S. Brown, *Eligibility for Copyright Protection: A Search for Principled Standards*, 70 MINN. L. REV. 579, 592-93 (1985).

[79] *See infra* text accompanying note 169.

will refer to this condition as the *essential causation requirement* for patent eligibility.

These conclusions rely on theoretical machinery drawn from various leading metaphysical accounts of causation, causal explanation, and laws of nature that appear to be consistent with the patent system's metaphysical commitments. Brian Ellis's theory of scientific essentialism,[80] Wesley Salmon's[81] and Phil Dowe's[82] theories of causal processes, and Albert Einstein's special and general theories of relativity[83] all play significant roles in this analysis. By singling out these theories, I do not seek or serve to dismiss alternative accounts or to resolve longstanding controversies in analytical philosophy. To borrow a distinction from the rules of evidence,[84] the metaphysical propositions presented in this Article are offered not for their analytical or empirical truth, but only to reveal the patent system's "state of mind" — i.e., the intended and designed purposes expressed in the patent laws — and to evaluate patent law doctrines for coherence with those purposes.[85]

An important subclass of the class of claims that fail the essential causation requirement consists of claims that purport to cover all structural applications of a *kinematic property*. A kinematic property is a geometric description of the motion of a physical body or system of bodies without taking into account their masses or forces acting on them.[86] The exclusion

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[80] *See, e.g.*, BRIAN ELLIS, SCIENTIFIC ESSENTIALISM 5-6 (2001) (describing causal powers from the perspective of scientific essentialism).

[81] *See, e.g.*, WESLEY C. SALMON, SCIENTIFIC EXPLANATION AND THE CAUSAL STRUCTURE OF THE WORLD 139-47 (1984) (characterizing causal processes in distinction to pseudo-processes); Wesley C. Salmon, *Causality Without Counterfactuals*, 61 PHILOSOPHY OF SCIENCE 297 (1994) (responding to and extending Dowe's theory of causal processes).

[82] *See, e.g.*, PHIL DOWE, PHYSICAL CAUSATION (2000) (presenting and defending a theory of causal processes).

[83] *See, e.g.*, ALBERT EINSTEIN, RELATIVITY: THE SPECIAL AND GENERAL THEORY (Robert W. Lawson tr. 1920) (presenting first English translation of Einstein's 1916 monograph on his theories of relativity).

[84] *See* FED. R. EVID. 803(3) (providing exception to hearsay rule for statements whose purpose is to establish the declarant's state of mind).

[85] *Cf.* JOHN R. SEARLE, THE REDISCOVERY OF THE MIND 25 (1992) ("[I]t is a very deep mistake to suppose that the crucial question for ontology is, 'What sorts of things exist in the world?' as opposed to, 'What must be the case in the world in order that our empirical statements be true?'").

[86] *See* R.J. DURLEY, KINEMATICS OF MACHINES 1 (1903) (defining kinematics of machines as "consider[ing] from a geometrical point of view the motion of any part of the machine with reference to any other part, without taking account of any of the forces acting on such parts"); Olivier Massin, *The Metaphysics of Forces*, 63 DIALECTICA 555, 558 (2009) ("Kinematic properties include motion, velocity and acceleration. With other properties such as distances or shapes, kinematic properties amount to spatio-temporal

of claims that effectively preempt kinematic properties from patentable subject matter would provide a jurisprudentially and scientifically sound response to many recent patent-eligibility controversies. In particular, in the field of information technology, the exclusion would address the concerns of software patent abolitionists regarding the purported patenting of mathematics,[87] and raise previously unrecognized[88] concerns regarding the patent-eligibility of mechanical devices claimed at an excessively high (i.e., kinematic) level of abstraction.[89] These concerns in turn suggest immediate applications of the theories developed in this Article in technologies ranging from software and semiconductors to nucleic acids and pharmacokinetics.

The remainder of this Article is organized as follows. Part III conducts an ontological inventory of the patent system to determine the boundaries of its ontology of "useful Arts," and the status of claims and embodiments as entities within that ontology. Part IV describes the scope of subject matter that satisfies the essential causation requirement and, therefore, falls within the patent system's ontology of "useful Arts." Part V illustrates the kinematic property exclusion with examples of static and dynamic geometric properties that could be the subject of claims subject to the exclusion. Part VI concludes by revisiting the "machine or transformation" requirement as a "clue" to patent-eligibility and identifying further areas of patent doctrine that could benefit from closer attention to the patent system's metaphysical underpinnings.

III. AN ONTOLOGICAL THEORY OF THE PATENT SYSTEM

A. The Ontological Status of Patent Claims

1. Claims as Kinds

In the modern patent system, patent claims "stand alone to define the invention."[90] Any study of the patent system's ontological commitments

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properties."); *see also* MATTHEW T. MASON, MECHANICS OF ROBOTIC MANIPULATION 24 (2001) (defining kinematics as "the study of motion, without regard for the cause of the motion").

[87] *See, e.g.*, BEN KLEMENS, MATH YOU CAN'T USE: PATENTS, COPYRIGHT AND SOFTWARE 63 (2005) (arguing that owning a software patent is the same as "own[ing] a piece of mathematics").

[88] *Cf.* ROBERT A. CHOATE, CASES AND MATERIALS ON PATENT LAW 515 (1973) ("There is seldom controversy in the courts at this stage of development of patent law as to whether a subject of a patent is or is not a [patent-eligible] machine.").

[89] *See infra* Part V.

[90] Ex Parte Fressola, 27 U.S.P.Q.2d 1608, 1609 (B.P.A.I. 1993).

must therefore begin with a precise metaphysical and linguistic characterization of the patent claims that are the subject of those commitments.

A widespread misconception about patent claims is that they are nothing more than *sets* of embodiments, so that certain doctrines about claim scope can be reduced to set-theoretic propositions.[91] This is a useful intuition for introducing the notion of claim scope and the distinction between claims and embodiments. It is an imprecise and inadequate ontological description, however, because while the definition of a set necessarily determines its elements,[92] the language of a claim does not determine which, if any, of its embodiments exist. Conversely, the number of existing embodiments of a patent claim has no effect on the claim's scope.[93] All empty sets are identical,[94] but there are many distinct patent claims with no existing embodiments.[95]

For purposes of metaphysical and linguistic ontology, it is more

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[91] *See, e.g.*, Thomas D. Brainard, *Patent Claim Construction: A Graphic Look*, 82 J. PAT. & TRADEMARK OFF. SOC'Y 670 (2000) (depicting "[t]he patent concepts of validity, infringement, prior art, the doctrine of equivalents, file history estoppel and principles of claim differentiation" with Venn diagrams); Raj S. Dave, *A Mathematical Approach to Claim Elements and the Doctrine of Equivalents*, 16 HARV. J. L. & TECH. 507, 518-25 (2003) (using Venn diagrams to illustrate doctrine of equivalents and prosecution history estoppel); Jeanne C. Fromer, *Claiming Intellectual Property*, 76 U. CHI. L. REV. 719, 772 (2009) (stating the "consensus" view that patent claims should "enable a properly sized set of embodiments — not too big, not too small — to be protected"); Charles L. Gholz, *A Critique of Recent Opinions in Patent Interferences*, 86 J. PAT. & TRADEMARK OFF. SOC'Y 464, 476-83 (2004) (using Venn diagram to illustrate blocking situation resulting from interference decision); 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, 1984 (2005) (describing the "refinement" of patent claims during prosecution as the "process of identifying and claiming the broadest patentable set of embodiments enabled by the disclosure in the patent specification"); Samson Vermont, *A New Way to Determine Obviousness: Applying the Pioneer Doctrine to 35 U.S.C. § 103(a)*, 29 AIPLA Q.J. 375, 418-24 (2001) (describing anticipation and obviousness in terms of Venn diagrams); *but cf.* Lefstin, *supra* note 39, at 1159-67 (finding that "[n]early all of the doctrines of patent law … may be posed almost as mathematical set-functions whose truth value is described in terms of the claimed subject matter," but concluding that "patent law [is] not reducible to a simple set-theoretic system" insofar as it is impossible "to formulate a doctrine of enablement as a simple function of exclusion or inclusion").

[92] *See* Nicholas Wolterstorff, *Toward an Ontology of Art Works*, 9 NOUS 115, 121 (1975) (noting that "whatever members a set has it has necessarily").

[93] *See* Collins, *supra* note 33, at 503 (noting that the exclusionary scope of a widget patent claim "is unaffected by a patentee's decision to manufacture ten or ten thousand widgets").

[94] *See* Wolterstorff, *supra* note 92 ("That there is but one null set is clear enough.").

[95] To be valid, a patent claim need not be actually reduced to practice.

accurate to describe patent claims and their embodiments in terms of the distinction between *types* and *tokens*. In metaphysics, the type-token distinction conceptually separates a category (an abstract type) from its members (a concrete token, which *exemplifies* the type).[96] In linguistics, the term *kind* is often used synonymously with *type*:[97] thus, a noun phrase may refer to a *kind* rather than a particular object, as in "The Irish economy became dependent upon *the potato*."[98] In both of these contexts, a patent claim is accurately understood as a *type* or *kind* whose embodiments are its *tokens* or *examples*.[99]

The metaphysics literature provides strong support for the view that patent claims are kinds of embodiments. In an influential[100] 1975 article, philosopher Nicholas Wolterstorff sets out to determine the ontological status of various creative works.[101] He takes pains to distinguish between works and their examples, in much the same way that the 1976 Copyright Act dissects the bundle of uses of an underlying copyrighted work.[102] (Despite the clear relevance of this work for copyright law, he does not mention copyright, and his analysis does not appear to have engaged the attention of legal scholars.[103]) Wolterstorff squarely rejects "the view that performance-works and object-works are *sets* of their examples,"[104] reasoning that the existence of a creative work is independent of the

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[96] *See* THE CAMBRIDGE DICTIONARY OF PHILOSOPHY 936-37 (Robert Audi ed. 1999) (defining "type-token distinction").

[97] *See, e.g.*, WAYNE A. DAVIS, MEANING, EXPRESSION, AND THOUGHT 316 ("I can see no metaphysical reason not to use 'type' and 'kind' interchangeably, and thus to describe words and thoughts as kinds of things.").

[98] *See* Manfred Krifka *et al.*, *Genericity: An Introduction*, in THE GENERIC BOOK 1, 2 (Gregory N. Carlson & Francis Jeffry Pelletier ed. 1995) (emphasis in original) (noting that "the potato" in this sentence does not refer to "some particular potato or group of potatoes, but rather the kind Potato (*Solanum tuberosum*) itself").

[99] *See* Collins, *supra* note 33, at 503 ("Except in the calculation of damages, references to 'things' or 'sets of things' in patent law invoke types, not tokens."); *cf.* Sean B. Seymore, *The Teaching Function of Patents*, 85 NOTRE DAME L. REV. 621 (2010) ("An 'embodiment' is a concrete form of an invention (like a chemical compound or a widget) described in a patent application or patent.").

[100] *See* Charles Nussbaum, *Kinds, Types, and Musical Ontology*, 61 J. AESTHETICS & ART CRITICISM 273, 273 (2003) (describing Wolterstorff's article as "influential").

[101] *See* Wolterstorff, *supra* note 92, at 115 ("What sort of entity is a symphony? A drama? A dance? A graphic art print? A sculpture? A poem? A film? A painting? Are works of art all fundamentally alike in their ontological status?").

[102] *See* 17 U.S.C. § 106.

[103] No citation to Wolterstoff's article appears in Westlaw's TP-ALL database. Subsequent philosophers, however, have recently begun to examine the ontological status of objects of copyright law. *See, e.g.*, Hick, *supra* note 29.

[104] Wolterstorff, *supra* note 92, at 121.

existence of performances and artifacts exemplifying the work:

> Just as an art work might have had different and more or fewer performances and objects than it does have, so too the kind Man, for example, might have had different and more or fewer examples than it does have. If Napoleon had not existed, it would not then have been the case that Man did not exist. Rather, Man would then have lacked one of the examples which in fact it had. And secondly, just as there may be two distinct unperformed symphonies, so too may there be two distinct unexampled kinds — e.g., the Unicorn and the Hippogriff.[105]

Wolterstorff writes that these observations "tend[] at once to confirm us in the suggestion that art works are kinds whose examples are the examples of those works."[106] More specifically, "[a] performance-work is a certain kind of performance; an object-work is a certain kind of object.[107]

Wolterstorff's analysis of creative works applies with equal force to patent claims. Like a symphony composition that exists (and is the subject of copyright) regardless of how often it has been performed, a patent claim exists and defines the same scope of patent rights regardless of which, if any, embodiments of the claim exist. Patent claims can also exist as unexampled kinds, because an inventor may obtain a patent without actually reducing the invention to practice. Under the doctrine of constructive reduction to practice, the filing of a patent application satisfying the written description, enablement and best mode requirements of § 112[108] has the same legal effect as conception and actual reduction to practice through the creation of an operative embodiment.[109] These observations support the conclusion that a patent claim is a kind whose examples are its embodiments.

Recent linguistics scholarship also leads to the conclusion that patent

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[105] Id. at 126-27.

[106] Id. at 126.

[107] Id.

[108] 35 U.S.C. § 112.

[109] *Compare* Hyatt v. Boone, 146 F.3d 1348, 1352 (Fed. Cir. 1998) ("The filing off a patent application serves as conception and constructive reduction to practice of the subject matter described in the application."); Yasuko Kawai v. Metlesics, 480 F.2d 880, 885 (C.C.P.A. 1973) ("[T]he act of filing the United States application has the legal effect of being, constructively at least, a simultaneous conception and reduction to practice of the invention.") *with* Slip Track Systems, Inc. v. Metal-Lite, Inc., 304 F.3d 1256, 1265 (Fed. Cir. 2002) ("In order to establish actual reduction to practice, the inventor must prove that he constructed an embodiment or performed a process that met all the limitations of the claim, and that he determined that the invention would work for its intended purpose.").

claims are kinds of embodiments. Interestingly, linguists have singled out the verb "invent" as a stock example of a *kind-level predicate*; i.e., an expression that can be true of a kind but not of individual members or of quantified sets of members of the kind.[110] As a group of leading scholars in the field explains:

> There are some predicates with argument places that can be filled only with kind-referring NPs [noun phrases]. Examples are the subject argument of *die out* or *be extinct* and the object argument of *invent* or *exterminate*. The reason is, of course, that only kinds (not objects) can die out or be invented.[111]

Linguists therefore justifiably regard a kind-level predicate as strongly indicative of an accompanying reference to a kind.[112]

As with Wolterstorff's dissection of creative works, this linguistic analysis neither references nor is referenced by the legal literature.[113] Yet the ongoing examination of "invent" as a linguistic predicate offers a significant insight into the grammar of patent claims.

Indefinite singular noun phrases (e.g., singular nouns preceded by the

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[110] *See* GREGORY N. CARLSON, REFERENCES TO KINDS IN ENGLISH 47-48 (1980) (identifying a class of predicates "which cannot meaningfully be said of any particular individuals, nor can they meaningfully be said of any of the quantified NP's of the language" and referring to them as "special predicates"); *see also Predicate (grammar)*, WIKIPEDIA <http://en.wikipedia.org/wiki/ Predicate_(grammar)#Kind-level_predicates> (visited February 15, 2011) (defining a kind-level predicate as a predicate that "is true of a kind of thing, but cannot be applied to individual members of the kind"). The characterization of kind-level predicates is credited to Carlson. *See, e.g.*, THEODORE B. FERNALD, PREDICATES AND TEMPORAL ARGUMENTS 37 (2000) (describing kind-level predicates as a "type theoretic distinction" drawn by Carlson).

[111] *See* Krifka, *supra* note 98, at 10 (Gregory N. Carlson & Francis Jeffry Pelletier eds. 1995); *see also* Berit Brogaard, *Sharvy's Theory of Definite Descriptions Revisited*, 88 PAC. PHIL. Q. 160, 160, 177 n.12 (2007) ("'Babbage invented the computer,' for example, does not seem to be making a claim about the sum of the world's computers. Rather, it seems to be making a claim about the concept *computer*."); Friederike Moltmann, *Properties and Kinds of Tropes: New Linguistic Facts and Old Philosophical Insights*, 113 MIND 1, 33 n.23 (2004) (citing "were invented" as an example of a "kind-specific predicate"); Roberto Zamparelli, *Definite and Bare Kind-Denoting Noun Phrases*, *in* ROMANTIC LANGUAGES AND LINGUISTIC THEORY 2000, at 305, 311-12 (Claire Beyssade *et al.* eds. 2002) (providing "invented" as an example of a kind-level predicate operating on "Edison" and "light-bulbs").

[112] *See* Zamparelli, *supra* note 111, at 309 ("Probably the best case for the linguistic relevance of kinds comes from predicates which cannot usually apply to ordinary individuals….").

[113] The terms "kind-level predicate," "kind-specific predicate" and "kind predicate" do not appear in Westlaw's TP-ALL database.

indefinite article "a" or "an") have been regarded as incompatible with kind-level predicates.[114] For example, it is valid to say "Bell invented *the telephone*" or "*Honeybees* are dying out" but unacceptable to say "*A lion* will become extinct soon."[115] Bart Geurts and Veneeta Dayal have pointed out, however, that an indefinite singular noun phrase is acceptable "provided it names a novel kind."[116] For example, the sentence "This morning Fred invented a pumpkin-crusher" is a valid sentence in which the noun phrase "a pumpkin-crusher" denotes a novel kind.[117] As Olav Mueller-Reichau explains,

> Dayal's point of departure was the widespread assumption that the use of an indefinite article is connected to a certain pragmatic novelty condition. This condition brings it about that any individual designated by an indefinite noun phrase must be understood as being newly introduced into the discourse. What is (more or less) common wisdom as far as interpretations at the object-level are concerned, is supposed to be true also at the kind-level: indefinite NPs are used to introduce kinds when they have the status of novel discourse referents.[118]

Read as a whole, the grammar of a patent claim is consistent with that of one or more novel kinds serving as object arguments for the predicate "invented." While boilerplate such as "I claim," "We claim," "The invention claimed is," or "What is claimed is," is more common,[119] implicit in the language preceding every set of patent claims is the assertion that the applicant invented the subject matter of the claims.[120] Thus, for example, in the following claim:

> 8. A golf ball having a cover and a core wherein the cover comprises a thermoset cationic polyurethane ionomer.[121]

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[114] *See* Krifka, *supra* note 98, at 10.

[115] *See id.*

[116] *See* Veneeta Dayal, *Number Marking and (In)Definiteness in Kind Terms*, 27 LINGUISTICS & PHILOSOPHY 393, 396 (2004) (citing Bart Geurts, *Genericity, Anaphora and Scope*, Paper presented at the Workshop on Genericity, University of Cologne (2001)).

[117] *See id.*

[118] *See* OLAV MUELLER-REICHAU, SORTING THE WORLD: ON THE RELEVANCE OF THE TYPE/TOKEN-DISTINCTION TO REFERENTIAL SEMANTICS 66 (2011) <http://semanticsarchive.net/Archive/zg0ODVjY/typetoken.pdf> (visited Feb. 15, 2011) (citation omitted).

[119] *See* FABER ON MECHANICS OF PATENT CLAIM DRAFTING § 2:2, at 2-2 (2009) (citing M.P.E.P. § 608.01(m)).

[120] *See* 35 U.S.C. § 102(f) (providing that "[a] person shall be entitled to a patent unless … he did not himself invent the subject matter sought to be patented").

[121] U.S. Patent No. 5,692,974, cl. 8 (issued Dec. 2, 1997).

"a golf ball," "a cover," "a core," and "a thermoset cationic polyurethane ionomer" are all indefinite singular noun phrases. The sentence that begins with "We invented" and concludes with the text of claim 8 is a valid sentence in which "invented" is a kind-level predicate and each indefinite noun phrase introduces a novel kind into the discourse of the claim.

More generally, the prohibition on "inferential claiming,"[122] a technical rule of claim drafting, strictly regulates the use of definite and indefinite articles preceding claim elements. Patent attorneys are instructed:

> It is important that a new item mentioned for the first time in the claim not be first mentioned as an element operated upon or cooperated with by a previous element described in the same clause….
>
> A new element or step is introduced with an indefinite article "a" or "an." (Some plural items have no introductory article "a" and are introduced by the plural noun itself. But, from the context, the silent introductory indefinite article can be inferred.) On the other hand, when a previously identified element or step is repeated, it is introduced by a definite article "the" or "said."[123]

In linguistic terms, each indefinite noun phrase in the body of the claim introduces a novel kind — i.e., a new element or step[124] — into the discourse of the claims. (As for the preamble of the claim, each indefinite noun phrase appearing therein introduces the claim as a whole, which itself refers to a novel kind, provided that the claim is valid.[125]) It therefore follows that claim drafting conforms with the linguistic practice of using indefinite noun phrases "to introduce kinds when they have the status of novel discourse referents";[126] i.e., when there is no antecedent basis in the claims that serves as a referent for the newly mentioned element or step. Simply put, claims are written as novel kinds are written.

As we have seen, recent scholarship in metaphysical and linguistic ontology provides strong analytical support for the characterization of patent claims as kinds, rather than sets, of embodiments. This may have

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[122] *See* Faber, *supra* note 119, at § 10:7.4, at 10-43.

[123] *Id.*

[124] Steps in process claims typically take the form of gerunds, *see, e.g.*, Lock See Yu-Jahnes, *An Introduction to Claim Drafting*, 906 PLI/Pat 143, 151 (2007), which have the external characteristics of a noun phrase and therefore can represent kinds. *See* Richard Hudson, *Gerunds Without Phrase Structure*, 21 NATURAL LANGUAGE & LINGUISTIC THEORY 579 (2003).

[125] *See* 35 U.S.C. § 102(a), (e), (f) & (g) (requiring the applicant to be the first inventor of the claimed invention).

[126] MULLER-REICHAU, *supra* note 118.

been a distinction without a difference in the previous patent literature,[127] but the significance of patent claims' kindhood is immediately evident when we undertake to examine the nature of the patent system's ontological commitments.[128]

2. Claim Language and Essential Sortals

Claims are kinds, but they are not *natural kinds*: their boundaries are fixed *a posteriori* by patent attorneys, not *a priori* by nature.[129] At least according to Aristotelian metaphysics, only natural kinds can be said to have essential properties;[130] i.e., properties that it is metaphysically necessary for a thing of the kind to have.[131] Evidently, however, the patent system's worldview is not Aristotle's worldview because, as I will now explain, claims are a kind of kind that has essential properties.[132] Specifically, the language of a claim facilitates picking out individuals of the claimed kind and specifies essential properties of those individuals. In metaphysical terms, the language of each claim corresponds to an *essential sortal*.

While the definition of a sortal varies,[133] a sortal is commonly understood to provide a criterion of identity for items of a kind.[134]

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[127] The search term "kind of embodiment" does not appear in Westlaw's TP-ALL database.

[128] *See infra* Section III.C.

[129] *See* ELLIS, *supra* note 80, at 19 ("[M]embership of a natural kind is decided by nature, not by us…. [T]he identity of a natural kind can never be dependent only on our interests, perceptual apparatus, languages, practices, or choices. For if the identity of a kind depended on any of these these things, then it might well be a kind of our own making, not one that exists in the world prior to our knowledge, perception, or description of it.").

[130] *See* Collins, *supra* note 33, at 525-26 (citing Michael R. Ayers, *Locke Versus Aristotle on Natural Kinds*, 78 J. PHIL. 247, 252 (1981)).

[131] *See* Teresa Robertson, *Essential vs. Accidental Properties*, *in* STANFORD ENCYLOPEDIA OF PHILOSOPHY, at § 1, http://plato.stanford.edu/entries/essential-accidental/ (characterizing essential properties modally in terms of metaphysical necessity and possibility).

[132] *Cf.* Collins, *supra* note 33, at 526-27 (suggesting that courts are influenced by "a different and more modern type of essentialism" that is "scientific, physical and structural").

[133] *See* Richard E. Grandy, *Sortals*, *in* STANFORD ENCYLOPEDIA OF PHILOSOPHY, http://plato.stanford.edu/entries/sortals/ (surveying characterizations of sortals).

[134] *See id.*; E.J. Lowe, *Individuation*, *in* A COMPANION TO METAPHYSICS 28 (Jaegwon Kim et al. eds. 2009) ("It is commonly said that the key distinction between sortal and adjectival terms is that while both possess criteria of *application*, only the former possess criteria of *identity*."); Penelope Mackie, *Sortal Concepts and Essential Properties*, 44 PHIL. Q. 311 (1994) ("Although [the notion of a sortal] has been employed in slightly different

Examples of terms that would widely be recognized as sortals include "person," "man," "brick," "tomato," "flamingo,"[135] "cat," "dog," "mountain," "star," and "table."[136] In contrast, as philosopher E.J. Lowe explains, "red thing" is not considered a sortal because whether or not one red thing is identical with another does not depend on a single condition applicable to all red things, but "depends at least in part on what sort or kind of red things they are — and then the relevant criterion of identity will be that supplied by the relevant sortal term, be it say, 'cat,' 'apple,' or 'star.'"[137] As philosopher Penelope Mackie explains more generally:

> [I]f '*C*' is not a sortal term, then the attempt to single something out as 'this *C*,' 'that *C*,' etc., will fail to determine what counts as the same individual as the one picked out, unless some sortal term is implicitly being invoked, in which case it is the sortal term, and not '*C*,' that is really doing the work.[138]

Mackie defines essential sortals as follows:

> A sortal concept *S* is an *essential sortal* if and only if the things that fall under *S* could not have existed without falling under *S*.[139]

Using terms to individuate things of an artificial kind is not necessarily straightforward. The term "clock" does not help to explain when a particular clock loses its original identity in the course of having all of its parts successively repaired and replaced.[140] The patent system, however, does not concern itself with the persistence of the identity of embodiments over time. In each of the contexts in which it is necessary for the patent system to identify individual products or processes to which claim terms apply— i.e., to determine whether a claim literally "reads on" a given product or process — there is a single temporal focus. In the interference context, the relevant time for the "reads on" inquiry is when a party

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ways, a common thread is provided by the idea that sortal concepts have a special role in *individuation*: they are concepts that provide *criteria of identity* or *principles of individuation* for the things that fall under them…").

[135] *See* Mackie, *supra* note 134, at 311-13.

[136] *See* Lowe, *supra* note 134, at 30.

[137] *See id.* at 28.

[138] *See* Mackie, *supra* note 134, at 313.

[139] *See id.*

[140] *See* David Wiggins, SAMENESS AND SUBSTANCE RENEWED 92 (2001) ("Nor is there one piece of clock — the spring, the regulator, the escapement, the face, the case ... which the concept clock could suggest that we should revere as the 'focus' or 'nucleus' of a clock, and which can help us past this difficulty.").

purports to have actually reduced the claimed invention to practice.[141] In an anticipation analysis, it is the effective date of the prior art reference that allegedly anticipates the claim.[142] And in a proceeding against literal infringement, it is the date of the challenged conduct involving the accused device.[143] In each of these contexts, the patent system's inquiry into the identity of an embodiment is confined to the properties the embodiment possesses at the relevant time, regardless of any prior or subsequent changes.

The boundless ability of humans to define and name parts of things can also complicate the use of sortals to count items of a kind. Consider an ancient puzzle posed by the Stoic philosopher Chrysippus:

> Dion, a whole-bodied man, has a proper part, Theon, which consists of all of Dion except Dion's left foot. This morning Dion's left foot was amputated. If Dion and Theon both survive there are two material objects coincident in space and time, and made of the same matter! Which has ceased to exist? Not Dion — a man can survive the loss of a foot. Not Theon, which has had no part chopped off.[144]

The apparent conclusion that such coincident material objects survive as numerically distinct entities is unacceptable to many philosophers.[145] To avoid this result, Michael Burke offers the following premises as an "essentialist solution" to Chrysippus's puzzle: (1) "the concept of a person is maximal, that is, that proper parts of persons are not themselves persons"; (2) "persons are essentially persons (and thus ... nonpersons are essentially nonpersons)"; (3) the separation from Theon of Dion's left foot was a change that would have made Theon a person if Theon survived.[146]

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[141] *See, e.g.*, Eaton v. Evans, 204 F.3d 1094, 1097 (Fed. Cir. 2000) ("In an interference proceeding, a party seeking to establish an actual reduction to practice must [have] ... constructed an embodiment or performed a process that met every element of the interference count ...").

[142] *See, e.g.*, Uniloc USA, Inc. v. Microsoft Corp., 632 F.3d 1292, 1322-23 (Fed. Cir. 2011) ("[T]he proper framework for challenging the validity of a patent is ... to show that every element of the patent claims reads on a single prior art reference.").

[143] *See, e.g.*, Jeneric/Pentron, Inc. v. Dillon Co., 205 F.3d 1377, 1382 (Fed. Cir. 2000) ("[A]n accused product literally infringes if every limitation recited in the claim appears in the accused product, i.e., the properly construed claim reads on the accused product exactly."); Mark A. Lemley, *The Changing Meaning of Patent Claim Terms*, 104 MICH. L. REV. 101, 108 (2005) ("Whether an accused device infringes is tested as of the time of the alleged infringement.").

[144] Jim Stone, *Why Sortal Essentialism Cannot Solve Chrysippus's Puzzle*, 62 ANALYSIS 216, 216 (2002).

[145] *See id*.

[146] *See* Michael Burke, *Dion and Theon: An Essentialist Solution to an Ancient Puzzle*,

According to these premises, Theon was essentially a nonperson (i.e., a proper part of Dion), and therefore could not have survived the separation from Dion's foot that would have changed him into a person.[147]

Burke's argument is debatable as a solution to Chrysippus's puzzle,[148] but it does provide a coherent account[149] that fits the patent system's treatment of a claim's embodiments. As a general matter, the patent system treats the concept of an embodiment as maximal. Given the claim "A thing comprising elements *A* and *B*," a thing *T* consisting solely of extensions of terms *A*, *B*, *C* and *D* counts as one embodiment (*A*+*B*+*C*+*D*), not four (*A*+*B*, *A*+*B*+*C*, *A*+*B*+*D*, *A*+*B*+*C*+*D*).[150] Only the whole thing *T* falls under the sortal *S* corresponding to the claim language (hereinafter "corresponding sortal"), which picks out embodiments and only embodiments of the claim.

Assuming for the moment that *S* is an essential sortal, it is straightforward to identify the essential properties of *T* within this account, namely *T*'s possession of extensions of terms *A* and *B* and the lack of another (i.e., larger) thing comprising extensions of terms *A* and *B*, of which *T* is a proper part. Note that this is just another way of saying that *T* is a complete thing that falls within the literal scope of the claim. Patent law's notion of essentiality for elements and limitations that determine the scope of a claim thus maps naturally onto the metaphysical notion of essentiality for properties of things falling under the corresponding sortal (i.e., embodiments of the claim). As I will explain in the next section, such essential properties may include causal powers and other dispositional properties.[151]

It only remains to note that the patent system is deeply committed to the view that every corresponding sortal is an essential sortal. The patent system does not entertain the ontological possibility of worlds in which an embodiment of a claimed invention exists, yet lacks an element of the

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90 J. PHIL. 129, 134 (1994).

[147] *See id.* at 135.

[148] *See* Stone, *supra* note 144, at 216; *but see* Marta Ujvari, *Cambridge Change and Sortal Essentialism*, 5 METAPHYSICA 25 (2004) (defending a reconstructed version of Burke's argument).

[149] *See id.* at 216-17 (explaining that his response to Burke "may discourage philosophers who hope to deploy essentialism against Chrysippus, but it will encourage those who believe in the viability of sortal essentialism or wish to better understand it").

[150] *See* FABER, *supra* note 119, § 2:5, at 2-13 (discussing interpretation of "comprising").

[151] [To discuss: Doctrine of equivalents/function-way-result test permits more precise/robust specification of causal powers/Lockean real essence of embodiments. Possible reforms? David Lange's suggestion.]

claim.[152] As far as the patent system is concerned, the embodiments of a claim could not have existed without falling under the sortal corresponding to the claim language. A worldview in which it is metaphysically possible for an embodiment of a claim to come into existence when, and only when, all elements of the claim are present, might seem strange to many philosophers,[153] but it follows concomitantly from the ontologically binary interpretation of the predicate "make"[154] that suffuses patent doctrine.[155]

B. The Ontological Status of Embodiments

Our conclusion that embodiments exemplify claims immediately implies that embodiments hold the ontological status of *particulars*; i.e., "something (not necessarily an object) that instantiates but is not itself instantiated."[156] But the patent system's ontology of "useful Arts" requires that embodiments be capable of more than instantiation. For an invention to have operative utility, an invention must be "capable of being used to effect the object proposed."[157] To have beneficial utility, it must be "capable of providing some identifiable benefit."[158] Thus, to be included among the

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[152] *See, e.g.*, Peeler v. Miller, 535 F.2d 647, 651 (C.C.P.A. 1976) ("[W]ithout an actual reduction to practice there is no invention in existence.") [but discuss *Pfaff*].

[153] *See generally* DAVID K. LEWIS, COUNTERFACTUALS (2001) (illustrating the wide range of metaphysical possibility).

[154] *See, e.g.*, Bayer AG v. Housey Pharmaceuticals, Inc., 340 F.3d 1367, 1372 nn. 5-6 (Fed. Cir. 2003) (citing Random House Webster's Unabridged Dictionary definitions of "make" as "to bring into existence..." and "cause to exist or happen").

[155] *See, e.g.*, 35 U.S.C. §§ 112, 116, 154, 271 [to discuss].

Some tentative scholarship by the late philosopher Jack Kaminsky appears to suggest that an ontologically binary reading of "make" is further supported by synthetic technological statements of the sort that comprise the substance of patent specifications. *See* JACK KAMINSKY, LANGUAGE AND ONTOLOGY 233-35 (1969) (arguing that "For every *x*, if *x* is a properly constructed relay being operated under specified conditions, then *x* produces an output at *o*" is a statement that "*prescribes* the existence of an object with a specified property") (emphasis in original); Jack Kaminsky & Raymond J. Nelson, *Scientific Statements and Statements About Humanly Created Objects*, 55 J. PHIL. 641 (1958) [to discuss further].

[156] E.J. Lowe, *The Metaphysics of Abstract Objects*, 92 J. PHIL. 509, 518 (1995); *see also* Nari Lee, *Patent Eligible Subject Matter Reconfiguration and the Emergence of Proprietarian Norms: The Patent Eligibility of Business Methods*, 45 IDEA 321, 325 (2005) ("What patent law gives is property-like protection on the instantiation of ideas."); Jerome T. Tao, Comment, *Theories of Computer Program Patentability*, 7 SANTA CLARA COMPUTER & HIGH TECH. L.J. 291, 300 (1991) (restating Pamela Samuelson's view that "'[i]nstantiation' is defined as the embodiment of the inventive concept.").

[157] Stiftung v. Renishaw PLC, 945 F.2d 1173, 1180 (Fed. Cir. 1991) (citation omitted).

[158] Juicy Whip, Inc. v. Orange Bang, Inc. 185 F.3d 1364, 1366 (Fed. Cir. 1999) ("An invention is "useful" under section 101 if it is capable of providing some identifiable

"useful Arts," an invention must have the capability, or power, to cause "a beneficial result or effect" when it is used.[159] Since to use a claimed invention is just to use one of its embodiments,[160] the utility of a claimed invention is grounded in the causal powers of the claim's embodiments. Our characterization of the ontological status of embodiments therefore focuses on the patent system's metaphysical commitments regarding the nature and role of their causal powers.

1. The Causal Powers of Embodiments

The term *causal power* is not in the vocabulary of patent law,[161] but the concept is familiar to patent doctrine. As I will use the term, a causal power is simply a disposition to engage in a process that relates a cause and an effect.[162] That a claim's embodiments have causal powers follows from the patent system's attribution of "a beneficial result or effect" to the use of an embodiment of the claimed invention; i.e., as a "practicable method or means of producing" the beneficial effect.[163]

As a preliminary matter, it is necessary to note that the causal powers of a claim's embodiments may vary, at least to the extent that the use of certain embodiments, under some or all conditions, might not achieve the intended purpose of the claimed invention.[164] The presence of such inoperative embodiments within the claim scope need not negate enablement, however, as long as their number does not "in effect force[]

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benefit.").

[159] *See* Diamond v. Diehr, 450 U.S. 175, 183 n.7 (1981) (citing Corning v. Burden, 56 U.S. 252, 268 (1854) ("It is for the discovery or invention of some practical method or means of producing a beneficial result or effect, that a patent is granted…"); Stifting, 945 F.2d at 1180 (noting the constitutional dimension of the utility requirement).

[160] *See, e.g.*, Zenith Electronics Corp. v. PDI Communications Systems, Inc., 522 F.3d 1348 (Fed. Cir. 2008) (citation omitted) (explaining that § 102(b) public use bar turns on "whether the public use related to a device that embodied the invention"); Timothy R. Holbrook, *Liability for the "Threat of a Sale": Assessing Patent Infringement for Offering to Sell an Invention and Implications for the On-Sale Patentability Bar and Other Forms of Infringement*, 43 SANTA CLARA L. REV. 751, 813-14 (2003) (reasoning that under a plain meaning interpretation of § 271(a), an infringing use requires "a physical embodiment of the patented invention").

[161] A search on Westlaw's Federal Circuit decision (CTAF) database finds no occurrences of the phrase "causal power."

[162] *See* BRIAN ELLIS, THE PHILOSOPHY OF NATURE 48 (2002).

[163] *See* Diamond v. Diehr, 450 U.S. at 183; *cf.* 1 CHISUM ON PATENTS § 1.03[2], at 117 (2009) ("In its primary significance, the exclusion of principles and abstract ideas merely emphasizes the fundamental concept that patents are issued only for new *means* to achieve useful results.").

[164] *See* In re Dinh-Nguyen, 492 F.2d 856, 858-59 (C.C.P.A. 1974) ("It is not a function of the claims to specifically exclude … possible inoperative substances….").

one of ordinary skill in the art to experiment unduly in order to practice the claimed invention."[165]

An enabling patent disclosure explains how to employ the causal powers of embodiments by "teach[ing] those skilled in the art how to make and use the full scope of the claimed invention without undue experimentation."[166] Given that every claim has infinitely many embodiments,[167] it is neither necessary nor possible for the disclosure to provide a specific teaching for every embodiment within the scope of the claim.[168] Patent applicants therefore employ generic disclosures to teach those skilled in the art how to employ the causal powers of a claim's embodiments, and such disclosures are considered sufficient as long as undue experimentation is not required to achieve operability.[169] Each embodiment within the scope of a generic disclosure possesses certain causal powers that are employed in using the claim's embodiments as taught by the disclosure (even though sometimes those causal powers may prove insufficient for operability in actual use). Such causal powers may be said to be *essential* to the embodiment, because the embodiment necessarily possesses them in virtue of being an example of the kind defined by the claim.[170]

Even without an explicit description of the cause and effect in question, a disclosure may be found sufficient to teach one (or more) of the causal

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[165] Atlas Powder Co. v. E.I. du Pont De Nemours & Co., 750 F.2d 1569, 1576-77 (Fed. Cir. 1984).

[166] Martek Biosciences Corp. v. Nutrinova, Inc., 579 F.3d 1363, 1378 (Fed. Cir. 2009) (citing In re Wright, 999 F.2d 1557, 1561 (Fed. Cir. 1993)).

[167] *See* Tun-Jen Chiang, *The Rules and Standards of Patentable Subject Matter*, 2010 WIS. L. REV. 1353, 1391 (2010); Lefstin, *supra* note 39, at 1168-74;

[168] There is no requirement that an enabling patent disclosure provide information pertaining to the enablement of specific embodiments (i.e., "working examples"). *See* In re Long, 368 F.2d 892, 895 (C.C.P.A. 1966) ("If by 'specific embodiment' is meant a working example, then the same is not required where sufficient working procedure has been set forth showing that one skilled in the art may prepare the claimed article without undue experimentation.").

[169] As the Federal Circuit has explained, despite the lack of specific enabling information regarding "every possible variant of the claimed invention, … the artisan's knowledge of the prior art and routine experimentation can often fill gaps, interpolate between embodiments, and perhaps even extrapolate beyond the disclosed embodiments, depending upon the predictability of the art." AK Steel Corp. v. Sollac and Ugine, 344 F.3d 1234, 1244 (Fed. Cir. 2003); *see also* In re Wands, 858 F.2d 731, 737 (Fed. Cir. 1988) (listing factors, including predictability of the art, to be considered in determining whether a disclosure would require undue experimentation).

[170] See Ellis, *supra* note 162, at 12 (defining "the kind essence of a thing" as "the set of its properties in virtue of which it is a thing of the kind it is" and subsequently using the term "essential properties" to refer to "kind essences").

powers employed in practicing an invention, through a theory of inherent disclosure.[171] To show inherency, the effect in question "must inevitably happen."[172] For this purpose, it is sufficient for the disclosure that the effect in question is "the natural result flowing from the operation as taught."[173] Causal powers of embodiments that manifest natural dispositions therefore exist necessarily, insofar as entities possessing such dispositions are involved in "the operation as taught" and the effects of such causal powers "must inevitably happen." Thus the causal laws of nature are necessary in the metaphysical sense: to say an effect is a natural result necessarily entails that it is also an inevitable result.[174]

2. Scientific Essentialism

The patent system's recognition of essential causal powers in embodiments and the necessity of laws of nature contrasts with the "regularity account" attributed to David Hume, which informs most modern theories of causation.[175] This so-called Humean[176] worldview holds that

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[171] *See* Pingree v. Hull, 518 F.2d 624, 627-28 (C.C.P.A. 1975) (applying inherency doctrine in interference context to find enablement by junior party). The inherency doctrine is more commonly applied in the context of finding teachings in prior art references. *See, e.g.*, Continental Can Co. v. Monsanto Co., 948 F.2d 1264, 1268 (Fed. Cir. 1991).

[172] *See* 518 F.2d at 627.

[173] *See id.* at 628 (citing Hansgirg v. Kemmer, 102 F.2d 212 (C.C.P.A. 1939)).

[174] *Accord* Newman v. Quigg, 877 F.2d 1575, 1580 (Fed. Cir. 1989) ("This court … believes that the laws of thermodynamics do not brook contradiction."); *cf.* BRIAN ELLIS, *supra* note 162, at 59 ("Essentialists believe that … the laws of nature are metaphysically necessary, because anything that belongs to a natural kind is logically required (or is necessarily disposed) to behave as its essential properties dictate.").

The metaphysical necessity of the natural dispositions of naturally occurring substances is also implicit in the "purification" doctrine relating to the exclusion of products of nature from patentable subject matter. An artificially purified form of a naturally occurring substance will not be found patentable unless it differs "in kind" (and not merely "in degree") from the impure form found in nature, *see* Parke-Davis & Co. v. H.K. Mulford & Co., 189 F. 95, 103 (S.D.N.Y. 1911), *aff'd*, 196 F. 496 (2d Cir. 1912) (Learned Hand, J.), and such a difference in kind "will normally be found only if the new pure compound has an entirely new utility from the old one," 1 CHISUM ON PATENTS § 1.02[9] (2010). Thus, where purification alters the essential causal powers of a natural substance (at least to the extent that it can be used to produce a beneficial result or effect not manifested in nature), patent doctrine recognizes the existence of a new, non-natural kind, of which the new pure substance is an example and the old impure substance is not.

[175] *See* DANIEL M. HAUSMAN, CAUSAL ASYMMETRIES 36 (1998) ("Hume's theory is the starting point for most modern treatments of causation, and the problems his theory must surmount are problems for all theories of causation.").

[176] *Compare* Alexander Rosenberg, *Hume and the Philosophy of Science*, *in* THE CAMBRIDGE COMPANION TO HUME 64, 73-78 (David Fate Norton ed. 1993) (describing

objects have no essential dispositional properties, the behavior of objects are completely determined by the laws of nature, laws of nature are contingent on regularities in the ways objects behave, and causal relationships are nothing more than connections between logically independent events.[177] Philosopher Brian David Ellis describes the Humean worldview as "still-dominant," and refers to it as "passivism," in that it is "[t]he view that things in nature are essentially passive, and obedient to nature's laws."[178] According to Ellis,

> To be a passivist, one must believe that inanimate things are capable of acting only as directed — depending, for example, on how they are pushed or pulled around by God, or by the forces of nature (or, in Hume's case, by what the laws of nature happen to be). A passivist therefore believes that the tendencies of things to behave as they do can never be inherent in the things themselves. They must always be imposed on them from the outside. The forces of nature, for example, are always seen as being external to the objects on which they act. They act on them, or between them, but the things themselves are never the source of any activity.[179]

Since passivism attributes the behavior of embodiments entirely to the laws of nature, a passivist views every invention as nothing more than the manifestation of a newly discovered aspect of a law of nature. This perspective is deeply incompatible with longstanding patentable subject matter doctrine, which holds that "[p]henomena of nature, though just discovered … are not patentable, as they are the basic tools of scientific and technological work"[180] and regards "manifestations of laws of nature" as "free to all men and reserved exclusively to none."[181] While patentable inventions may arise "from the application of [a] law of nature to a new and useful end,"[182] the notion of an embodiment capable of applying a law of nature to a new and useful end is foreign to passivism. Equally foreign is

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Hume's views that "notions of efficacy or causal power or causal necessity in the objects are without the requisite pedigree in experience to be meaningful" and that "laws are the instantiation of contingent regularities whose evidential strength … sustains an attribution of some sort of necessity to the connections they report") with TOM L. BEAUCHAMP & ALEXANDER ROSENBERG, HUME AND THE PROBLEM OF CAUSATION 32-37 (1981) (arguing that Hume himself did not hold these views).

[177] *See* ELLIS, *supra* note 162, at 59-60.

[178] *See id.* at 2.

[179] *Id.* at 2-3.

[180] *See* Gottschalk v. Benson, 409 U.S. 63, 67 (1972).

[181] *See* Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 130 (1948).

[182] *See* Diamond v. Diehr, 450 U.S. 175, 188 n.11 (1981).

the idea that the use of an embodiment of a patentable invention represents "a practical method or means of producing a beneficial result or effect."[183] If the previous section's account of the causal powers of embodiments is more or less accurate, then there is no place for passivism in the patent system.

The patent system's worldview also differs from that of classical (Aristotelian) essentialism, in which everything that exists by nature has an essential *telos*, or purpose; i.e., "that for the sake of which a thing … exists."[184] Patent doctrine contemplates the existence of objects without essential purposes; it does not "conceive of the world as a grand teleological system in which the parts exist for the sake of a whole."[185] In granting patents for the "new use of a known … machine, manufacture, composition of matter, or material,"[186] the patent system acknowledges that the causal powers of objects may be made to serve a new purpose. In so doing, the patent system generally declines to treat the new purpose as an essential property that can, by itself, distinguish the claimed invention over the prior art;[187] the claimed method of using the old object must also recite a new manipulative step.[188]

A patent claim may state "a purpose or intended use" for the invention in its preamble, but such a stated purpose has no independent status as an essential property of an embodiment of the claim.[189] Preambular language is considered "essential" (and therefore held to affect claim scope) only to the extent that it may be found to state "essential structure or steps" of the

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[183] *See id.* at 183 n.7 (citing Corning v. Burden, 56 U.S. 252, 268 (1854)

[184] *See* ELLIS, *supra* note 162, at 11-12 (citation omitted).

[185] *See id.* at 13.

[186] *See* 35 U.S.C. § 100(b),

[187] *See* David A. Kelly, *What Constitutes a "New Use" of a Known Composition and Should a Patentee's Purported Objective Make Any Difference?*, 21 SANTA CLARA COMPUTER & HIGH TECH. L.J. 319, 322-32 (2005) (discussing cases supporting the principle that "when the claim recites using an old composition and the 'use' is directed to a result or property of that composition, then the claim is inherently anticipated").

[188] *See id.* at 336 & n. 77 (citing Integra Life Sciences I, Ltd. V. Merck KgaA, 50 U.S.P.Q.2d 1846, 1850-51 (S.D. Cal. 1999), *aff'd in relevant part*, 331 F.3d 860 (Fed. Cir. 2003), *vacated on other grounds*, 545 U.S. 193 (2005)); *but see* Jansen v. Rexall Sundown, Inc., 342 F.3d 1329, 1333 (Fed. Cir. 2003) (construing a preambular "statement of the intentional purpose for which the method must be performed" as a claim limitation).

[189] *See* Rowe v. Dror, 112 F.3d 473, 478 (Fed. Cir. 1997) ("[W]here a patentee defines a structurally complete invention in the claim body and uses the preamble only to state a purpose or intended use for the invention, the preamble is not a claim limitation."); *see also* Catalina Marketing Int'l, Inc. v. Coolsavings.com, Inc., 289 F.3d 801, 809 (Fed. Cir. 2002) ("[T]he patentability of apparatus or composition claims depends on the claimed structure, not on the use or purpose of that structure.").

claimed invention or to give "life, meaning, and vitality" to a claim that would otherwise fail meaningfully to define essential structure or steps.[190] Accordingly, infringement doctrine does not treat a preambular purpose as an essential property of a patent claim, because "[i]ntent is not an element of infringement."[191]

By recognizing causal powers but not purposes as essential properties of embodiments, the patent system appears to be committed to a third metaphysical worldview, known as *scientific essentialism.* In the words of Ellis, who jointly coined the term,[192] scientific essentialism holds that "there are genuine causal powers, capacities, and propensities that … exist in nature as universals, and are therefore the same in all possible worlds."[193] For example, gravitational mass and charge are properties of an object that determine its causal role in generating gravitational and electromagnetic fields, respectively, and hence the effects it has on other objects present in these fields.[194]

Scientific essentialism holds that there are *natural kinds*;[195] i.e., kinds that are "independent of human interests, language and epistemic considerations, and thereby reflect true divisions of the world."[196] Paradigmatic examples of natural kinds include *water, electron,* and *planet,*

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[190] *See, e.g.*, Vizio, Inc. v. International Trade Com'n, 605 F.3d 1330, 1340-41 (Fed. Cir. 2010) (citation omitted) (finding that claims "would have little meaning without the intended objective" recited in the preamble and that preambular language "does not 'only add[] an intended use,' but rather, states an essential limitation to the claims"); Griffin v. Bertina, 285 F.3d 1029, 1033 (Fed. Cir. 2002) (finding that "diagnosis is … the essence of this invention" because "its appearance in the count gives 'life and meaning' to the manipulative steps"); *see also* Catalina, 289 F.3d at 808 ("[C]lear reliance on the preamble during prosecution to distinguish the claimed invention from the prior art transforms the preamble into a claim limitation because such reliance indicates use of the preamble to define, in part, the claimed invention.").

[191] Hilton Davis Chemical Co. v. Warner-Jenkinson Co., 62 F.3d 1512, 1519 (Fed. Cir. 1995), *rev'd on other grounds*, 520 U.S. 17 (1997); *see also* Florida Prepaid Postsecondary Education Expense Board v. College Savings Bank, 527 U.S. 627, 645 (1999) ("Actions predicated on direct patent infringement, however, do not require any showing of intent to infringe; instead, knowledge and intent are considered only with respect to damages."); Warner-Jenkinson v. Hilton-Davis Chem. Co., 520 U.S. 17, 35 (1997) ("Application of the doctrine of equivalents, therefore, is akin to determining literal infringement, and neither requires proof of intent."); *see also* Kelly, *supra* note 187, at 333-34 (discussing cases).

[192] *See* ELLIS, *supra* note 80, at 57 n.16.

[193] *Id.* at 48.

[194] *See id.* at 6.

[195] *See id.* at 19 (explaining that "[n]atural kinds clearly have a central place" in the ontology underlying scientific essentialism).

[196] RICHARD A. RICHARDS, THE SPECIES PROBLEM: A PHILOSOPHICAL ANALYSIS 149 (2010).

because these kinds "are out there in the natural world, not just in our way of thinking about the world."[197] Scientific essentialism holds that scientific explanations are based at least in part on "postulates concerning the essential natures of the fundamental natural kinds of objects and processes occurring in the world."[198] On this view, the task of science "is to discover what makes a thing the kind of thing it is and hence to explain why it behaves or has the properties it has."[199] For example, science has discovered that an electron "has a certain mass and a certain charge essentially," and must therefore "generate [certain gravitational and electromagnetic] fields in any world in which it might exist, and have precisely the same effects on things of just the same kinds."[200] Because a disposition to generate these fields is essential to the electron, "[i]f a particle lacked this causal power, essentialists say, then, whatever else it might be, it would not be an electron."[201]

Consistent with the patent system's worldview,[202] scientific essentialism holds that "[t]he laws of nature are not contingent, but metaphysically necessary."[203] This is because laws of nature are simply "descriptions of natural kinds of processes arising from the intrinsic properties of things belonging to natural kinds."[204] Thus, "[i]f the laws of nature were different, the things existing in the world would have to be different,"[205] because, *inter alia*, their causal powers, capacities and propensities would be different.[206] Electrons would not exist, because nothing would have an electron's essential causal powers.[207]

This is not to say that causal powers cannot vary among different things of the same kind. While the causal powers and other dispositional properties of "the "most elementary things" of a natural kind are "fixed by their essential natures," scientific essentialism contemplates variability in the causal powers of "more complicated things."[208] "One cannot … teach a copper atom or a proton any new tricks,"[209] but the causal powers of a more

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[197] *Id.* at 150.
[198] *See* ELLIS, *supra* note 80, at 57 n.16.
[199] Id. at 55.
[200] *Id.* at 6.
[201] ELLIS, *supra* note 162, at 13.
[202] *See supra* text accompanying note 174.
[203] *See* ELLIS, *supra* note 80, at 7.
[204] *Id.*
[205] *Id.*
[206] *See supra* text accompanying note 193.
[207] See supra text accompanying notes 200-201.
[208] *See* ELLIS, *supra* note 162, at 142.
[209] *See* ELLIS, *supra* note 80, at 21.

complex object may change because of its history or circumstances. For example, an iron object may become fatigued, and therefore brittle, or magnetized, and therefore capable of attracting other pieces of iron.[210] Furthermore, even when an object (such as a mousetrap spring) actually possesses a given causal power, the history or circumstances surrounding the object's use may affect whether the causal power is manifested as an intended effect, as Ellis describes:

> If the mousetrap is not set off by the taking of the cheese, then presumably the disturbance was not enough to release the causal power latent in the spring. Unless there are extraordinary defeating circumstances, there can be no question of the catch being released and the mousetrap not snapping shut.[211]

Scientific essentialism can therefore account for the potentially wide variations among the causal powers of embodiments of a given patent claim and the manifestations of those causal powers as effects.[212] Patent claims are non-natural kinds of relatively complex objects and processes, and the making of an embodiment may entail introducing changes to the causal powers of many constituent elements.[213] Thus the causal powers of different embodiments of the same claim may vary, depending on the ways the causal powers of natural kinds are brought into play and the circumstances in which each embodiment is made. Because of this variation in causal powers, some embodiments of a claimed invention may even be inoperable within the range of circumstances of the invention's intended use. Some mousetraps may fail to snap shut when they should — but it is always possible to build a better one.[214]

While the causal powers of embodiments may vary widely due to complexity and circumstances, scientific essentialism does imply that all embodiments (and other objects and processes of non-natural kinds) are ontologically grounded in the fundamental properties that exist in our world, in the following sense:

> All objects and processes that do not belong to natural kinds

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[210] *See* ELLIS, *supra* note 162, at 142.

[211] *See id.*

[212] *See supra* text accompanying note 164.

[213] *See, e.g.*, Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd., 535 U.S. 722, 728-29 (2002) (describing claim limitation requiring that "the outer shell of the device, the sleeve, be made of a magnetizable material" and noting that the commercial embodiment of the claim uses a "magnetized alloy").

[214] *But see* Graham v. John Deere Co., 383 U.S. 1, 19 (1966) (noting that due to advances in the field, "[h]e who seeks to build a better mousetrap today has a long path to tread before reaching the Patent Office.").

> depend ontologically on objects and processes that do, since those very same objects and processes could not exist, or occur, in any world in which any of the natural kinds of things of which it is constituted did not exist. Therefore the kinds of objects and processes that actually exist or occur could not exist or occur in any possible world except one with the same fundamental property universals and the same spatio-temporal-energy structural possibilities as ours.[215]

According to scientific essentialism, the fundamental dispositional properties of things in our world and spatio-temporal structure of our world are manifested in "instances of the most fundamental natural kinds of processes."[216] By leaving to science the task of identifying and explaining the natural kinds of processes that actually exist,[217] scientific essentialism entails an epistemological commitment to *scientific realism*,[218] as I will now discuss.

3. Scientific Realism and Unobserved Embodiments

Scientific realism is "the view that our best scientific theories give approximately true descriptions of both observable and unobservable aspects of a mind-independent world"[219] or, in other words, "the doctrine that scientific theories are to be taken seriously, in particular with respect to ontological commitment."[220] As an epistemological thesis, scientific realism holds that "[t]he things our best scientific theories tell us about entities and processes are decent descriptions of the way the world really is."[221]

Scientific essentialism's epistemological commitment to scientific realism justifies its taking the causal powers of the electron to be real essences of a natural kind.[222] Implicit in scientific essentialism's view that "[u]nit charge, unit mass, and spin 1/2 are essential properties of electrons,

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[215] *See* ELLIS, *supra* note 80, at 252.

[216] *See id.* at 217-18.

[217] *See supra* text accompanying note 199.

[218] *See* ELLIS, *supra* note 80, at 145-46 (explaining that scientific essentialism entails a form of scientific realism that may appropriately be called "essentialist realism").

[219] ANJAN CHAKRAVARTTY, A METAPHYSICS FOR SCIENTIFIC REALISM: KNOWING THE UNOBSERVABLE 212 (2007).

[220] Richard Creath, *Taking Theories Seriously*, 62 SYNTHESE 317, 317 (1985).

[221] CHAKRAVARTTY, *supra* note 219, at 9; *see also* THE PHILOSOPHY OF SCIENCE: AN ENCYLOPEDIA 686 (Sahotra Sarkar & Jessica Pfeifer ed. 2006) ("[Scientific r]ealism takes the explanatory and predictive success of theories to warrant an ontological commitment to the existence of the entities they posit.").

[222] *See* ELLIS, *supra* note 80, at 54-55.

and electrons are by their very nature bound to act and interact as these properties determine,"[223] is scientific realism's view that electrons exist. While no one has ever directly observed an electron,[224] scientific realists reason that "[i]f the world behaves as if things like atoms and electrons exist, then the best explanation of this fact is that they really do exist."[225] This appeal to scientific theory[226] is often described as the "argument from the best explanation"[227] or "inference to the best explanation."[228] According to Ellis, the argument from the best explanation is the "main argument" for scientific realism.[229]

Patent doctrine evidences a strong commitment to scientific realism. As long as an assertion of a claimed invention's utility is not "incredible in light of the knowledge of the art, or factually misleading," the Patent Office and the courts do not need to observe an embodiment to satisfy themselves that embodiments of the claim can exist and be capable of causing the asserted beneficial effect.[230] Accordingly, the Patent Office advises

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[223] *See id.* at 48-49; *see also supra* text accompanying note 201.

[224] *See generally* THEODORE ARABATZIS, REPRESENTING ELECTRONS: A BIOGRAPHICAL APPROACH TO THEORETICAL ENTITIES (2006) (providing a history of theoretical representations of the electron as an unobservable entity).

[225] *See* ELLIS, *supra* note 80, at 146.

[226] *See supra* text accompanying note 221; Creath, *supra* note 220, at 317 ("If the theories we adopt say that there are protons or pi-mesons, then we are ontologically committed to things of these sorts every bit as much as we are ontologically committed to peanuts and pachyderms by our views at the observational level.").

[227] *See* ELLIS, THE METAPHYSICS OF SCIENTIFIC REALISM 24 (2009).

[228] *See Peter Lipton*, INFERENCE TO THE BEST EXPLANATION 1 (1991) (describing inference to the best explanation as the practice whereby "[b]eginning with the evidence available to us, we infer what would, if true, provide the best explanation of that evidence").

[229] *See* ELLIS, *supra* note 227, at 24, 30.

[230] *See* In re Isaacs, 347 F.2d 887, 890 (C.C.P.A. 1965) (citing In re Citron, 325 F.2d 248, 253 (C.C.P.A. 1963)).

Realism about unobserved embodiments has not been a permanent fixture in the patent system, which required applicants to furnish working models of their inventions, where possible, between 1836 and 1880. *See* Kendall J. Dood, *Patent Models and the Patent Law: 1790-1880 (Part I)*, 65 J. PAT. OFF. SOC'Y 187, 187 (1983). A few years before dispensing with the requirement, Patent Office Commissioner Ellis Spear noted:

> It will be necessary only that provision be made for requiring models in cases where the *capability of the machine to operate is called into question*, or where the Examiner is in doubt as to the sufficiency of the drawings, or where models may be necessary for ready illustration on appeal, or interference cases.

See Kendall J. Dood, *Patent Models and the Patent Law: 1790-1880 (Part II)*, 65 J. PAT. OFF. SOC'Y 234, 271 (1983) (emphasis added).

Many issued patent claims expressly recite theoretical entities that would be

examiners:

> With the exception of cases involving perpetual motion, a model is not ordinarily required by the Office to demonstrate the operability of a device. If operability of a device is questioned, the applicant must establish it to the satisfaction of the examiner, but he or she may choose his or her own way of so doing.[231]

In advising the public, however, the Patent Office reserves its right to require a working model:

> A working model, or other physical exhibit, may be required by the Office if deemed necessary. This is not done very often. A working model may be requested in the case of applications for patent for alleged perpetual motion devices.[232]

Consistent with scientific realism's epistemological grounding in "the best explanation" informed by "our best scientific theories," the patent system may require proof of utility where there are "factual reasons which would lead one skilled in the art to question the objective truth of the statement of operability."[233] For example, the "highly unusual nature" of an invention[234] or "considerable doubt" within the scientific community[235] may justify a requirement that the applicant provide proof of utility. Except in the case of alleged perpetual motion machines,[236] such proof does not necessarily require the demonstration of a working model[237] or a correct account of the invention's theory of operation,[238] but must convince one

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unobservable even in a completed embodiment. For example, a search of the Patent Office's PatFT database shows that the word "electron" appears in the claims of 49,181 patents. <http://patft.uspto.gov/netahtml/PTO/search-bool.html> (visited March 9, 2011).

[231] U.S. PATENT & TRADEMARK OFFICE, MANUAL OF PATENT EXAMINING PROCEDURE § 608.03 (July 2010) [hereinafter "MPEP"].

[232] U.S. Patent & Trademark Office, *General Information Concerning Patents* <http://www.uspto.gov/web/offices/pac/doc/general/> (January 2005).

[233] In re Gaubert, 524 F.2d 1222, 1224 (C.C.P.A. 1975).

[234] *See* In re Houghton, 433 F.2d 820 (C.C.P.A. 1970).

[235] *See* In re Dash, 118 Fed. Appx. 488 (Fed. Cir. 2004), *cert. denied*, 126 S. Ct. 346 (2005) (unpublished opinion); *cf.* In re Marzocchi, 439 F.2d 220, 223 (C.C.P.A. 1971) (dicta) (stating that unpredictability of chemical reactions may create reasonable doubt as to enablement where a broad representation "is, on its face, contrary to generally accepted scientific principles.").

[236] *See supra* text accompanying notes 231-232.

[237] *See supra* note 231 and accompanying text; *see also* In re Houghton, 433 F.2d at 821 (noting that Patent Office did not require working model as proof of utility).

[238] *See* Newman v. Quigg, 77 F.2d 1575, 1581-82 (Fed. Cir. 1989).

skilled in the art of the asserted utility.[239] If an applicant does rely on scientific theories to show operability, the theories must be part of the "knowledge of the art,"[240] and one of skill in the art must be able to recognize that the theories are applicable to the claimed invention.[241]

My description of the patent system's ontology thus far has characterized the ontological status of claims and their embodiments under settled patent doctrine. Claims are non-natural kinds with corresponding essential sortals; embodiments are particulars that have essential causal powers in virtue of being examples of those kinds and falling under those sortals. Operative embodiments have utility in virtue of their essential causal powers. Other embodiments of the same claim also have these essential causal powers, but may be inoperative due to wide variations in causal powers and in the history or circumstances of reduction to practice and use. When a claim is filed, typically none of the embodiments described by the claim is observable to the patent system. Nevertheless, the patent system is committed to scientific essentialism and scientific realism, and therefore accepts that operative embodiments of a claim can exist, without knowledge or observation of the actual existence of any such entities, based on an argument from the best explanation. In the next section, I will present and defend an account of how the patent system incurs and warrants ontological commitments to claims and their embodiments as entities whose status I have just described.

C. Ontological Commitments to Claims and Embodiments

As a statement of facts about the potential and actual existence of embodiments and kinds of embodiments, the specification of a filed patent application plays a central role in the patent system's ontological

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[239] *See* In re Brana, 51 F.3d 1560, 1566 (Fed. Cir. 1995).

[240] *See supra* text accompanying note 230; *see also* BlackLight Power, Inc. v. Rogan, 295 F.3d 1269, 1271 (holding that Patent Office's withdrawal of patent from issuance was not unreasonable in light of examining group director's determination that "the applicant was claiming the electron going to a lower orbital in a fashion that I knew was contrary to the known laws of physics and chemistry"); In re Houghton, 433 F.2d at 821 n.1 (finding applicant's reliance on published articles purporting to provide theoretical support for invention "not persuasive" where "most of these articles were authored by appellant, and none of them appear in the record").

[241] *See* In re Houghton, 433 F.2d at 821 (finding claimed hovercraft inoperable where applicant "presented no evidence from any skilled persons other than himself to show that such persons would be convinced for the practical applicability of the [disclosed aerodynamic] equations to a flying machine"); cf. In re Gazave, 379 F.2d at 978 (citation omitted) (where a claimed device is of "such a nature that it could not be tested by any known scientific principles … it is incumbent on the applicant to demonstrate the workability and utility of the device and make clear the principles on which it operates").

commitments to these entities. The enablement, written description and best mode requirements of section 112 of the Patent Act serve in part to govern how the patent system incurs and warrants these ontological commitments. The precise nature of these ontological commitments can perhaps best be explained by way of contrast to an account of patent law's disclosure doctrines that does not explore the role of these doctrines in ontological commitment.

1. Lefstin's Definitional Account of Written Description Doctrine

In his 2008 article *The Formal Structure of Patent Law and the Limits of Enablement*,[242] Jeffrey Lefstin persuasively shows that the patent system's need for adequate disclosure cannot be satisfied by a formal, set-theoretic inquiry[243] as to whether all embodiments within the claim satisfy the legal standard for enablement.[244] This is not only because every claim contains some non-enabled subject matter,[245] but also because a claim's embodiments may be adequately enabled even though "the scope of the claim has little or nothing to do with what the inventor actually

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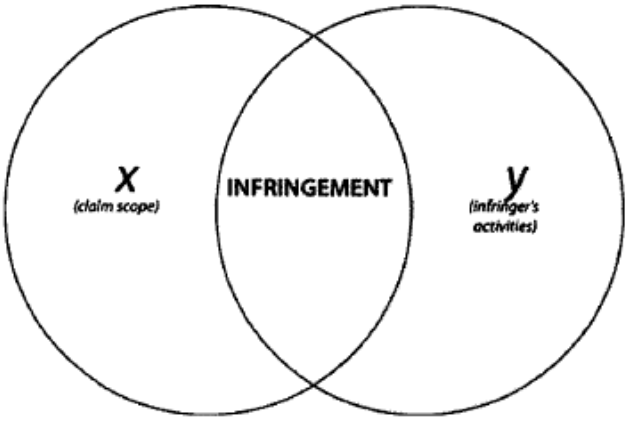
[242] *See* Lefstin, *supra* note 39.

[243] Lefstin contrasts enablement doctrine with other patent doctrines that he says are amenable to a set-theoretic characterization. *See id.* at 1159-67. For example, if we "[t]ake a claim reciting particular properties, and call the set of all possible things or events characterized by those properties as *x*," and "[l]et *y* be the set of all things the accused infringer has made, used, sold, or offered for sale within the United States," then "[t]he claim is infringed if and only if *x* and *y* intersect" as shown in the figure below.



Id. at 1159-60.

[244] *See id.* at 1167.

[245] *See id.* at 1175 ("Due to the infinite scope of patent claims, a patentee certainly need not, and in most cases cannot, enable every embodiment falling within the 'full scope' of the claims."); *see supra* text accompanying notes 164-165.

invented."[246] Lefstin contends that the written description requirement can bring needed coherence to the patent system by providing a legal test directed to "the scope of the claim itself" rather than "a particular embodiment or collection of embodiments."[247] Specifically, Lefstin proposes that written description requirement be understood as an inquiry into whether the disclosure provides adequate "definitional information" concerning the scope of the claim.[248]

According to Lefstin, the Federal Circuit provided guidance regarding the written description's definitional function in its 1997 *Lilly* decision.[249] Prior to *Lilly*, it was widely believed that originally-filed patent claims adequately described their own subject matter, so that the written description requirement served solely to prohibit the later claiming of new matter added during prosecution.[250] In *Lilly*, however, the Federal Circuit held invalid an originally filed claim directed to a microorganism modified to contain human insulin-encoding cDNA.[251] The specification disclosed "a process for obtaining human insulin-encoding cDNA" and "the amino acid sequence of the human insulin A and B chains," but gave "no further information … pertaining to that cDNA's relevant structural or physical characteristics."[252] The court found that the disclosure did not provide a written description of the cDNA, and went on to explain what an adequate description would "usually" entail:

> [A] cDNA is not defined or described by the mere name "cDNA," even if accompanied by the name of the protein

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[246] *See id.* at 1194 (emphasis omitted). For example, Lefstin points out that the following claim would be enabled: "All material objects which are enabled by the prior art, excluding those which are known or obvious in light of the prior art." *Id.* at 1182-85.

[247] *See id.*

[248] *See id.* at 1217.

[249] Regents of the Univ. of Cal. v. Eli Lilly & Co., 119 F.3d 1559 (Fed. Cir. 1997).

[250] *See* Christopher M. Holman, *Is* Lilly *Written Description a Paper Tiger? A Comprehensive Assessment of the Impact of* Eli Lilly *and Its Progeny in the Courts and PTO*, 17 ALB. L.J. SCI. & TECH. 1, 6 (2007); *but see* Lefstin, *supra* note 39, at 1200-02 (citing WILLIAM C. ROBINSON, THE LAW OF PATENTS FOR USEFUL INVENTIONS § 484 (1890)) (noting that Robinson's "monumental and influential 1890 treatise" recognized a written description requirement separate from the enablement requirement for original claims); Zhibin Ren, Note, *Confusing Reasoning, Right Result: The Written Description Requirement and Regents of the University of California v. Eli Lilly & Company*, 1999 WIS. L. REV. 1297, 1312 (1999) ("Although prior to *Lilly* the written description requirement had been used exclusively to prevent later-claims from obtaining an earlier priority date, the court never expressly closed the door on applying the written description requirement to originally filed claims.").

[251] 119 F.3d at 1567 (paraphrase in original).

[252] *Id.*

> that it encodes, but requires a kind of specificity usually achieved by means of the recitation of the sequence of nucleotides that make up the cDNA. A description of a genus of cDNAs may be achieved by means of a recitation of a representative number of cDNAs, defined by nucleotide sequence, falling within the scope of the genus or of a recitation of structural features common to the members of the genus, which features constitute a substantial portion of the genus.[253]

Departing from the majority of *Lilly*'s commentators who "have focused on the Federal Circuit's demand for structure or sequence information,"[254] Lefstin interprets the court's language as a call for definitional information about the claimed genus.[255] He notes that the two descriptive approaches suggested by the court "correspond perfectly to the two modes of definition" presented in Peter Coffey's classic text *The Science of Logic*[256]; i.e., *definition by intension* and *definition by type*.[257] Definition by intension involves "specifying the proximate genus to which it belongs, and those properties which differentiate it from other members of the genus."[258] As Coffey writes, differentiating properties "are intended as much to be diagnostic — i.e., features by which a species may be identified — as to declare the essential nature of the species."[259] Definition by type "proceeds by designating some individual or group of individuals as central or typical members of the genus and determining membership in the genus by degree of resemblance."[260] According to Coffey, the "perfect" definition by type of a class of things consists of an "exemplification" of the class by a smaller group of individuals[261] such that "the class exemplified does possess in common those attributes, those only, possessed in common by the smaller group."[262]

Lefstin argues that by requiring a claimed genus to be defined by one of

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[253] *Id.* at 1569 (citation omitted).

[254] *See* Lefstin, *supra* note 39, at 1205 (citing Holman, *supra* note 250, at 19 n. 89 (collecting structural criticisms); Dan L. Burk & Mark A. Lemley, *Biotechnology's Uncertainty Principle*, 54 CASE W. RES. L. REV. 691, 697-98 (2004)).

[255] *See* Lefstin, *supra* note 39, at 1205.

[256] PETER COFFEY, THE SCIENCE OF LOGIC (1912).

[257] *See* Lefstin, *supra* note 39, at 1205.

[258] *See* Lefstin, *supra* note 39, at 1205-06 & n. 200 (citing COFFEY, *supra* note 256, at 94).

[259] COFFEY, *supra* note 256, at 94.

[260] *See* Lefstin, *supra* note 39, at 1206 & n. 201 (citing COFFEY, *supra* note 256, at 98).

[261] *See* COFFEY, *supra* note 256, at 94.

[262] *See id.* at 103 n. 1.

these approaches, *Lilly*'s written description requirement "anchor[s] claim scope within the hierarchy of definitional genera."[263] For example, *Lilly* itself is concerned with locating claims amidst a hierarchy of successfully narrower genera consisting of "DNA," "vertebrate DNA," "vertebrate insulin DNA," "mammalian insulin DNA," "rat insulin DNA," and some "particular variant of rat insulin DNA."[264] According to Lefstin, an inventor who discovers and discloses only rat insulin DNA may claim "rat insulin DNA" but not "vertebrate insulin DNA," because the inventor's disclosure defines the broader genus "neither by properties that distinguish it from other genera, nor by a set of types by which the genus can be recognized by degrees of resemblance."[265] Thus conceived as an "anchor[]" of claim scope, the written description requirement performs at least two needed functions: "more precisely defin[ing] the boundaries of the patent,"[266] and providing a way for "the disclosure of the invention [to] become a more significant source of definitional information" in keeping with its increasingly vital role in claim construction.[267]

In the course of proposing his definitional account of the written description requirement, Lefstin rejects the Federal Circuit's explanation of the requirement as a rule that the applicant must demonstrate "possession of the invention" as of the filing date.[268] Lefstin essentially accuses the court of a category error,[269] reasoning that "[i]t is not syntactically sensible to ask whether an inventor 'invented' or 'possessed' an abstract bundle of properties defining a legally cognizable right."[270] As I argue below,[271] however, the Federal Circuit's "possession" jurisprudence, which the court pointedly reaffirmed in *Ariad Pharmaceuticals* (2010),[272] is neither metaphysically erroneous nor incompatible with Lefstin's definitional account. I am inclined to accept that the written description requirement serves both functions.

I find Lefstin's other arguments convincing and his ontological perspectives on claim scope insightful, though ultimately incomplete.

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[263] *See* Lefstin, *supra* note 39, at 1212.
[264] *See id.* at 1211.
[265] *See id.*
[266] *See id.* at 1219.
[267] *See id.* at 1220-21.
[268] *See id.* at 1197-1200 (citing Vas-Kath v. Mahurkar, 935 F.2d 1555, 1563-64 (Fed. Cir. 1991)).
[269] *See supra* note 24 (defining category error).
[270] *Id.* at 1199.
[271] *See infra* section III.C.2.
[272] Ariad Pharmaceuticals, Inc. v. Eli Lilly & Co., 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc).

Lefstin persuasively demonstrates that the enablement requirement cannot alone define the scope of patent claims, and that the written description requirement serves in part to provide this definitional function. But Lefstin does not explore how the patent system confers ontological status upon inventions and embodiments under the doctrine of constructive reduction to practice. The issue of ontological commitment does not arise in Lefstin's analysis, because nothing in his incomplete account of patent doctrine entails that claims and embodiments have any particular status in the patent system's ontology.

Lefstin is careful in his ontological description of patent claims, as far as he goes. He notes that many of patent law's doctrines, including infringement, anticipation, nonobviousness and utility, can be described using the set-theoretic concepts of intersection and containment,[273] but finds that the enablement standard cannot be so characterized, because the nature of the patent claim "makes patent law not reducible to a simple set-theoretic system."[274] He accurately concludes that the "ontological nature of patent claims" is that they are classes having infinite scope.[275] But Lefstin's analysis does not entail that the patent system be ontologically committed to the existence of claims as either set-entities or class-entities. The intersection and containment relationships he employs can be adequately expressed without ontological commitment to sets or classes, by characterizing claims as *mereological sums* or *fusions* of their embodiments (and embodiments as *parts* of claims).[276] For example, making a collection of things *y* infringes claim *x* iff there is an embodiment *z* that is both a part of *x* and a part of *y*; in other words, there is an *overlap* between *x* and *y*,[277]

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[273] *See id.* at 1161-64.

[274] *See* Lefstin, *supra* note 39, at 1167.

[275] *See id.* at 1168.

[276] ROUTLEDGE ENCYCLOPEDIA OF PHILOSOPHY 318 (Edward Craig ed. 1998) (defining mereology as "the theory of the part-whole relation" that "tak[es] the part-whole relation as primitive"); ROBERT CASATI & ACHILLE C. VARZI, PARTS AND PLACES: THE STRUCTURES OF SPATIAL REPRESENTATION 11 (1999) ("Mereologically, for every whole there is a set of parts, and to every set of parts (that is, every arbitrary collection of objects) there may in principle correspond a complete whole, viz. their mereological sum or fusion.").

This is not to say that patent claims can accurately be characterized as mereological sums or fusions of their embodiments, as such a characterization incorrectly ties claim scope to the embodiments that make up the claim. *See supra* text accompanying note 93 ("[T]he number of existing embodiments of a patent claim has no effect on the claim's scope."). There is nothing in Lefstin's incomplete account of patent doctrine, however, that is inconsistent with a mereological account of claims and embodiments.

[277] *See id.* at 36.

or *x shares parts with y*.[278] On this reading, an adequate written description performs its definitional function by picking out the embodiments whose fusion *is* the claim, thereby determining the claim's (infinite) scope.[279] Such a mereological account need not be taken to entail any ontological commitment to claims beyond that already provided to their embodiments.[280]

Lefstin's account of patent doctrine is sufficient, and indeed well suited, to support his central thesis that the written description requirement has a necessary function in limiting claim scope; however, it misses the adequate disclosure requirements' more fundamental roles in connection with incurring and warranting ontological commitments to claims and embodiments. In the sections that follow, I will attempt to explain how these roles not only subsume both the definitional and "possession" conceptions of the written description requirement, but also critically illuminate the patent system's ontology of "useful Arts."

2. Ontological Commitments and Warrants in Patent Discourse

In the metaphysics literature, a theorist is said to incur an *ontological commitment* if she is committed to acknowledging an entity's existence in virtue of her acceptance of the truth of a given theory.[281] The theorist's

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[278] *See id.* at 33; *cf. supra* note 243 (describing Lefstin's set-theoretic description of infringement doctrine).

[279] *See* Lefstin, *supra* note 39, at 1211 ("Once we recognize written description as a method of logical definition, then its function in determining claim scope becomes clear.").

[280] *See* DAVID LEWIS, PARTS OF CLASSES 81 (1991) (describing mereology as "ontologically innocent"). Lewis gives the following example:

> Given a prior commitment to cats, say, a commitment to cat-fusions is not a *further* commitment. The fusion is nothing over and above the cats that compose it. It just *is* them. They just *are* it. Take them together or take them separately, the cats are the same portion of Reality either way.

Id. (emphasis in original); *see also* D.M. ARMSTRONG, A THEORY OF UNIVERSALS: UNIVERSALS AND SCIENTIFIC REALISM v. 2, at 36-38 (1978); Donald L.M. Baxter, *Identity in the Loose and Popular Sense*, 97 MIND 575 (1988). Lewis's view on this matter is not undisputed. *See, e.g.*, Peter Forrest, *How Innocent is Mereology?*, 56 ANALYSIS 127 (1996) (arguing against mereological innocence); Verity Harte, *Plato's Problem of Composition*, *in* PROC. BOSTON AREA COLLOQUIUM IN ANCIENT PHILOSOPHY v. 17, at 5-6 (John J. Cleary & Gary M. Gurtler eds. 2001) (same); Byeong-uk Yi, *Is Mereology Ontologically Innocent?*, 93 PHIL. STUDIES 141 (1999) (same). The point here, however, is that Lefstin's logic is valid even on a mereological reading, so it was not necessary for Lefstin's analysis to explore the issue of ontological commitment for it to be complete on its own terms.

[281] *See* E.J. LOWE, A SURVEY OF METAPHYSICS 215 (2002) (defining criterion of ontological commitment as "a principle which will reliably tell us what kinds of entities a theorist is committed to acknowledging as existent, in virtue of his acceptance of the truth

warrant for this commitment is the set of facts she takes to justify such an assertion of the entity's existence.[282]

An ontological commitment may be *de dicto* or *de re*. A *de dicto* commitment is to be understood as a proposition about a state of affairs, while a *de re* commitment is understood to refer to a specific entity.[283] As Michael Jubien explains, a *de dicto* commitment to a particular holds that the truth of a theory implies the existence of some unique entity, but does not *per se* restrict the identity of this entity to a "*particular* particular."[284] For example, the truth of a theorem that "there is a unique president at a given moment in 1972" incurs a commitment to the existence of exactly one president at that moment in time, but does not by its terms incur a commitment to the existence of Richard Nixon at that time.[285] In contrast, a *de re* commitment to a particular implies the existence of a specific entity. A theorem stating that "there is an x such that $x=c$," where c is a constant interpreted as referring to Richard Nixon would incur such a commitment.[286]

Analogously, a *de dicto* commitment to a kind takes the form "The theory is committed to the existence of (possible) objects of a given kind," in contrast to a *de re* commitment, which essentially states "There are certain (possible) objects of a given kind to which the theory is committed."[287] As Jubien notes, a *de re* commitment to a kind is equivalent to a *de re* commitment to certain particulars of the kind.[288]

The decisions and actions of legal institutions, including the Patent Office and the courts, are premised on facts and theories that such institutions take to be true in law, whether or not known to be true in fact.[289]

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of a given theory").

[282] Such warrants are often implicit. *See* Alexander Bird, *Laws and Criteria*, 32 CAN. J. PHIL. 511, 515-16 (2002) (explaining that for a thinker who is not "consciously or reflectively aware" of her propositional attitudes, "[w]hat facts she 'takes to warrant' what other facts will be shown in the inferences she is disposed to make, what beliefs she forms given certain information and so forth, and need not be manifested by assertions equivalent to 'I take *p* to provide me with warrant for asserting *q*.'")

[283] *See* Justin Broakes, *Belief* De Re *and* De Dicto, 36 PHIL. Q. 374, 374 (1986) ("Belief *de dicto* is belief that a certain *dictum* (or proposition) is true, whereas belief *de re* is belief about a particular *res* (or thing) that it has a certain property.").

[284] *See* Michael Jubien, *Ontological Commitment to Particulars*, 28 SYNTHESE 513, 513 (1974).

[285] *See id.*

[286] *See id.*

[287] *See* Michael Jubien, *Ontological Commitment to Kinds*, 31 SYNTHESE 85, 86 (1975).

[288] *See id.*

[289] *See* Harold J. Berman & Charles J. Reid, Jr., *The Transformation of English Legal*

Accordingly, the patent system may be said to incur ontological commitments to claims and embodiments whenever it engages in legally operative discourse predicated on the existence of such entities. Such discourse reveals the patent system's *criteria of ontological commitment.* A criterion of ontological commitment is "a principle for determining just what objects or entities a theory says there are (or what entities must exist in order for a theory to be true)." [290] The warrants for the patent system's ontological commitments are the facts taken by the patent system to be legally sufficient to justify its decisions and actions arising from the discourse in question. By this account, the patent system appears to incur ontological commitments to patent claims and embodiments in at least three situations.

First, under the doctrine of constructive reduction to practice, the disclosure of an invention in a filed patent application is given the same legal effect as a finding that the patent specification is a true description of existing kinds of entities with essential causal properties; i.e., the claim exists as a kind whose examples include (possible) embodiments,[291] and any specifically disclosed embodiments exist as particulars.[292] The patent system thereby incurs a *de dicto* ontological commitment to the claim as a kind,[293] *de re* ontological commitments to any specifically disclosed actual embodiments as particulars, and *de dicto* ontological commitments to any specifically disclosed prophetic embodiments as particulars.[294] Each of

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Science: From Hale to Blackstone, 45 EMORY L.J. 437, 458 (1996) ("Like a literary work of fiction, a legal fiction is not meant to be taken as true in fact. It is, however, true in another sense — it is true in law.").

[290] *See* MACDONALD, *supra* note 27, at 25.

[291] *See, e.g.*, Hoffman-LaRoche, Inc. v. Promega Corp., 323 F.3d 1354, 1377 (Fed. Cir. 2003) ("The patent law authorizes that an invention may be constructively reduced to practice by filing a patent application, whether the embodiments were actually made or are constructed in the patent application.").

[292] A priority determination in the interference context may be predicated on the constructive reduction to practice of a specifically disclosed embodiment. *See, e.g.*, Hunt v. Treppschuh, 523 F.2d 1386, 1387 (C.C.P.A. 1975) (explaining that support of a count requires "disclosure of an embodiment within the count that meets the requirements of the first paragraph of 35 U.S.C. § 112").

[293] *See supra* note 168 (explaining that support for a claim need not include support for actual embodiments); *cf.* Jubien, *supra* note 287 at 88-89 (for a kind that is a natural kind or species, suggesting approach of using "a species-term" to refer to "the (possible) species it would correctly pick out if the relevant parts of the story were true reports of the accurate observations of a naturalist (if such a species exists).").

[294] A prophetic (or paper) example "describe[s] the manner and process of making an embodiment of the invention which has not actually been conducted." MPEP, *supra* note 231, at § 608.01(p). Under the doctrine of constructive reduction to practice, a prophetic example is given same the same legal effect as a finding of the existence of a specific

these commitments is warranted by the adequacy of the filed disclosure under the first paragraph of § 112 with respect to the claim or embodiment in question.[295]

Second, when a claim is found anticipated by use[296] or prior reduction to practice under § 102(a),[297] or barred by public use or on-sale activity under § 102(b),[298] it is because the patent system has affirmed the existence of a specific embodiment of the claim prior to the invention or the critical date (or its constructive equivalent in another inventor's patent application[299]). The patent system incurs a *de re* ontological commitment to the prior art embodiment referred to in the evidentiary finding (as in "*x* was in public use more than a year before the filing date"), which is warranted by clear and convincing evidence of direct experience of a particular that is an example of the claim.[300]

Finally, when a claim is found infringed under § 271(a), it is because the patent system has affirmed the existence of a specific embodiment of the claim that was made, used, offered for sale, sold or imported by the

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embodiment enabled by the example, even though no *particular* embodiment of that sort can be identified. *See* Hoffman-LaRoche, Inc. v. Promega Corp., 323 F.3d 1354, 1377 (Fed. Cir. 2003) (Newman, J., dissenting) ("To fulfill their legal purpose, [prophetic] examples must be enabling of specific embodiments…. The patent law authorizes that an invention may be constructively reduced to practice by filing a patent application, whether the embodiments were actually made or are constructed in the patent application.").

[295] *See* 3A CHISUM ON PATENTS § 10.05[5], at 10-162 ("In order to constitute constructive reduction to practice as of its filing date, the application must comply with the requirements of the first paragraph of Section 112.").

[296] *See* 35 U.S.C. § 102(a) (denying patentability where the claimed "invention was … used by others in this country … before the invention thereof by the applicant for patent");

[297] See 35 U.S.C. § 102(g) (denying patentability if the claimed invention was made earlier by the other party in an interference, or made earlier in the United States by another inventor, and not abandoned, suppressed or concealed).

An applicant who is first to reduce to practice may also lose priority to another inventor who is first to conceive and diligent in reducing to practice. *See id.* In such a case, no ontological commitment to a prior embodiment of the claim is incurred.

[298] *See* 35 U.S.C. § 102(b) (denying patentability where the claimed "invention was … in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States);

[299] *See* Frazer v. Schlegel, 498 F.3d 1283 (Fed. Cir. 2007) (citations omitted) ("When interference priority is at issue, constructive reduction to practice of a count may be established by disclosure of an embodiment within the count.").

[300] *See* Orion IP, LLC v. Hyundai Motor America, 605 F.3d 967, 975 (Fed. Cir. 2010) (citation omitted) ("[T]he party asserting invalidity due to anticipation must prove anticipation, a question of fact, by clear and convincing evidence."); Netscape Communications Corp. v. Konrad, 295 F.3d 1315, 1320 (Fed. Cir. 2002) ("A conclusion that a section 102(b) bar invalidates a patent must be based on clear and convincing evidence.")

defendant.[301] The patent system incurs a *de re* ontological commitment to the infringing embodiment, which is warranted by the preponderance of evidence of past or present direct experience of a particular that is an example of the claim.

If the above inventory is basically correct, then the patent system's ontological commitments to claims and embodiments are grounded in either (1) adequate disclosure in a filed patent application or (2) a proven report of past or present direct experience. Moreover, given that proven reports of direct experience would be acceptable ontological warrants even in a minimal legal epistemology,[302] it is patent law's doctrines of adequate disclosure that determine the overall extent of the patent system's ontological commitments to claims and embodiments.

It is costly for the patent system to incur ontological commitments to claims and embodiments.[303] The filing of a claim in a patent application is a demand that the patent system not only admit a new kind into its ontology of "useful Arts," but regulate the creation, use and sale of all entities within its jurisdiction that are examples of the kind.[304] As I will argue below, the

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[301] *Cf.* Waymark Corp. v. Porta Systems Corp., 245 F.3d 1364 (Fed. Cir. 2001) (noting that "infringement without a completed infringing embodiment is not the norm in patent law" but is contemplated by statutory provisions beyond the scope of § 271(a)).

[302] *See, e.g.*, FED. R. EVID. 602 advisory committee's note (citation omitted) ("'[T]he rule requiring that a witness who testifies to a fact which can be perceived by the senses must have had an opportunity to observe, and must have actually observed the fact' is a 'most pervasive manifestation' of the common law insistence upon 'the most reliable sources of information.'"); Joseph Boyle, *Free Choice, Incommensurable Goods and the Self-Refutation of Determinism*, 50 AM. J. JUR. 139, 157 (2005) ("[I]t may be possible to stand back epistemologically from one's assent, but seeing an event, or remembering a recent event, you just believe the proposition describing it, and reasonably so. There seems to be no choice in the matter.").

Of course, the patent system does not accept all reports of direct experience as *proof* of existence, *see, e.g.*, Woodland Trust v. Flowertree Nursery, Inc., 148 F.3d 1368 (Fed. Cir. 1998) (rejecting "uncorroborated oral testimony … of interested persons recalling long-past events" regarding prior use of patented method). In admitting reports of direct experience as *evidence* of existence, however, the patent system rejects a posture of *universal* skepticism toward sensory experience and memory, such as that expressed in René Descartes's *Meditations*. *Compare* FED. R. EVID. 602 ("Evidence to prove personal knowledge may … consist of the witness' own testimony.") *with* RENÉ DESCARTES, MEDITATIONS ON FIRST PHILOSOPHY 51 (Donald A. Cress ed. 1996) ("[E]verything I ever thought I sensed while awake I could believe I also sometimes sensed while asleep").

[303] *See generally* JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK 38-45 (2008) (describing costs of defining new property rights).

[304] See 35 U.S.C. § 154(a) (granting the patentee "the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States" during the patent term).

written description and enablement doctrines serve in part to enforce the conditions under which the patent system incurs ontological commitments to claims and takes such commitments to be warranted, respectively.

3. The Written Description Requirement as a Doctrine of Ontological Possession

A comprehensive analysis of the patent system's criteria of ontological commitment to claims as kinds is beyond the scope of this Article.[305] It is sufficient here to argue as a more general matter that any kind that is the subject of ontological commitment must pick out a definite (possibly empty) class of examples. As philosopher Michael Jubien describes this proposition,[306] this is "a very modest and natural assumption about kinds — one that I think would be met by any plausible philosophical doctrine on the nature of kinds."[307] Jubien himself relies on this assumption in formulating a criterion of *de dicto* ontological commitment to kinds[308] suitable for theories in which kinds may stand in definitional hierarchies.[309]

By this account, the patent system's criteria of ontological commitment subsume Lefstin's definitional account of the written description requirement. According to Lefstin, the standard for the written description's definitional function is to be found in the Federal Circuit's *Lilly* decision, which characterizes "a fully described genus" as one that allows "one skilled in the art … [to] visualize or recognize the identity of the members of the genus."[310] A claim that is "fully described" according to this standard is one that can be the subject of ontological commitment, as one skilled in the art can recognize (and therefore pick out) the embodiments of the claim, which form a definite class of examples.

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[305] *Cf.* Jubien, *supra* note 287, at 85 (noting that his explanation of ontological commitment to kinds is "not self-contained," but relies on "technical notions introduced" in a previous article).

[306] *See id.* at 85 (stating the assumption more formally as "for any kind κ, there exists in every world a definite (possibly empty) class of objects of that kind" and denoting the class of objects of kind κ in world *H* by $\{x \mid \kappa x\}_H$).

[307] *See id.*

[308] More formally, Jubien states the criterion as follows: "$\langle T, I \rangle$ is committed to objects of kind κ iff for every $I_u(H)$-model *M*, $D(M) \cap \{x \mid \kappa x\}_H \neq \emptyset$ for every *H* in which $\langle T_u, I_u \rangle$ is true." *See id.* at 87.

[309] *See id.* at 86. ("The criterion we seek should satisfy the condition that if a theory is committed to objects of kind κ, and if objects of kind κ are necessarily also of kind κ', then the theory is committed to objects of kind κ' as well.").

[310] Lefstin, *supra* note 39, at 1206 (citing Lilly, 119 F.3d at 1568).

This reinterpretation of Lefstin's account also plausibly explains the Federal Circuit's characterization of the written description requirement as an obligation that the applicant show "that, as of the filing date sought, he or she was in possession of the invention."[311] To Lefstin, the Federal Circuit's "possession" jurisprudence makes no sense, because "'the invention' is a bundle of properties recited by the claims, defining the perimeter of the patentee's legal right to exclude": it may be meaningful to ask whether an inventor possessed certain "ideas and things," but not "abstract legal entities or infinite sets of subject matter."[312] Since *Lilly*, however, the court has continued to frame the written description requirement as a possession inquiry,[313] including in its recent en banc decision in *Ariad*.[314]

Lefstin sees in this recent caselaw a missed opportunity to follow *Lilly*'s lead in clarifying that the "true role of the written description doctrine" was in requiring definitional information rather than a showing of possession.[315] But *Lilly* need not be read as a departure from the Federal Circuit's "possession" jurisprudence. In *Lilly*, the court refers to its opinion four months earlier in *Lockwood v. American Airlines*[316] for what it takes to be the definitive statement of the written description requirement: "To fulfill the written description requirement, a patent specification must describe an invention and do so in sufficient detail that one skilled in the art can clearly conclude that 'the inventor invented the claimed invention.'"[317] The *Lockwood* court, in turn, finds that it is "accurate[]" to say that the requirement is met by a "show[ing] that one is 'in possession' of the

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[311] *See, e.g.*, Vas-Cath Inc. v. Mahurkar, 935 F.2d 1555, 1563-64 (Fed. Cir. 1991). For other commentary challenging this characterization, *see, e.g.*, Mark D. Janis, *On Courts Herding Cats: Contending with the "Written Description" Requirement (and Other Unruly Patent Disclosure Doctrines*, 2 WASH. U.J. L. & POL'Y 55, 62 (2000) (arguing that the written description requirement is "an essentially standardless disclosure doctrine that can be deployed arbitrarily"); Timothy R. Holbrook, *Possession in Patent Law*, 59 SMU L. REV. 123, 161-63 (2006) (arguing that the written description requirement should not be used to ensure possession, as that function is better performed by the enablement requirement).

[312] *See* Lefstin, *supra* note 39, at 1199.

[313] *See id.* at 1210 & n. 220 (citing cases).

[314] Ariad Pharmaceuticals, Inc. v. Eli Lilly & Co., 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc) ("[T]he test for sufficiency is whether the disclosure of the application relied upon reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date.").

[315] *See* Lefstin, *supra* note 39, at 1207-10.

[316] Lockwood v. American Airlines, Inc., 107 F.3d 1565 (Fed. Cir. 1997).

[317] *See* Lilly, 119 F.3d at 1566 (citing Lockwood, 107 F.3d at 1572).

invention,"[318] and goes on to explain what such a showing entails:

> One shows that one is "in possession" of the invention by describing the invention, with all its claimed limitations, not that which makes it obvious. ("[T]he applicant must also convey to those skilled in the art that, as of the filing date sought, he or she was in possession *of the invention*. The invention is, for purposes of the 'written description' inquiry, *whatever is now claimed*.") One does that by such descriptive means as words, structures, figures, diagrams, formulas, etc., that fully set forth the claimed invention.[319]

The effect of this explanation is to read into the language preceding the patent claims (e.g., "I claim"[320]) a further predicate of the form "I am now in possession of." Under a standard interpretation, the speaker of such a predicate (i.e., the patent applicant) incurs an ontological commitment to each entity that is an object of the predicate: one can possess only what exists. By our account above, the written description requirement serves to ensure that the claims are kinds that pick out well-defined classes,[321] as is necessary to satisfy the patent system's criteria of ontological commitment.

On this interpretation, to "possess" a claimed invention is to possess the claim as a kind in one's ontology, having incurred a *de dicto*[322] ontological commitment to the claim according to the patent system's criteria for such commitment. The filing of a patent application that meets the written description requirement serves to "convey" this ontological commitment "to those skilled in the art" who read the application, insofar as a reader's acceptance of the truth of the patent specification (including the applicant's representations of possession) implies the existence of the claims as kinds whose examples include (possible) working embodiments.

Whatever the *inventor*'s criteria of ontological commitment may be, the written description requirement ensures that the patent disclosure convey ontological commitment to a reader according to the *patent system*'s criteria for such commitment. Every such reader is entitled to "possess" the

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[318] *See* Lockwood, 107 F.3d at 1572 (citing Vas-Cath, 935 F.2d at 1563-64) ("Lockwood argues that all that is necessary to satisfy the description requirement is to show that one is 'in possession' of the invention. Lockwood accurately states the test….").

[319] 107 F.3d at 1572 (citation omitted) (emphasis in original).

[320] *See supra* text accompanying note 119.

[321] *See supra* text accompanying note 310.

[322] In this case, the entities are kinds to which the patent system incurs only a *de dicto* and not a *de re* ontological commitment. *See supra* text accompanying note 293. Since the language of the patent application need convey no more than a *de dicto* commitment to these kinds, the applicant need incur only a *de dicto* commitment in making the application.

invention in this ontological sense.[323] By demonstrating ontological possession of the claimed and described invention at the time of filing, however, the inventor is uniquely entitled to establish priority for the filed claims. (The written description requirement's role in securing ontological commitment thus also subsumes the requirement's traditional role in policing against the addition of new matter.[324]) Upon securing priority in this way and meeting the other requirements for patentability, the inventor is awarded an entitlement to regulate the ontological possession of future *de re* commitments to the claim and its embodiments; i.e., by excluding others from bringing into existence any embodiments that might be the subject of such commitments. On this reading, then, the patent right does not include an exclusive right to "possess" the claimed invention, but does include the most important of the "sticks" in the property rights "bundle": the right to exclude others.[325]

In summary, I have provided an ontological account of the written description requirement that both incorporates Lefstin's definitional account and supports the Federal Circuit's "possession" jurisprudence. In this account, the written description requirement serves to ensure that one who reads the applicant's claims in light of the specification thereby incurs *de dicto* ontological commitments to those claims according to the patent system's criteria for such commitments. I will now turn to an account of the enablement requirement as providing the complementary function of ensuring that any ontological commitments so incurred are warranted

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[323] *Cf.* In re Borst, 345 F.2d 851, 855 (C.C.P.A. 1965) (holding that for the teachings of a prior art patent to anticipate a claimed invention, "the [prior art] disclosure must be such as will give possession of the invention to the person of ordinary skill."). Since such ontological possession includes knowledge of claim scope, this account also recognizes the notice function of the written description requirement. *Cf.* Lefstin, *supra* note 39, at 1219 (arguing that by demanding definitional information, the written description requirement improves notice of patent scope).

[324] *See, e.g.*, In re Curtis, 354 F.3d 1347, 1351 (Fed. Cir. 2004) (explaining that later-filed claims can claim the priority date of an earlier application only if the earlier application's disclosure "reasonably convey[s] to one of ordinary skill in the art that the inventors possessed the later-claimed subject matter when they filed the earlier application").

[325] *Cf.* College Sav. Bank v. Florida Prepaid Postsecondary Educ. Expense Bd., 527 U.S. 666, 673 (1999) (citation omitted) ("The hallmark of a protected property interest is the right to exclude others. That is 'one of the most essential sticks in the bundle of rights that are commonly characterized as property.'"); Aleksandar Nikolic, *Securitization of Patents and Its Continued Viability In Light of the Current Economic Conditions*, 19 ALB. L.J. SCI. & TECH. 393, 395-96 (2009) ("While a patent is considered property, an owner is not granted the full 'bundle of sticks' of property rights in an invention but merely 'the [negative] right to exclude others.'").

according to the patent system's epistemology.

4. The Enablement Requirement as a Doctrine of Ontological Warrant

To complete our account of the patent system's ontological commitments, it remains to show how the enablement requirement secures warrants to *de dicto* ontological commitments to claims as kinds; i.e., how an enabling disclosure serves to justify (according to the patent system's epistemology) the belief that entities of the claimed kind, having certain essential causal properties, may exist in this world. To understand what an enabling disclosure needs to do to fulfill this justificatory role, it is necessary first to examine the epistemological burdens such a belief places on the patent system. In particular, the enforceability of a patent claim requires that the patent system have available sufficient epistemological machinery to make factual determinations as to whether a given accused entity exists and is of the claimed kind.

These determinations may involve extensive appeals to scientific realism, as *Centricut v. Esab Group*[326] illustrates. In that case, Esab Group ("Esab") asserted two patent claims directed to an improved electrode for a plasma arc torch.[327] Centricut sought a declaratory judgment of invalidity and noninfringement against Esab, and Esab filed infringement counterclaims.[328] After a bench trial,[329] the district court held one of Esab's claims infringed.[330] The Federal Circuit reversed the trial court's finding of infringement, relying heavily on the testimony of Centricut's expert that Esab had not conducted testing sufficient to show that the accused electrode fell within the scope of the claim.[331] In giving weight to this expert testimony, the appeals court discounted the rebuttal testimony of Esab's inventor and other witnesses, none of whom were qualified as experts.[332]

The Federal Circuit based its decision on the following facts. Plasma arc torches use electrical arcs — essentially, artificial lightning bolts[333] —to superheat a stream of gas to a plasma state at temperatures of around 30,000

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[326] Centricut, LLC v. Esab Group, Inc., 390 F.3d 1361 (Fed. Cir. 2004), *cert. denied*, 546 U.S. 814 (2005).

[327] *See id.* at 1363.

[328] *See id.*

[329] *See id.* at 1365.

[330] *See id.* at 1366-67.

[331] *See id.* at 1367-68.

[332] *See id.* at 1368-69.

[333] *See, e.g.*, KATHRYN D. WAGNER, 1 ENVIRONMENTAL MANAGEMENT IN HEALTHCARE FACILITIES 34 (1998) ("Plasma Arc reactors generate intense heat … through discharge of a powerful electrical arc (artificial lightning).").

degrees Kelvin, hot enough to cut metal.[334] Torches that use oxygen gas are particularly suitable for cutting carbon steel.[335] Most conventional torch electrodes consist of a metal emissive insert embedded in a holder made of a different metal.[336]

According to Esab's patent disclosure, the emissive insert is composed of a metal that has a low "work function"; i.e., the amount of energy required to "permit[] thermionic emission of [an electron from] a metal at a given temperature."[337] This low work function makes the insert "capable of readily emitting electrons when an electric potential is applied thereto," so that in the torch's normal operation the arc is supported by the insert.[338] In conventional torches, however, the use of oxygen gas can cause the metal holder to oxidize.[339] If the holder is made of a metal such as copper whose work function falls when it is oxidized, the arc may begin to emanate from the holder in preference to the insert, causing the holder to melt and the electrode to fail.[340] Esab's invention provides a sleeve positioned between the insert and the holder that has a high work function relative to the emissive insert.[341] The addition of the sleeve keeps the arc on the emissive insert even when the holder becomes oxidized, thereby prolonging the electrode's life.[342]

Claim 1, the broader of Esab's claims recited, *inter alia*, "an emissive insert composed of a metallic material having a relatively low work function, and a sleeve surrounding said emissive insert … composed of a metallic material having a work function which is greater than that of the material of said emissive insert."[343] Esab's other claim, claim 8, further specified, *inter alia*, that the sleeve's work function was greater than that of the holder and that the insert's "relatively low work function" adapted it "to readily emit electrons upon an electric potential being applied thereto."[344]

In the district court, Centricut moved for summary judgment of invalidity for indefiniteness, arguing that the work function of a metallic material is dependent on too many variables (e.g., surface treatment and crystalline structure) for one of skill in the art to determine whether either

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[334] *See id.* at 1363.
[335] *See id.*
[336] *See id.*
[337] *See* U.S. Patent No. 5,023,425, col. 1 (issued June 11, 1991).
[338] *See id.*
[339] *See id.*
[340] *See id.*
[341] *See* Centricut, 390 F.3d at 1363-64.
[342] *See id.* at 1364.
[343] *See id.*
[344] *See id.* at 1364 n.1.

claim read on a particular combination of holder, sleeve and insert materials.[345] The court rejected this argument, finding the claims' work function limitation to be definite:

> It may well be, as Centricut claims, that some silver sleeves could be within the claims while others silver sleeves fall outside the claims, depending upon the physical characteristics of the particular sample of silver used and the identity of the metal used for the emissive insert, but that is not due to any indefiniteness in the claim. Rather, it is due to the nature of work function as an electro-chemical characteristic that is dependent upon a variety of variables…. [A]ll one must do to make a silver [sleeve] that avoids the work-function limitation… is to use silver with the necessary physical characteristics (surface treatment, crystalline structure, etc.) to give it a work function equal to or lower than the work function of the material selected for the emissive insert….[346]

In Centricut's accused electrode, the holder was made of copper, the sleeve was made of silver, and the insert was made of hafnium.[347] At trial, Centricut's expert had submitted tables providing work function values for various element samples, including one that reported values ranging from 3.08 to 4.81 electron-volts for silver and a single value of 3.53 electron-volts for hafnium.[348] The district court inferred from these tables that "silver commonly has a higher work function than halfnium [sic]."[349] Noting that "[n]othing in the record suggests that Centricut made its silver sleeves from one of the relatively few low-work-function forms of silver," the court concluded that it was more likely than not that Centricut's electrode infringed claim 1.[350] In contrast, the court found "too great an overlap in relative work-function values for silver and copper to give rise to a reliable inference" as to whether the electrode infringed claim 8.[351]

Centricut did not appeal the district court's ruling on indefiniteness,[352] but raised the issue of the variability of work functions again in appealing

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[345] Centricut, LLC v. Esab Group, Inc., No. 99-039-M, 2002 WL 220057, at *4 (D.N.H. 2002).

[346] *Id.* at *5.

[347] *See* Centricut, 390 F.3d at 1366; Centricut, LLC v. Esab Group, Inc., No. 99-CV-39, 2003 WL 21558348 at *2 (D.N.H. July 9, 2003)).

[348] *See id.* at 1366 & n.3.

[349] *See id.* at 1366 (citing Centricut, 2003 WL 21558348, at *3.)).

[350] *See id.*

[351] *See id.* (citing Centricut, 2003 WL 21558348, at *3).

[352] *See id.* at 1367 n. 4

the district court's judgment of infringement.[353] As Centricut noted, there was no evidence in the record "of either the *actual* work-function values or the *actual* relative work-function rankings in the accused Centricut electrode."[354] According to Centricut, the district court erred in relying on work function tables as evidence of the actual values applicable to the accused electrode.[355] Such tables "do not show values for materials in bulk," because the work function of each specimen varies according to its own surface and atomic arrangements and the conditions under which the emission is measured.[356]

The Federal Circuit agreed with this argument, crediting the testimony of Centricut's expert to the effect that "work function is not an intrinsic property of a metal, but is rather a property of specific surfaces under specific conditions."[357] The appeals court found that this testimony "directly contradicted" the district court's conclusion that the tables showed that the accused electrode met the work function limitation by a preponderance of the evidence.[358] The Federal Circuit also credited Centricut's expert testimony that the observed durability of Centricut's accused electrode "could be attributed to a number of different factors, including temperature, the geometry of the electrode, the thermal and electrical conductivity of the sleeve, or the sleeve's resistance to oxidation, and that it was not reasonable to conclude that longer useful life was attributable to work function."[359] Noting the district court's finding that "the field of technology from which [the invention] sprang is so poorly understood that it qualifies as a 'black art,'" the appeals court deemed the case to be one in which expert testimony was necessary to prove infringement:

> We do not state a per se rule that expert testimony is required to prove infringement when the art is complex. Suffice it to say that in a case involving complex technology, where the accused infringer offers expert testimony negating infringement, the patentee cannot satisfy its burden of proof

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[353] Brief of Appellants at 7-26, Centricut, LLC v. Esab Group, Inc., 390 F.3d 1361 (Fed. Cir. 2004) (No. 03-1574).

[354] *Id.* at 7; *see also* Centricut, 390 F.3d at 1365 ("[N]either party introduced any evidence of tests conducted to directly measure the work function of the materials used in the accused device. Indeed, neither party introduced evidence of tests or other evidence concerning the exact materials used in the accused device.").

[355] *See* Brief of Appellants, *supra* note 353, at 11.

[356] *See id.* at 11-14.

[357] *See* Centricut, 390 F.3d at 1365.

[358] *See id.* at 1367.

[359] *See id.* at 1368.

> by relying only on testimony from those who are admittedly not expert in the field.[360]

Since Esab had not presented any expert witnesses on the issue of work function, the court concluded that Esab had failed to satisfy its burden of proof on infringement.[361]

Identifying the patent system's ontological commitments in connection with the *Centricut* case reveals at least three illustrative examples of the patent system's reliance on scientific essentialism and scientific realism.

First, the issuance of claim 8 required the patent system to incur a *de dicto* ontological commitment to a kind of device with essential causal powers that include "readily emit[ting] electrons upon an electric potential being applied thereto."[362] While the electron is a paradigmatic unobservable entity,[363] "our best scientific theories" tell us that thermionic emission is an observable manifestation of a real entity of the natural kind known to science as the electron.[364] The patent system's commitments to scientific essentialism and to scientific realism serve to warrant its acceptance that devices capable of emitting electrons according to claim 8 can exist.[365]

Second, the Patent Office's issuance of claims 1 and 8 and the district court's judgment of validity entail a finding that well-defined classes of particulars can be picked out, each particular having, *inter alia*, a sleeve characterized by a relatively high work function.[366] The work function of a material is a causal power, insofar as it describes the disposition of the

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[360] *See id.* at 1370.

[361] *See id.*

[362] *See supra* text accompanying note 344.

[363] *See supra* text accompanying notes 223-225.

[364] In a recent book exploring the historicity of scientific realism in the case of the electron, Theodore Arabtzis describes the emergence of this scientific consensus:

> Lorentz, Larmor, and even Thomson eventually adopted a single name, "electron," for the theoretical entities they had put forward. Apparently, they must have thought that those theoretical entities were representations of the same unobservable entity. A prominent reason for their thinking so was that the charge-to-mass ratio of ions, electrons, and corpuscles turned out to be approximately the same. As a result of the stability of that quantity across different experimental contexts, several experimental situations (the Zeeman effect, cathode rays, *thermionic emission*, the photoelectric effect, beta-rays, etc.) came to be considered observable manifestations of the same entity, the electron.

ARABATZIS, *supra* note 224, at 107-08. (citations omitted) (emphasis added).

[365] See *supra* text accompanying note 222.

[366] *See supra* text accompanying notes 343-346.

material to engage in a causal process (i.e., thermionic emission).[367] The patent system's commitment to scientific essentialism warrants the district court's treatment of the sleeve's work function as an essential property of each embodiment of the claims,[368] even though work function may vary widely among different specimens of the same metallic element and under different conditions of use.[369] As the court explained in its ruling on indefiniteness, any embodiments with silver sleeves that fall within the scope of Esab's claims do so in virtue of the sleeves' work functions rather than their silver composition.[370]

Finally and most crucially, the Federal Circuit's judgment of noninfringement illustrates that the warrants provided by scientific essentialism and scientific realism to the patent system's ontological commitments are limited in scope by their epistemological reliance on the argument from the best explanation.[371] The district court's findings regarding the elemental composition of Centricut's accused electrode[372] did not warrant a *de re* ontological commitment to the electrode as an embodiment of the claim, because such a commitment could not be grounded in the best available scientific theories.[373] In the absence of other record evidence regarding the scientific theories pertaining to work function, the Federal Circuit credited the testimony of the only expert in the case qualified on the subject.[374] Given the expert's testimony to the effect that the unobserved[375] work function of the accused electrode's sleeve was neither an intrinsic property of the elemental silver observed in the sleeve's composition[376] nor an adequate explanation for the electrode's observed durability,[377] the argument from the best explanation could not justify a reasonable belief that the accused electrode was an example of the claim.[378]

The above examination of the *Centricut* case serves to situate the role of enablement doctrine in warranting the patent system's ontological

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[367] *See supra* text accompanying note 337. The parties agreed to construe the term "work function" as it was defined in Esab's patent. Centricut, 390 F.3d at 1364.

[368] See supra text accompanying note 192.

[369] *See supra* text accompanying notes 208-211.

[370] *See supra* text accompanying note 346.

[371] *See supra* text accompanying notes 226-229.

[372] *See supra* text accompanying note 347.

[373] See supra text accompanying note 221.

[374] See supra text accompanying notes 360-361.

[375] *See supra* text accompanying note 354.

[376] *See supra* text accompanying note 357.

[377] *See supra* text accompanying note 359.

[378] *See supra* text accompanying note 360-361; *cf. supra* text accompanying notes 222-225 (explaining argument from the best explanation as the main justification for scientific essentialism's ontological commitment to electrons as a natural kind).

commitments to claims as kinds whose examples are (possible) embodiments with essential causal powers. Given that claims are novel kinds, most of whose examples are unobservable entities,[379] such warrants rely heavily on scientific realism and are justified in doing so by the argument from the best explanation. The warranting role of an enabling disclosure, then, is to furnish any theoretical or factual support that may be required in addition to the support provided by information known in the art, in order to satisfy the patent system that such reliance on the argument from the best explanation is justified.

The enablement requirement is met if one of skill in the art "could make or use the invention from disclosures in the patent coupled with information known in the art without undue experimentation."[380] The ability of a reader of the patent disclosure to "make … the invention … without undue experimentation" logically implies the possible existence of embodiments as entities. What remains to be warranted by the ability to "use the invention … without undue experimentation" is the ontological status of the claim as a kind whose examples are embodiments with essential causal powers.[381] This task is effectively performed by patent law's operable utility doctrine,[382] which requires that the claimed invention "be 'capable of being used to effect the object proposed.'"[383]

Under the operable utility doctrine, the patent system is normally inclined to admit a claim into its ontology of "useful Arts" on the basis of a filed patent application's representation that embodiments of the claim can be used for the described purpose.[384] Where there are "factual reasons

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[379] *See supra* section III.B.3.

[380] United States v. Telectronics, Inc., 857 F.2d 778, 785 (Fed. Cir. 1988).

[381] *See supra* text accompanying notes 166-170; *see generally* Atlas Powder.

[382] Enablement entails operable utility. *See, e.g.*, Process Control Corp. v. HydReclaim Corp., 190 F.3d 1350 (Fed. Cir. 1999) ("If a patent claim fails to meet the utility requirement because it is not useful or operative, then it also fails to meet the how-to-use aspect of the enablement requirement.").

[383] Mitchell v. Tilghman, 86 U.S. (19 Wall.) 287, 396 (1873) (citation omitted) ("To meet the utility requirement, the Supreme Court has held that a new product or process must be shown to be 'operable' — that is, it must be 'capable of being used to effect the object proposed.'").

[384] *See* In re Swartz, 232 F.3d 862, 864 (Fed. Cir. 2000) (citations omitted) ("The PTO has the initial burden of challenging a patent applicant's presumptively correct assertion of utility."); *see also* Ex parte Dash, 27 U.S.P.Q.2d 1481, 1484 (Bd. Pat. App. & Int'f 1993), *aff'd*, 118 Fed. Appx. 488 (Fed. Cir. 2004) (unpublished opinion), *cert. denied*, 126 S. Ct. 346 (2005) ("A disclosure of a utility satisfies the utility requirement of section 101 unless there are reasons for the artisan to question the truth of such disclosure."); In re Gazave, 379 F.2d 973 (C.C.P.A. 1967) ("[I]n the usual case where the mode of operation alleged can be readily understood and conforms to the known laws of physics and chemistry,

which would lead one skilled in the art to question the objective truth of the statement of operability,"[385] however, the patent system cannot accept such a representation as an ontological warrant, and therefore requires proof of utility sufficient to convince one skilled in the art.[386] Furthermore, patent law recognizes no scientific theories capable of supporting a belief in the existence and causal powers of a perpetual motion device,[387] and the patent system in such a case can find warrant for a *de dicto* ontological commitment to this kind of device only in a direct observation of an embodiment that can also warrant *de re* ontological commitments to both the claim and the embodiment.[388]

The patent system's commitment to scientific realism[389] thus manifests itself doctrinally as a rather liberal approach to epistemological justification, at least when it comes to *de dicto* commitment to a claim. Absent factual or theoretical inconsistencies with the argument from the best explanation, the patent system may find an acceptable warrant for such a commitment in the bare assertion that a kind of (possible) entity with certain essential causal powers exists in *this* (mind-independent) world, and not merely the (mind-dependent) world of the inventor's conception.

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operativeness is not questioned, and no further evidence is required.").

[385] In re Gaubert, 524 F.2d at 1224.

[386] *See supra* text accompanying notes 233-235.

[387] *See supra* notes 236-241 and accompanying text; *see also* In re Gazave, 379 F.2d at 978 ("[I]f the alleged operation seems clearly to conflict with a recognized scientific principle as, for example, where an applicant purports to have discovered a machine producing perpetual motion, the presumption of inoperativeness is so strong that very clear evidence is required to overcome it.").

[388] *See supra* text accompanying note 232.

The distinction between *de re* and *de dicto* ontological commitments to embodiments may be material to patentability, e.g., where an examiner relies on the applicant's experimental results. *See* Hoffmann-La Roche, Inc. v. Promega Corp., 323 F.3d 1354, 1367-68 (Fed. Cir. 2003).

To maintain this distinction, the patent system has adopted the linguistic practice of referring to a disclosed embodiment in the past tense only where *de re* ontological commitment is warranted. *See id.* at 1363-64 ("Example VI is written in the past tense…. From the language used, a reader of the patent would conclude that the protocol was performed and that the following results were actually achieved."); MPEP, supra note 209, at § 608.01(p) ("No results should be represented as actual results unless they have actually been achieved. Paper examples should not be described using the past tense.").

To the extent that warrants for *de re* ontological commitment entail evidence of actual existence, the patent system may find that a disclosure provides a warrant for *de dicto* but not *de re* commitment. For example, prophetic examples can provide support for a claim if enabling. *See* Atlas Powder Co. v. E.I. du Pont DeNemours & Co., 750 F.2d 1569 (Fed. Cir. 1984) (accepting trial court's finding that prophetic examples "would be helpful in enabling someone to make the invention").

[389] *See supra* section III.B.3.

D. The Ontological Status of "Abstract Ideas"

In this Part, I have presented a descriptive theory of the ontology of "useful Arts" as it is revealed by the patent system's legal doctrines and practices. In this ontology, claims are novel kinds of embodiments;[390] and embodiments are entities whose properties include essential causal powers,[391] and whose possible existence is therefore warranted by scientific essentialism and scientific realism.[392] Many of the most fundamental and well-established doctrines of patent law commit the patent system to this ontology, including (1) the patentable subject matter requirement, which confines patentability to kinds of entities having causal powers;[393] (2) doctrines pertaining to generic disclosure,[394] inherent disclosure,[395] and operable utility,[396] which presuppose that the possible embodiments of a claim possess certain (variable) causal powers in virtue of being examples of the kind defined by the claim; (3) the doctrines of constructive reduction to practice, anticipation and infringement, which entail commitments to claims and embodiments in this ontology;[397] (4) the written description requirement, which serves in part to satisfy the patent system's criteria for incurring such commitments;[398] and (5) the enablement requirement, which serves in part to warrant such commitments.[399] Several other well-known features of the patent system are also consistent with this ontological picture, including the infinite scope of patent claims,[400] the prohibition on inferential claiming,[401] the construction of preambular language in claims,[402] and the near elimination of the Patent Office's working model requirement.[403]

If this theory correctly describes the patent system's implicit ontology, then it also provides a precise criterion for distinguishing between a patent-ineligible abstract idea and a patent-eligible "practical method or means of

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[390] *See supra* section III.A.
[391] *See supra* sections III.B.1 & III.B.2.
[392] *See supra* sections III.B.2 & III.B.3.
[393] *See supra* text accompanying note 163.
[394] *See supra* text accompanying notes 169-170.
[395] *See supra* text accompanying notes 171-174.
[396] *See supra* text accompanying notes 230-232.
[397] *See supra* text accompanying notes 291-301.
[398] *See supra* text accompanying section III.C.3.
[399] *See supra* text accompanying section III.C.4.
[400] *See supra* text accompanying note 167.
[401] *See supra* text accompanying note 122.
[402] *See supra* text accompanying notes 189-191.
[403] *See supra* text accompanying notes 230-232.

producing a beneficial result or effect."[404] The latter characterization is applicable only to claims whose embodiments are entities whose properties include essential causal powers, and whose possible existence is therefore warranted by scientific essentialism and scientific realism;[405] i.e., claims I have referred to as meeting the *essential causation requirement*.[406]

In other words, the essential causation requirement states a necessary and sufficient condition for the subject matter of a patent claim to be sufficiently concrete to satisfy the ontological demands of the patent system's doctrines and practices. A claim covering subject matter that does not meet the requirement is unpatentable as directed to an abstract idea. The remainder of this Article will describe the scope of subject matter that does and does not meet the essential causation requirement, illustrate the requirement's potential application in guarding against the claiming of abstract ideas, and relate the requirement to *Bilski*'s "machine-or-transformation" test.

IV. THE ESSENTIAL CAUSATION REQUIREMENT

A. Essentialist Realism and the Scope of Ontological Warrant

We have already seen that the essential causation requirement imposes a meaningful limitation on patentable subject matter. As the *Centricut* case illustrates, the warrants provided by scientific essentialism and scientific realism to the patent system's ontological commitments are limited in scope by their epistemological reliance on the argument from the best explanation.[407] To formulate a general characterization of the class of entities whose properties include essential causal powers, and whose possible existence is warranted by scientific essentialism and scientific realism, however, it is necessary to return to the metaphysics literature.

Brian Ellis, on whose theory of scientific essentialism the essential causation requirement is based, has argued that scientific essentialism entails a particular kind of scientific realism, which he calls "essentialist realism."[408] According to Ellis:

> Essentialist realism only requires realism about those theoretical entities that are postulated as being essentially involved in the causal processes described in our best causal-process theories. Some of these are things to which any

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[404] *See supra* note 159 and accompanying text.
[405] *See supra* text accompanying notes 390-392.
[406] *See supra* text accompanying note 79.
[407] *See supra* text accompanying notes 371-378.
[408] *See* ELLIS, *supra* note 80, at 145-46.

> scientific realist ought to be committed. Yet, essentialist realist is almost unique among forms of scientific realism in that it implies realism about the causal powers, capacities, and propensities of the things postulated as participants in these causal processes. It treats all such modal properties as genuine, not just as convenient fictions.[409]

This description of essentialist realism is of a piece with Ellis's other writings on the scope of the ontology of scientific realism, in which he holds that the scope of scientific realism's ontological warrant is limited to the theoretical entities of causal process theories.[410] According to Ellis, the argument from the best explanation, on which scientific realism relies, applies strictly only to such entities, "[f]or it gains its strength from the roles these entities are supposed to have in bringing about what is to be explained. The world has to be *as if* these things existed."[411] For example, Ellis describes a causal process explanation of Donald Glaser's bubble chamber experiment:[412]

> When tracks appear in a bubble chamber, for example, we may explain their appearance by the ionizing effects of certain fundamental particles…. The theory, if it is any good, explains the appearance of the tracks in considerable detail — their thickness, curvature, and sudden deviations of direction — all in a manner which is compatible with some very general conservation and symmetry principles which we suppose to govern the behaviour of the fundamental particles. Such an explanation as this undoubtedly carries an ontological commitment. To accept the theory is to accept that the particles in question exist, that they have the

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[409] *Id.* at 146. Throughout this part, it should be noted that the term "process" is used in various theories of causation in a different sense from the term "process" as it appears in the Patent Act, and does not necessarily refer to a patent-eligible "process." *See* In re Nuijten, 500 F.3d 1346, 1355 (Fed. Cir. 2007) ("[A] process claim must cover an act or series of acts").

[410] *See, e.g.*, Brian Ellis, *The Ontology of Scientific Realism*, *in* METAPHYSICS & MORALITY: ESSAYS IN HONOUR OF J.J.C. SMART (J.J.C. Smart et al. eds. 1987), at 50, 56.

Ellis is not alone in taking causal involvement as a warrant for ontological commitment. *See, e.g.*, D.M. ARMSTRONG, A THEORY OF UNIVERSALS 5 (1980) ("A general argument is given against postulating any of these entities. They all lack causal power; they do not act."); JERRY A. FODOR, HUME VARIATIONS 136 (2003) ("Whatever the right story about numbers and the like may be, the proof of ontological commitment to a kind of concrete particulars is that they are acknowledged as links in causal chains.").

[411] *Id.*

[412] *See* Donald A. Glaser, *Some Effects of Ionizing Radiation on the Formation of Bubbles in Liquids*, 87 PHYSICAL REV. 665 (1952).

> properties which are ascribed to them, and that they interact with each other in the ways they are said to.[413]

In contrast, the argument from the best explanation does not apply to "theoretical entities occurring in other kinds of theories which are not supposed to have any such causal roles."[414] Ellis refers to these theories as "abstract model theories,"[415] and describes the entities involved in such theories as "ideal types of one kind or another," whose properties are often "ones which no ordinary physical system does, or even could, possess."[416] Ellis finds that "[f]ar from there being any commitment to the existence of these entities, there may even be a commitment to their non-existence."[417] For example, Ellis describes Euclidean geometry as a model-theoretic explanation of spatial relationships:

> We can use it to explain why this angle is equal to that one, why this distance is twice as great as that one, or why this volume is greater than that. But the points, lines and planes of Euclidean geometry have properties which no physical systems could have. Consequently, there is no question of their being such entities in nature. There are certain things which we can represent theoretically as points, lines or planes in a Euclidean space. Therefore, we can use the theory to make predictions about the spatial relationships which ought to hold between such things. But so far there are no references to any physical causal processes. And none would be required at all if the predictions made using the theory proved to be sufficiently accurate.[418]

Ellis concludes that "[n]either Euclidean figures, nor the abstract ideal entities of which they are composed, can make any claim to reality."[419]

Ellis is unwilling to find warrants for the ontology of scientific realism in the theorems of Euclid, but is content to find them in the theories of Einstein. Ellis "fairly confidently" ascribes the world view of scientific essentialism to the structural principles of general relativity,[420] in which he envisions "a global causal structure" where "all of the events and processes

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[413] BRIAN ELLIS, TRUTH AND OBJECTIVITY 21 (1990).
[414] *Id.*
[415] *See* ELLIS, *supra* note 80, at 145.
[416] *See* ELLIS, *supra* note 413, at 21.
[417] *Id.*
[418] *Id.* at 25.
[419] *Id.* at 26-27.
[420] *See id.* at 249 ("We can say fairly confidently, first, that ours is an expanding four-dimensional space-time world that is structured according to the principles of General Relativity.").

occurring in the world (including the Big Bang and the process of inflation) consist ultimately of energy (and other conserved quantity) transmission processes and the instantaneous changes of state by which such processes are initiated or terminated."[421]

Ellis's account of the ontology of scientific realism holds that "all causal interactions are reducible to basic interactions between fundamental particles," and that all causes and effects "are related somehow by energy transfer processes."[422] Similarly, scientific essentialism holds that there are "fundamental dispositional properties of things [that] are the truth-makers for the most fundamental causal laws that ultimately determine the ways in which things are disposed to behave, or with what probabilities they will be so disposed," and that these properties are displayed in "the instances of the most fundamental natural kinds of processes," i.e., "basic causal interactions and energy transmission processes."[423] By this account, entities with essential causal powers are essentially involved in causal processes — and therefore come within the scope of essentialist realism's ontological warrant[424] — insofar as they are intrinsically disposed to behave as they do in virtue of being examples of their kinds.[425]

While Ellis describes his account of causal processes as "comprehensive,"[426] there are at least two highly similar but more detailed causal process theories available to inform the ontology of scientific realism: namely, those of Wesley Salmon and Phil Dowe. As a reviewer of Ellis has observed, Ellis's concept of a causal process "bears a strong family resemblance" to these theories.[427] In the next section, I will show how certain features of Salmon's and Dowe's causal process theories can aid in the task of circumscribing the patent system's ontology of "useful Arts," specifically by highlighting the metaphysical significance of the distinction between kinematic and kinetic properties.

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[421] *See id.* Ellis explains that the elementary transmission processes he has in mind are "conservative of mass-energy, charge, spin, momentum, and all other universally conserved quantities." *Id.*

[422] *See* Ellis, *supra* note 410, at 64.

[423] *See* ELLIS, *supra* note 80, at 217-18.

[424] *See supra* text accompanying note 409.

[425] *See id.* at 217 ("[A]nything that has a causal power essentially must be disposed to behave as it does when this power is activated, not because of anything extrinsic to it … but because, in virtue of its being a thing of this kind, it is intrinsically disposed to behave in this way.").

[426] *See* Ellis, *supra* note 410, at 65.

[427] Anjan Chakravartty, *Review of Brian Ellis,* The Metaphysics of Scientific Realism, 7 NOTRE DAME PHIL. REV. 2 (2010).

B. Causal Processes, Kinematics and Kinetics

Salmon developed two different causal process theories, presented in books published in 1984[428] and 1998;[429] Dowe's theory is presented in a 2000 volume.[430] Salmon acknowledged a heavy debt to Dowe in the development of his 1998 theory,[431] which is similar in many ways to Dowe's.[432] A full survey of these theories is beyond the scope of this Article; interested readers may consult the respective books for details. It is sufficient here to discuss certain salient features of Salmon's earlier theory and of Dowe's theory.

Salmon developed his first causal process theory (hereinafter referred to simply as "Salmon's theory") in the 1980s[433] as a "theory of causality in which processes, rather than events, are taken as fundamental."[434] In Salmon's theory, processes include "waves and material objects that persist through time,"[435] and may be represented by lines on a *space-time diagram*.[436] Space-time diagrams use a coordinate plane to depict the positions of objects over time relative to some *inertial reference frame*.[437] By convention, the vertical coordinate axis of a space-time diagram is devoted to time, so the diagram is limited to showing positions in only one dimension. For example, Figure 1 shows the trajectories of two balls of different masses moving in the same direction along a line, but at different speeds. After the more massive, faster black ball collides with the smaller, slower gray ball, their respective speeds change: the black ball decelerates slightly, and the gray ball accelerates away from it.

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[428] WESLEY C. SALMON, SCIENTIFIC EXPLANATION AND THE CAUSAL STRUCTURE OF THE WORLD (1984).

[429] WESLEY C. SALMON, CAUSALITY AND EXPLANATION (1998).

[430] PHIL DOWE, PHYSICAL CAUSATION (2000).

[431] *See* Wesley C. Salmon, *Causality Without Counterfactuals*, 61 PHIL. SCI. 297, 298 (1994) ("I will attempt to show how the account can be modified so as to remove the genuine shortcomings. In this … endeavor I rely heavily on work of P. Dowe.").

[432] *See* Phil Dowe, *Causality and Conserved Quantities: A Reply to Salmon*, 62 PHIL. SCI. 321, 321 (1995) ("Salmon and I agree on much.").

[433] For a preliminary version of Salmon's earlier causal process theory, *see* Wesley C. Salmon, *Causality: Production and Propagation*, *in* CAUSATION (Ernest Sosa & Michael Tooley eds. 1988).

[434] *See* SALMON, *supra* note 428, at 140.

[435] *See id.* at 140.

[436] *See id.* at 139.

[437] *See generally* JURGEN FREUND, SPECIAL RELATIVITY FOR BEGINNERS 47-78 (2008) (providing a general introduction to space-time and Minkowski diagrams).

An inertial reference frame is an observational perspective that is "rectilinear, uniform, and irrotational (i.e. without any acceleration)," as is the case of objects that are "not acted on by any forces" and are thus "subject to the principle of inertia." *See id.* at 4.

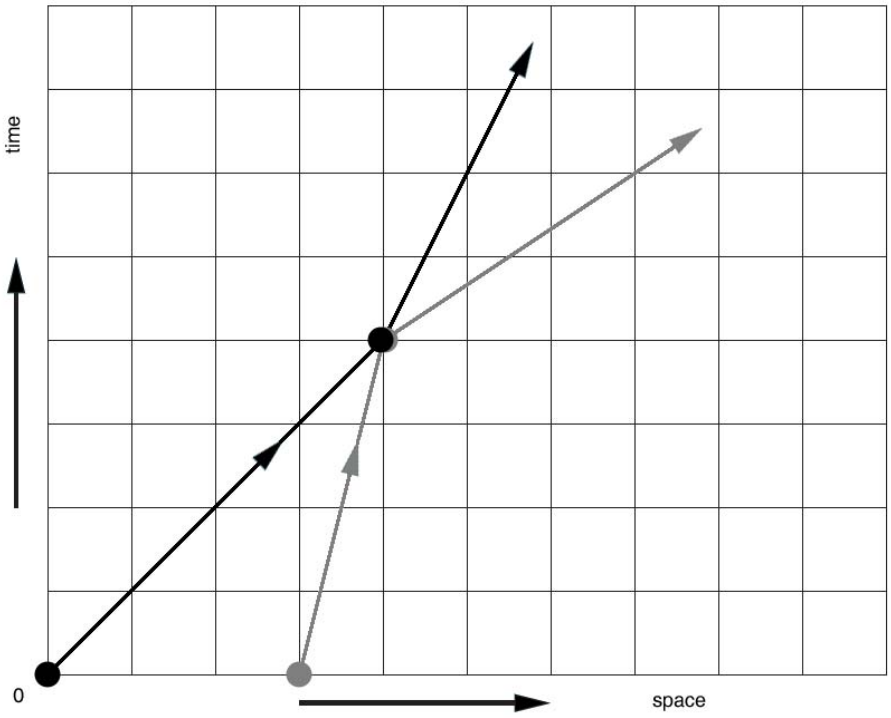

Figure 1. A space-time diagram illustrating the trajectories of two balls before and after a collision.

In illustrating the principles of special relativity, it is customary to set the scales for the coordinate axes so that a line with unit slope (i.e., at 45 degrees) represents an object moving at the speed of light. Space-time diagrams that employ this convention are called *Minkowski diagrams*, after Hermann Minkowski, the pioneering geometric interpreter of Einstein's special theory of relativity.[438] A *world line* is the trajectory of an object on a Minkowski diagram.[439] An *event* is represented by a point on a Minkowski diagram.[440]

According to Einstein's theory, objects moving at the speed of light do so with respect to all inertial reference frames.[441] This fact is illustrated in the Minkowski diagram of Figure 2, in which the coordinate systems for

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[438] *See* DAVID J. GRIFFITHS, INTRODUCTION TO ELECTRODYNAMICS 503-04 (1999).
[439] *See id.* at 503.
[440] *See* FREUND, *supra* note 437, at 50-51.
[441] *See id.* at 9 (stating this as "Einstein's second postulate").

two inertial reference frames are superimposed.[442] Even though one observer is moving relative to the other (along trajectory x'), a photon appears to both observers to be moving at the speed of light; i.e., it has the same world line in both frames.

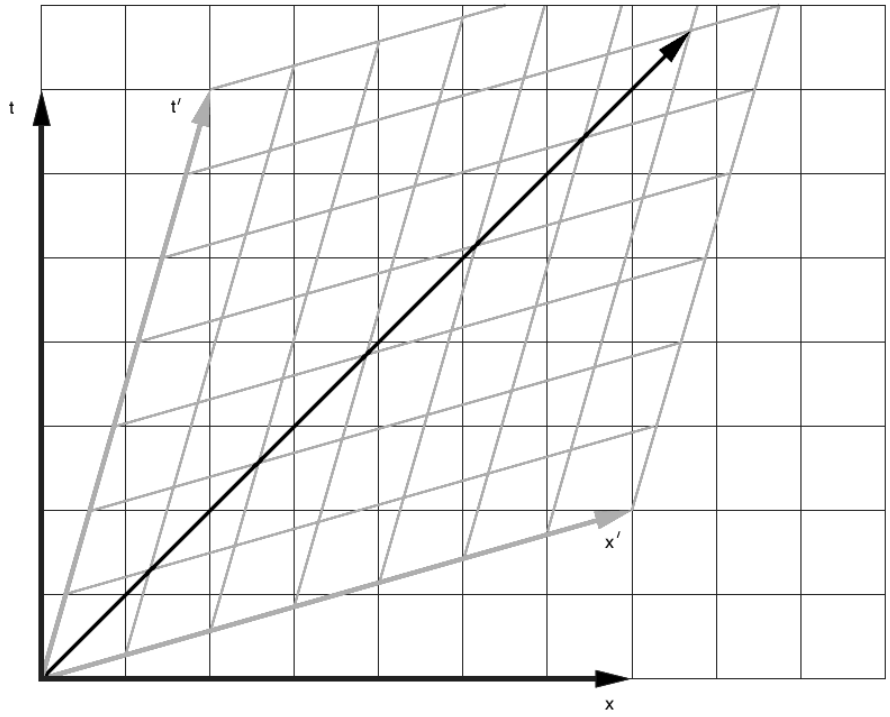

Figure 2. Trajectory of a photon relative to two different inertial frames of reference.

Minkowski diagrams can geometrically illustrate the principle that the propagation of causal influence through spacetime is limited by the speed of light.[443] As Salmon explains:

> [A]ny given event E_0, occurring at a particular space-time point P_0, has an associated double-sheeted light cone. All events that could have a causal influence on E_0 are located in the interior or on the surface of the past light cone, and all

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[442] *Cf. id.* at 50 (illustrating superimposition of space-time diagrams for two inertial reference frames).

[443] *See* GRIFFITHS, *supra* note 438, at 504.

> events upon which E_0 could have any causal influence are located on the interior or on the surface of the future light cone…. [T]hose [events] that are outside of the cone are said to have a spacelike separation from E_0.

Figure 3 is a Minkowski diagram illustrating two events, A and B, relative to the inertial reference frames of the same two observers as in Figure 2. From one observer's perspective, event A precedes event B; from the other observer's perspective, event B precedes event A. Note, however, that the light cones from events A and B are invariant with respect to inertial reference frames, since their surfaces may be traced out by objects moving at the speed of light as in Figure 2. Thus, from either observer's perspective, A and B lie outside each other's light cones, and A and B are spacelike separated. The possibility of causal influence thus turns out to be a question not of temporal precedence, but of separation in spacetime.

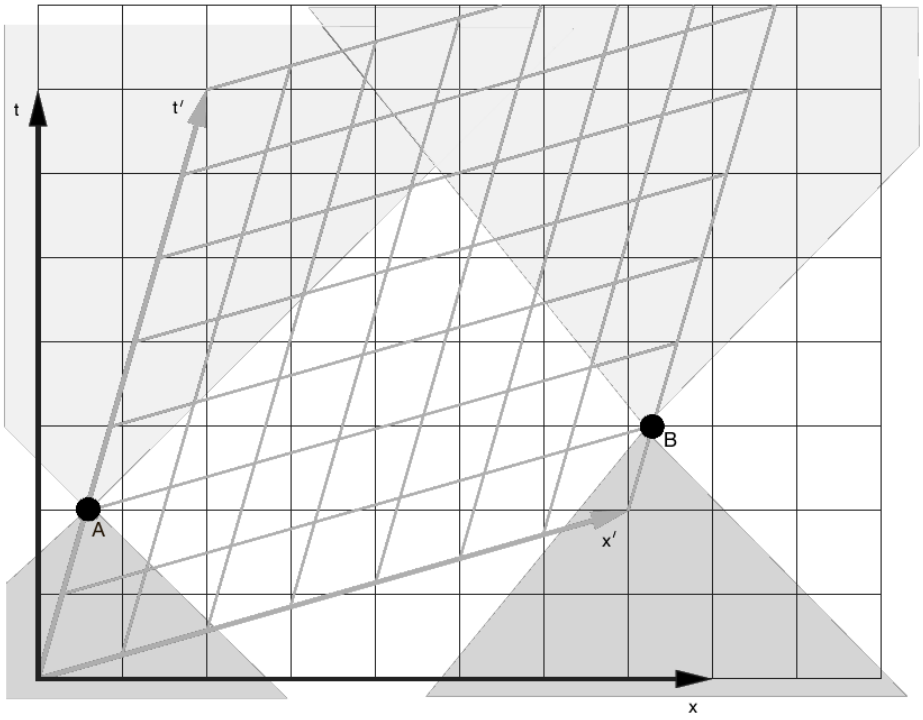

Figure 3. Light cones of events A and B. Neither event can have a causal influence on the other, because they do not lie in each other's light cones.

Just as some pairs of events may not causally influence each other, some lines on a Minkowski diagram may not represent processes capable of

propagating causal influences. Salmon uses the term "causal process" to refer to a process (i.e., an entity represented by a line on a space-time diagram) that is capable of propagating causal influence and transmitting energy and information,[444] and uses the term "pseudo-process" to refer to a process that lacks these capabilities.[445] He notes that while causal processes are limited by the speed of light, pseudo-processes are not:

> Special relativity demands that we make a distinction between causal processes and pseudo-processes. It is a fundamental principle of that theory that light is a first signal — that is, no signal can be transmitted at a velocity greater than the velocity of light in a vacuum. There are, however, certain processes that can transpire at arbitrarily high velocities — at velocities vastly exceeding that of light. This fact does not violate the basic relativistic principle, however, for these 'processes' are incapable of serving as signals or of transmitting information. Causal processes are those that are capable of transmitting signals; pseudo-processes are incapable of doing so.[446]

As an example of a pseudo-process that exceeds the speed of light, Salmon describes a rotating spotlight mounted on a rotating mechanism at the center of a very large circular building. If the rotation is fast enough (say, one revolution per second) and the enclosure is large enough (say, over 50,000 kilometers), then the spot of light that it casts on the walls of the enclosure moves at a velocity that exceeds the speed of light. The spot is a process, in that it can be represented by a line on a space-time diagram. The spot is not, however, capable of propagating causal influence or transmitting energy or information. In short, it is incapable of "transmitting a mark," in the following sense:

> [W]e can place a red filter at the wall with the result that the spot of light becomes red at that point. But if we make such a modification in the traveling spot, it will not be transmitted beyond the point of interaction. As soon as the light spot moves beyond the point at which the red filter was placed, it will become white again. The mark can be made, but it will not be transmitted.[447]

Because of this inability, Salmon describes the moving spot of light on the wall as "a paradigm of what we mean by a pseudo-process." According to

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[444] *See* SALMON, *supra* note 427, at 146.
[445] *See id.* at 141.
[446] *Id.*
[447] *Id.* at 142.

Salmon, "[t]he basic method for distinguishing causal processes from pseudo-processes is the criterion of mark transmission."[448]

Dowe rejects Salmon's mark-transmission criterion, finding that it "fails to adequately capture the distinction between causal and pseudo processes."[449] Dowe's causal process theory is based on the idea that "it is the possession of a conserved quantity, rather than the ability to transmit a mark, that makes a process a causal process."[450] The theory consists of two propositions:

> CQ1. A *causal process* is a world line of an object that possesses a conserved quantity.
>
> CQ2. A *causal interaction* is an intersection of world lines that involves exchange of a conserved quantity.[451]

Informally, the respective roles of causal processes and causal interactions are to transmit and produce *causal influence*.[452]

Dowe illustrates his theory with the following account of a causal relation as a series of causal processes and interactions. Figure 4 illustrates "a transmutation reaction where a nitrogen atom ($^{14}_{7}$N) is hit by an alpha particle ($^{4}_{2}$He), producing an oxygen atom ($^{17}_{8}$O) and a proton ($^{1}_{1}$He)." The intersection of the two world lines indicates a causal interaction where one unit of charge (a conserved quantity) is transferred from the alpha particle to the nitrogen atom.

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[448] *See id.*
[449] DOWE, *supra* note 430, at 79.
[450] *See id.* at 89.
[451] *See id.* at 90.
[452] *See id.* at 147.

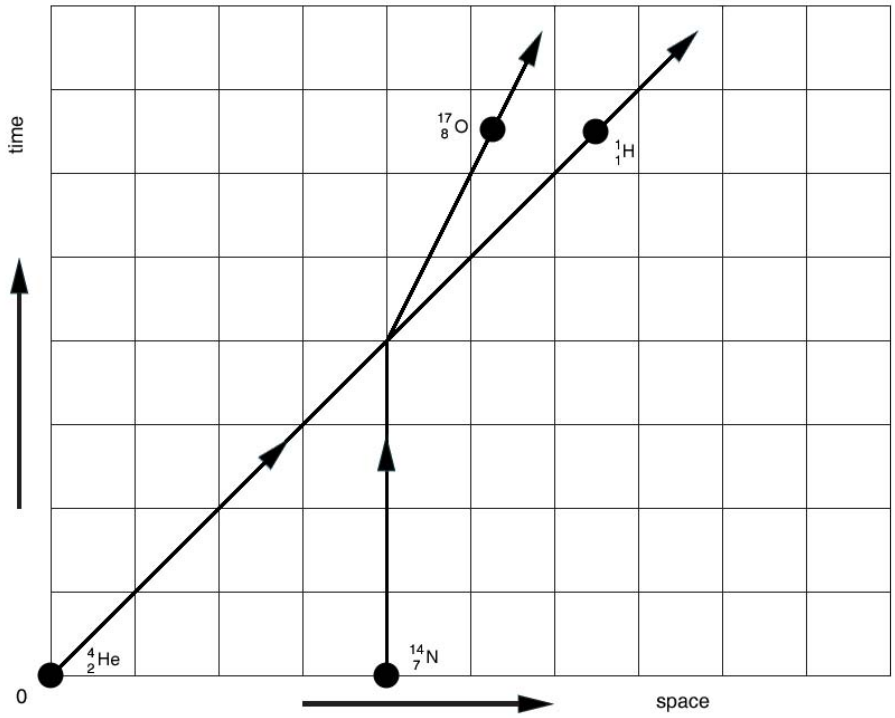

Figure 4. Causal processes and interaction involved in a transmutation reaction.

Dowe's theory defines a pseudo-process as a process that does not possess a conserved quantity.[453] A conserved quantity is "any quantity that is governed by a conservation law, and current scientific theory is our best guide as to what these are: quantities such as mass-energy, linear momentum, and charge."[454] Salmon's spot is also an example of a pseudo-process in Dowe's theory, because it does not possess a conserved quantity. As Dowe explains:

> The causal processes involved … are the light beam (energy, momentum) and the wall (mass). The spot or moving patch of illumination cannot be ascribed a conserved quantity. It has other quantities: size, speed, position; but no conserved quantity. The exchange involved in the interaction between the wall and the light beam involves, for example,

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[453] *See id.* ("To generalize, pseudo processes do not possess the type of physical quantities that are governed by conservation laws.").

[454] *See id.* at 94.

> momentum (the light's momentum is changed on reflection by the wall) or energy (some energy of the reflected beam is lost to heat transferred initially to the molecules of the wall's surface, and subsequently dissipated). No energy is brought to the interaction by the spot or carried off by the spot. Spots do not possess energy.[455]

An object is "anything found in the ontology of science (such as particles, waves and fields), or common sense (such as chairs, buildings and people)" and can include "noncausal objects such as spots and shadows."[456] Dowe's theory is therefore well suited to both the macroscopic scale inhabited by most patented inventions, as well as the microscopic scale in which Ellis's ontology of causation is fundamentally grounded.[457]

According to Dowe, for two token events[458] to be connected in a causal relation, it is necessary (but not sufficient) that a continuous line of causal processes and interactions can be traced between them.[459] Dowe appears to

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[455] Phil Dowe, *An Empiricist Defence of the Causal Account of Explanation*, 6 INT'L STUD. PHIL. SCI. 123, 127 (1992).

Because a spot lacks tangible causes and effects, it is even more "transient," "fleeting" and intangible than the claimed "signal" at issue in In re Nuijten, 500 F.3d 1356 (Fed. Cir. 2007). In determining that "a transient electric or electromagnetic transmission" was not a patent-eligible "manufacture," Judge Gajarsa reasoned:

> While such a transmission is man-made and physical — it exists in the real world and has tangible causes and effects — it is a change in electric potential that, to be perceived, must be measured at a certain point in space and time by equipment capable of detecting and interpreting the signal. In essence, energy embodying the claimed signal is fleeting and is devoid of any semblance of permanence during transmission. Moreover, any tangibility arguably attributed to a signal is embodied in the principle that it is perceptible — e.g., changes in electrical potential can be measured.

Id. at 1356.

[456] *See* DOWE, *supra* note 430, at 91.

[457] *Cf.* Brian Ellis, *Causal Laws and Singular Causation*, 61 PHIL. & PHENOMENOLOGICAL RES. 329, 347 (2000) ("No doubt all instances of causation are reducible to elementary causal processes involving elementary events and processes, and all elementary causal processes must be instances of causal laws. But the standard exemplars of causal processes are not elementary. Typically, they involve a great many microlevel processes, occurring in a kind of avalanche.").

[458] *See supra* text accompanying 96 for an explanation of the type-token distinction.

[459] *See* DOWE, *supra* note 430, at 146-48 (stating the encompassing necessary and sufficient condition as a "naïve process theory" and concluding that there is "reason to suppose that the naïve process theory does provide a necessary condition for singular causation"); Phil Dowe, *Review Article*: Causality and Explanation, 51 BRIT. J. PHIL. SCI. 165, 173 (2000) ("We must conclude that the conserved quantity theory … provides only a necessary condition for singular causation."); Phil Dowe, Causes Are Physically Connected

be correct,[460] at least as long as *negative causation* is excluded from consideration as a causal relation.[461] Negative causation "occurs when an absence serves as cause, effect, or causal intermediary."[462] While negative causation can figure in causal accounts of legal responsibility (e.g., in theories of negligence or breach of contract),[463] it does not have a place in the patent system's ontology of "useful Arts," inasmuch as the scope of the patent right is limited to affirmative acts such as making and using the structural elements or performing the steps recited in a claim.[464] Thus, it is reasonable to conclude that Dowe's theory accurately describes the instances of causal processes and causal interactions that display the essential causal powers of a claim's embodiments.[465]

In contrast, consider a claim such that for an embodiment to meet all of its limitations, it is sufficient that the use of the embodiment involve the movement of one or more structural elements relative to some observer in trajectories in space-time that satisfy some specified geometric properties. In particular, the claim does not impose limitations regarding any conserved quantities such objects exchange, so that even if the use of an embodiment inherently involves the exchange of a conserved quantity, any such exchange is not necessary to the display of the embodiment's causal powers in virtue of the embodiment's being an example of the claim. This is the

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to Their Effects: Why Preventers and Omissions Are Not Causes

[460] Ellis makes an even stronger claim, in arguing that type-level causation is ultimately determined by "basic causal interactions and energy transmission processes." *See supra* text accompanying note 423. It is also worth noting that Dowe's conserved quantity account ultimately persuaded Salmon. *See supra* note 431 and accompanying text.

[461] *Compare* Phil Dowe, *Causes Are Physically Connected to Their Effects: Why Preventers and Omissions Are Not Causes*, *in* CONTEMPORARY DEBATES IN PHILOSOPHY OF SCIENCE (Christopher Hitchcock ed. 2004), at 189, 190 (arguing that cases involving negative events are not, strictly speaking, cases of causation); *with* Jonathan Schaffer, *Causes Need Not Be Physically Connected to Their Effects: The Case for Negative Causation*, *in* CONTEMPORARY DEBATES IN PHILOSOPHY OF SCIENCE (Christopher Hitchcock ed. 2004), at 197, 197 (arguing that negative causation does not necessarily involve connection by causal processes and interactions).

[462] *See* Schaffer, *supra* note 461, at 197.

[463] *See id.* at 201 (citing HART & HONORÉ, *supra* note 36, at 2-3).

[464] See 35 U.S.C. § 154.

An absence is not cognizable as an element of a claim without a supporting structural element. *Compare* Margaret A. Boulware, *An Overview of Intellectual Property Rights Abroad*, 16 HOUS. J. INT'L L. 441, 447 n. 23 (1994) ("[O]ne cannot claim a "hole" because a hole is "nothing." One must therefore claim some structure "having a hole."); *with* FABER, *supra* note 119, at § 3.18, at 3-68 (noting that while "[y]ou may claim holes positively and make them claim elements," the "[b]etter practice is to claim "a [member] having a hole, groove, slot, aperture, etc.").

[465] *See supra* text accompanying notes 423-425.

sort of claim that I have previously referred to as a claim directed to a *kinematic property*.[466] Such a claim does not meet the essential causation requirement, because any causal interactions that happen to be involved in the use of its embodiments are not displays of *essential* causal powers.[467]

Some claims directed to kinematic properties have embodiments that lack any causal powers at all. For example, the embodiments of the following claim include the spot pseudo-process described by Salmon:

> 1. An object on a cylindrical surface, said object moving counterclockwise on said cylindrical surface at a rate of at least one revolution per second.[468]

Claims directed to kinematic properties are a significant enough subclass of the class of claims that fail the essential causation requirement for us to speak of a "kinematic property exclusion" from patentable subject matter. The next Part will present two case studies that illustrate the application and scope of the kinematic property exclusion.

V. THE KINEMATIC PROPERTY EXCLUSION

A. Structural Applications of the Pythagorean Theorem

Credited to Pythagoras but possibly known to the Babylonians and/or the Chinese a millennium earlier,[469] the Pythagorean Theorem is known to us today as an equation, $a^2 + b^2 = c^2$, expressing the relationship between the length c of the hypotenuse of a right triangle and the lengths a and b of the other two sides[470] (also known as "legs"[471]). Stated more formally:

> Theorem 1. (The Pythagorean Theorem) Let ΔABC be a right triangle, with its right angle at C. Then $AB^2 = AC^2 + BC^2$.[472]

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[466] *See supra* text accompanying note 86.

[467] *Cf.* Kit Fine, *Essence and Modality*, 8 PHILOSOPHICAL PERSPECTIVES 1, 13 (1994) (concluding that the essential properties of an object are properties that are part of its definition).

[468] This is true provided that the term "object" is construed, as Dowe construes it, to include a spot of light. See supra text accompanying note 456

[469] *See* ELI MAOR, THE PYTHAGOREAN THEOREM: A 4,000-YEAR HISTORY xi (2007); FRANK J. SWETZ & T.I. KAO, WAS PYTHAGORAS CHINESE? 66 (1977).

[470] *See* MAOR, *supra* note 469, at xi.

[471] *See* SERGE LANG & GENE MURROW, GEOMETRY 44 (2000).

[472] *See, e.g.*, RON LARSON ET AL., GEOMETRY: AN INTEGRATED APPROACH 459 (1995). In a triangle, it is conventional to use lowercase letters to denote the sides opposite the vertices denoted by the corresponding uppercase letters. *See* EDWIN E. MOISE, ELEMENTARY GEOMETRY FROM AN ADVANCED STANDPOINT 148 (1974).

Theorems cannot be the subject of a patent grant; only claims can.[473] What does it mean then to say that the Pythagorean Theorem is unpatentable? In *Parker v. Flook*, the Supreme Court describes a hypothetical attempt by a "competent draftsman" to claim the theorem in a patent application:

> A competent draftsman could attach some form of post-solution activity to almost any mathematical formula; the Pythagorean theorem would not have been patentable, or partially patentable, because a patent application contained a final step indicating that the formula, when solved, could be usefully applied to existing surveying techniques.[474]

The Court did not expressly cite any claim language in making these points. Given the court's suggestion that the claim might contain a "final step" after the formula was "solved," however, it appears that the Court had in mind a process claim that recited steps for calculating $\sqrt{AC^2 + BC^2}$, followed by a final step using the result, *AB*, in a known method for solving some surveying problem. The *Flook* Court would have found such a claim ineligible, even though it does not wholly preempt the formula $AB^2 = AC^2 + BC^2$ (because of the final surveying step), because the claim's only point of novelty is the formula $AB^2 = AC^2 + BC^2$. As we have seen in Chapter 1, however, this "point of novelty" approach to eligible subject matter analysis is at least controversial, if not discredited. Moreover, the Pythagorean Theorem is a mathematical theorem, not merely a "formula" to be "solved."[475] This distinction was lost as the Court drew comparisons to Flook's invention, which had earlier been characterized as a "mathematical formula" followed by "conventional post-solution applications" of the formula.[476] Thus, while the *Flook* Court's exclusion of the Pythagorean

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[473] *See* 35 U.S.C. § 112, ¶ 2 ("The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.").

[474] 437 U.S. at 590.

[475] The government's brief in Benson argued for separate recognition of mathematical theorems as a categorical exclusion from patentable subject matter:

> For that reason, the Pythagorean Theorem, the binomial theorem, Gibbs' vectors, the Laplace Transform, the general theory of relativity, and Russell's theory of types, for example, even though the products of great intellectual effort, or a flash of genius, are not patentable under our law. Mathematical theorems, abstractions, ideas, and laws of nature are the property of everyone and the [exclusive] right of no one.

Brief for Petitioner at 19, Gottschalk v. Benson, 409 U.S. 63 (1972) (No. 71-485).

[476] *Id.* at 585; *cf.* Paine, Webber, Jackson & Curtis, Inc. v. Merrill Lynch, Pierce, Fenner & Smith, Inc., 564 F. Supp. 1358, 1366-67 (D. Del. 1983) ("[T]he Pythagorean theorem . . . is not patentable because it defines a mathematical formula. Likewise a

Theorem from patent-eligible subject matter is "well-established," the caselaw has not clarified the implications of this exclusion for specific claims that recite the use of the Pythagorean Theorem.

Consider instead the following hypothetical apparatus claim:

1. An apparatus for measuring angles, comprising:
a first leg member having a first end and a second end separated by a first distance *a*;
a second leg member having a first end and a second end separated by a second distance *b*, the first end of said second leg member being attached to the first end of said first leg member; and
a hypotenuse member having a first end and a second end separated by a third distance $\sqrt{a^2 + b^2}$, the first end of said hypotenuse member being attached to the second end of said first leg member and the second end of said hypotenuse member being attached to the second end of said second leg member,
whereby said first leg member and said second leg member form a right angle.

On its face, Claim 1 covers every apparatus that may be made by attaching the respectively paired ends of three "members" whose lengths are related by the equation $a^2 + b^2 = c^2$, thereby forming a right triangle. It therefore appears that Claim 1 covers every structural application of the Pythagorean Theorem.

Two subtleties of claim construction are needed to confirm this conclusion. First, while the claim's preamble recites the function of measuring angles, the claim covers every apparatus that meets the claim's structural limitations, regardless of its intended function.[477] Second, there is a "heavy presumption" that claim terms carry their ordinary and customary meanings.[478] As the Federal Circuit found in *CCS Fitness, Inc. v. Brunswick Corp.*,[479] the ordinary meaning of the term "member" is broad, and may refer to a "structural unit such as a . . . beam or tie, or a

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computer program which does no more than apply a theorem to a set of numbers is not patentable.").

[477] *See, e.g.*, Cross Medical Products, Inc. v. Medtronic Sofamor Danek, Inc., 424 F.3d 1293, 1311-12 (Fed. Cir. 2005) ("To infringe an apparatus claim, the device must meet all of the structural limitations."); Hewlett-Packard Co. v. Bausch & Lomb Inc., 909 F.2d 1464, 1468 (Fed. Cir. 1990) ("[A]pparatus claims cover what a device *is*, not what a device *does*.") (emphasis in original).

[478] CCS Fitness, Inc. v. Brunswick Corp., 288 F.3d 1359, 1365 (Fed. Cir. 2002) (citing Johnson Worldwide Assocs., Inc. v. Zebco Corp., 175 F.3d 985, 989 (Fed. Cir. 1999)).

[479] Id.

combination of these,"[480] or a "distinct part of a whole."[481] This breadth makes "member" a preferred generic term for a structural unit in the drafting of mechanical patent claims.[482] Read in the context of the claim limitations,[483] each of the recited "members" can be any structural unit of the apparatus having two identifiable ends separated by a specified distance. The term "member" therefore covers, *inter alia*, any structural unit capable of representing a side of a right-triangle-shaped apparatus.[484]

It is interesting to compare the abstract language of hypothetical Claim 1 with the more concrete language of an actual claim from an issued patent in this field. U.S. Patent 4,575,943, "Right Triangle Measuring Apparatus,"[485] describes a device comprising three tape measures (**16**, **22**, **28**) arranged in a cyclical formation as shown in Figure 5, with the free end of each tape (e.g., tape **18** extending from tape measure **16**) connected to the corner (e.g., **24)** of the next tape measure (e.g., **22**).[486] According to the specification, the tape measure housings may be triangular, thereby "enabling the sides of the tape to be juxtaposed with the tape measure side walls as shown in the drawing."[487]

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[480] *See id.* at 1367 (quoting MCGRAW-HILL DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS 1237 (5th ed.1994)).

[481] *See id.* (quoting AMERICAN HERITAGE DICTIONARY 849 (3d ed.1996)).

[482] *See* Richard G. Berkley, *Some Practical Aspects of Amendment Practice in the Electromechanical Arts*, in FIFTH ANNUAL PATENT PROSECUTION WORKSHOP, at 161, 205 (PLI Patents, Copyrights, Trademarks and Literary Property Course Handbook Series No. 426, 1995).

[483] *See* Ronald C. Faber, *The Winning Mechanical Claim*, in ADVANCED PATENT PROSECUTION WORKSHOP 2009: CLAIM DRAFTING & AMENDMENT WRITING, at 295, 321-22 (PLI Patents, Copyrights, Trademarks and Literary Property Course Handbook Series No. 977, 2009) (noting that construction of "member" as a claim element may require some guidance "perhaps obtained from the rest of the limitation including that element . . . [o]r perhaps referring back to the specification or drawing"). In this hypothetical, I assume that nothing in the specification or drawings further limits the meaning of "member."

[484] *See* MOISE, *supra* note **Error! Bookmark not defined.**, at 55 (stating that each side of a triangle is a line segment); *id.* at 54-55 (showing that every line segment has two end points).

[485] U.S. Patent No. 4,575,943 (issued Mar. 18, 1986).

[486] *See id.* at col. 2.

[487] *See id.* at cols. 2-3.

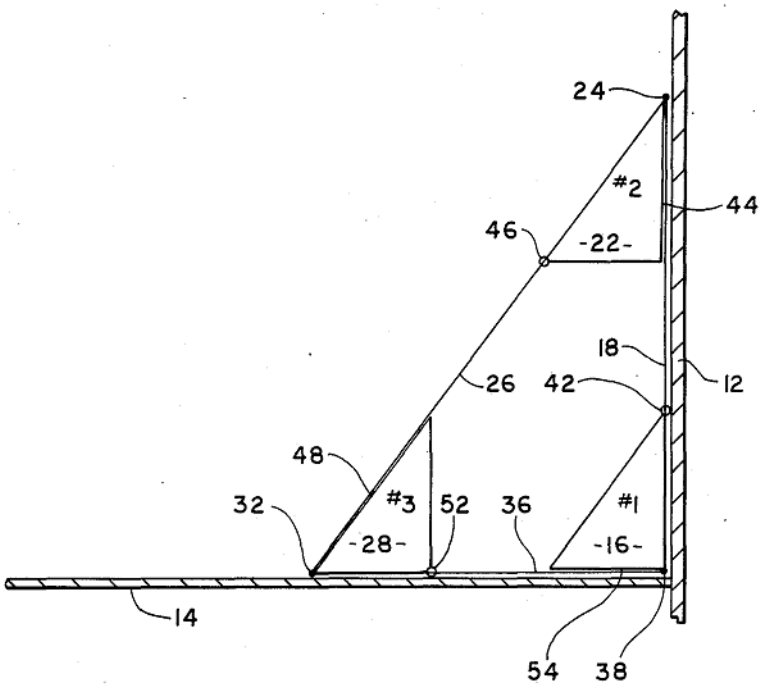

Figure 5. Right triangle measuring apparatus according to U.S. Patent No. 4,575,943.

Since the tapes will form a right triangle if their lengths remain in, e.g., a 3-4-5 ratio, the invention also includes marking the tapes according to different scales so that they all give the same readings when their lengths are in this ratio.[488] Claim 1 of this patent, which I will refer to here as Claim 1A, reads:

1A. An angle measuring apparatus comprising:
three tape measures each having a housing and a tape extending therefrom;
the tape of the first of said tape measures being connected to the housing of said second tape measure;
the tape of said second tape measure being connected to the housing of said third tape measure; and
the tape of said third tape measure being connected to the housing of said first tape measure;
said tape measures being adjustable such that the indicia output on each are identical when said apparatus indicates a right triangle.

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[488] *See id.* at col. 4.

Claim 1 is abstract enough to read on the apparatus of Claim 1A when the tape measures are adjusted so as to form a right triangle. Each of the tape measures constitutes a structural "member" (i.e., a "tie") with two identifiable ends, namely the free end of the tape and the corner of the housing to which the free end of the preceding tape measure is attached.

Abstraction is, of course, a matter of degree.[489] Though less abstract than "member," the "tape measures" recited in Claim 1A are also abstract terms, omitting such physical details such as the length and composition of the tape. A person having ordinary skill reading the claims in light of the patent specification, however, will recognize that these parameters are not unlimited. According to the specification, each tape measure has "a housing and a retractable tape extending therefrom,"[490] and each tape measure is capable of determining the length of its respective side of the triangle,[491] so as to provide a device that is "simple, compact, and yet readily available for large measurements and are easily read by an unskilled craftsman."[492] The design consideration of compactness imposes limits on the size of the tape measure housings; and the size of the housings, the design consideration of retractability, and the desire for large measurements all impose limits on the lengths and composition of the tapes. The use of a long tape that can roll up and retract into a compact housing represents a design response to the tradeoff between the device's compactness and its capability for large measurements.

In contrast, there are no physical constraints on "members" other than the express limitations recited in Claim 1, and in particular, there are no limitations in Claim 1 responsive to tradeoffs between resources (e.g., space) used by the device and the functionality of the device (e.g., large-measurement capability). Thus, while Claims 1 and 1A both use abstract language, only Claim 1 abstracts away the resource limitations that pervade the real world. As I will argue later in this chapter, this failure to address real-world resource constraints legally distinguishes Claim 1 from Claim 1A and, more generally, should be treated as an important consideration in the analysis of patent-eligibility.

As highly abstract as Claim 1 is, however, it is definite and has limited scope. In particular, Claim 1 covers only physical structures made up of distinct structural units. For this reason, I concluded earlier that Claim 1 covers every *structural* application of the Pythagorean Theorem. It is not

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[489] *See* John E. Nolt, *Mathematical Intuition*, 44 PHILOSOPHY & PHENOMENOLOGICAL RESEARCH 189, 209 (1983).

[490] *See* U.S. Patent 4,575,943, *supra* note **Error! Bookmark not defined.**, at col. 2.

[491] *See id.* at col. 3.

[492] *Id.* at col 1.

yet clear whether this conclusion is sufficient to support a determination that Claim 1 entirely preempts the Pythagorean Theorem, and is therefore drawn to unpatentable subject matter. I will now address this question with a different example.

B. Yates's Linkage and the Sources of Mathematical Intuition

In 1931, University of Maryland mathematics professor Robert Yates derived a surface of constant curvature whose meridian cross-section could be generated by "rolling an ellipse along a straight line and taking the curve traced out by a focus."[493] At the suggestion of his colleague Frank Morley, Yates built a mechanical device for generating the cross-section, as shown in Figure 6.[494] He then published a description of his device in the *American Mathematical Monthly*.[495]

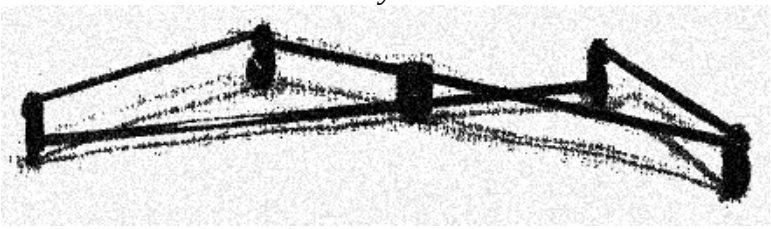

Figure 6. **Yates's linkage for generating the meridian cross-section of a surface of constant curvature.**

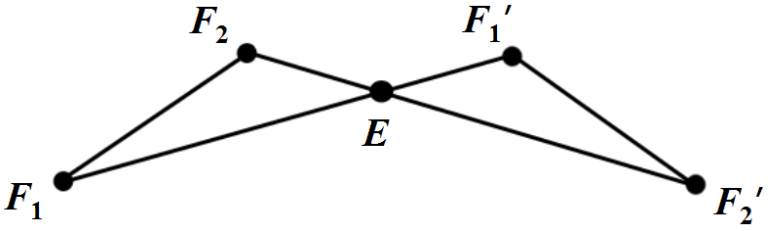

Figure 7. **Yates's linkage represented as a geometric figure in the plane.**

Yates's linkage has the interesting property that when one of the shorter links is fixed in the plane, the point at which the two longer links intersect will trace out an ellipse. This result can be formalized in the following geometric theorem:

Theorem 2. In Figure 7, suppose that $F_1F_2 = F_1'F_2' = c$, $F_1F_1' = F_2F_2' = a > c$, $\overline{F_1F_2}$ is fixed in the plane, and E is the point of

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[493] *See* Robert C. Yates, *The Description of a Surface of Constant Curvature*, 38 AM. MATH. MONTHLY 573, 573 (1931).

[494] *See id.*

[495] *See id.* at 573-74.

intersection of $\overline{F_1F_1'}$ with $\overline{F_2F_2'}$. Then as F_1' moves in a circle about F_1, E traces an ellipse with foci F_1 and F_2.

Proof. By the SSS Theorem, we have $\Delta F_1F_2F_2' \cong \Delta F_2'F_1'F_1$, so $\angle F_1F_2'F_2 \cong \angle F_2'F_1F_1'$. By the SAS Theorem, $\Delta F_1F_2E \cong \Delta F_2'F_1'E$. Thus $F_2E = F_1'E$, and $F_1E + F_2E = F_1E + EF_1' = F_1F_1'$, a constant.

Yates's "mechanical description" immediately caught the attention of David Hilbert, one of the most influential mathematicians of the late 19th and early 20th century.[496] In his classic 1932 monograph, *Anschauliche Geometrie*,[497] Hilbert described Yates's linkage (Figure 8):

> Let *c* and *cN* be two rods of the same length *c*. Let a_1 and a_2 be two other rods both equal to $a > c$ in length. Let the extremities F_1, F_2 of *c* and F_1N, F_2N of *c*N be linked to a_1 and a_2 by pin joints in such a way as to form a self-intersecting quadrilateral with opposite sides equal. . . . Let *E* be the point at which a_1 and a_2 cross. Its position on these two rods will change as the plane linkage assumes its various possible positions. At *E* we place a joint with two sleeves which are free to turn about *E* and in which the rods a_1 and a_2 can slide freely.[498]

Hilbert observed that when the rod *c* is held fixed, the point *E* traces out an ellipse with F_1, F_2 as foci and with *a* as the constant sum of its focal distances.[499] Following Yates's suggestion,[500] Hilbert also considered the case where F_1 and F_2 are no longer fixed, and where "two wheels Z_1 and Z_2 [are] mounted at any two points of the rods [F_1F_1' and F_2F_2'] in such a way as to be free to rotate about these rods but not to slide along them."[501]

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[496] *See* CONSTANCE REID, HILBERT 218 (2007) (quoting mathematician Alfred Tarski) ("The future historian of science concerned with the development of mathematics in the late nineteenth and the first half of the twentieth century will undoubtedly state that several branches of mathematics are highly indebted to Hilbert's achievements for their vigorous advancement in that period."

[497] DAVID HILBERT, GEOMETRY AND THE IMAGINATION (P. Nemenyi trans. 1990) (1932).

[498] *Id.* at 283.

[499] *See id.*

[500] *See* Yates, *supra* note **Error! Bookmark not defined.**, at 574 ("Toothed wheels are placed at the extremities (or at any convenient point) of the rods representing the axis of the ellipse in order that each rod may move at right angles to itself. These wheels cut out two of the four degrees of freedom.").

[501] HILBERT, *supra* note **Error! Bookmark not defined.**, at 283.

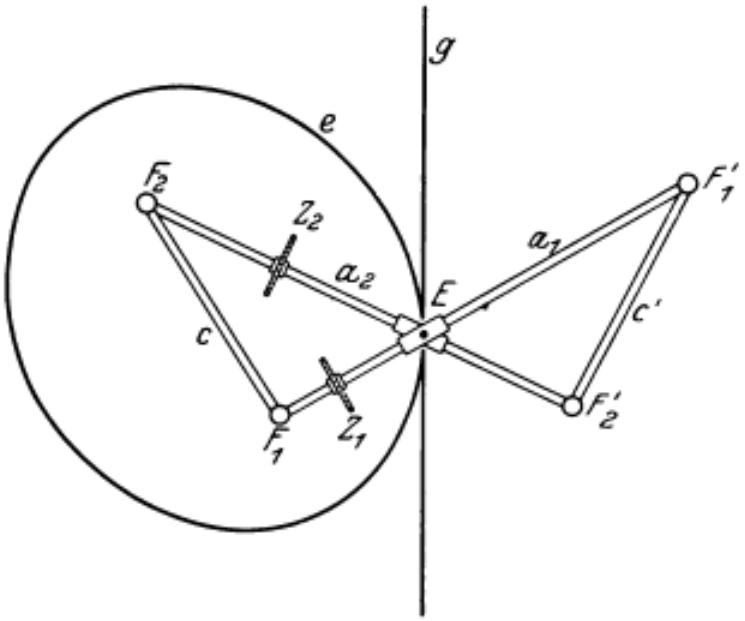

Figure 8. **Hilbert's diagram of Yates's linkage with wheels attached.**[502]

From this construction, Hilbert was able to prove a new mathematical result. Hilbert wrote:

> Thus the study of Yates' apparatus leads to a peculiar geometrical theorem which may be formulated [as] follows: Given a roulette generated by a focus of an ellipse, on the normals to the roulette draw the points whose distance from the curve, measured in the direction of the center of curvature, is equal to the constant sum of focal radii for the ellipse; then the points thus marked out lie on another roulette generated by a focus of the ellipse; this ellipse is congruent to the first ellipse and rolls on the same curve as the first ellipse but on the opposite side of that curve.[503]

By studying the behavior of Yates's apparatus, Hilbert was able to prove a new mathematical result, his "peculiar geometric theorem." Suppose, however, that Yates had been precluded from building his apparatus by the following hypothetical patent claim:

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[502] *Id.*

[503] *Id.* at 284-85. A *roulette* is the curve traced out by a point rigidly attached to a plane curve as it rolls upon a second fixed plane curve. *See* 2 HOWARD EVES, A SURVEY OF GEOMETRY 271 (1965).

2. An apparatus for drawing ellipses, comprising:
a base;
a first member having a first end and a second end separated by a first distance *c*, both of said ends being attached to said base;
a second member having a first end and a second end separated by a second distance $a > c$, the first end of said second member being connected by a revolute joint to the first end of said first member;
a third member having a first end and a second end separated by said first distance *c*, the first end of said third member being connected by a revolute joint to the second end of said second member;
a fourth member having a first end and a second end separated by said second distance *a*, the first end of said fourth member being connected by a revolute joint to the second end of said third member and the second end of said fourth member being connected by a revolute joint to the second end of said first member; and
a revolute joint assembly slidably attached to said second member and to said fourth member, permitting said second member and said fourth member to slide independently of each other and to rotate independently of each other about an axial point *E*, said axial point *E* being located on said revolute joint assembly,
whereby the movement of said axial point *E* relative to said base is constrained to the points of an ellipse whose foci are the first end and the second end of said first member and whose major diameter is *a*.

It is straightforward to verify that Claim 2 covers every apparatus that may be made by attaching four "members" as depicted in Figure 7 and described in Theorem 2 so as to produce a kinematic movement for the point *E*; i.e., Claim 2 covers every structural application of Theorem 2. In particular, Yates's linkage is a representative embodiment of Claim 2.[504]

The granting of a patent on Claim 2 would have had significant consequences for the development of pure mathematics. Yates and Hilbert would not have been able to build the apparatus, let alone add the wheels necessary to produce the roulettes of an ellipse.[505] Yates's article on the surface of constant curvature would have had to omit the mechanical description of the cross-section, and may not have been published at all.

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[504] In the case where F_1 and F_2 are not fixed in the plane, the "base" may be construed as the first member or any part thereof; *E* will still be constrained to move along an ellipse relative to this "base." *See* HILBERT, *supra* note **Error! Bookmark not defined.**, at 284 (explaining when "the rod *c* [is] rigidly attached during the motion to a moving plane . . . the moving centrode must be the ellipse *e*").

[505] *See supra* note **Error! Bookmark not defined.** and accompanying text.

Hilbert would not have been able to analyze the behavior of Yates's linkage, and would not thereby have synthesized that analysis into his "peculiar geometric theorem."

Since the progress of mathematics is so heavily dependent on the sustained efforts of individual mathematicians[506] with relatively brief productive life spans,[507] the preclusive effect of a 20-year patent term should not be underestimated. In the example just given, a patent covering every structural application of Theorem 2 would likely have precluded Hilbert from discovering and proving a more advanced geometric theorem. Yates's article and Hilbert's book were published only one year apart, and Hilbert passed away eleven years later.[508]

Hilbert's reliance on a mechanical apparatus to provide him with the necessary intuition for his "peculiar geometric theorem" is not at all unusual. Mechanisms have long been recognized as a source of geometric intuition,[509] and are increasingly being used as mathematical teaching tools.[510] Furthermore, as mathematical philosopher John Nolt has pointed out, physical objects and geometric diagrams stand on equal footing as sources of geometric intuition, because "[t]he figures we perceive and

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[506] *See, e.g.*, AMIR D. ACZEL, FERMAT'S LAST THEOREM: UNLOCKING THE SECRET OF AN ANCIENT MATHEMATICAL PROBLEM 2 (1997) (describing Andrew Wiles's solitary work to complete the proof of Fermat's Last Theorem, for which he spent "seven years of his life a virtual prisoner in his own attic"); Peter G. Hinman & B. Alan Taylor, *The Mathematics Major at Research Universities*, in CONTEMPORARY ISSUES IN MATHEMATICS EDUCATION (Estela A. Gavosto et al., eds.) 25, 27 (1999) (explaining that the received wisdom that "mathematics is a solitary occupation" is valid for "research mathematics," though not for a "B.A. mathematician work[ing] in industry").

[507] *See, e.g.*, SYLVIA NASAR, A BEAUTIFUL MIND 381 (1998) (quoting JOHN FORBES NASH JR., LES PRIX NOBEL 1994) ("Statistically, it would seem improbable that any mathematician or scientist, at the age of 66, would be able through continued research efforts to add to his or her previous achievements.").

[508] *See* REID, *supra* note **Error! Bookmark not defined.**, at 213 (giving Hilbert's date of death as February 14, 1943).

[509] *See, e.g.*, ROBERT S. TRAGESSER, HUSSERL AND REALISM IN LOGIC AND MATHEMATICS 15 (1984) (crediting philosopher Edmund Husserl (1859-1938) with understanding geometric intuitions as "acts of consciousness" that are "founded" in of visually experienced objects but subject to "principles of reasoning different from those cogent and valid for" such visually experienced objects).

[510] *See, e.g.*, BRIAN BOLT, MATHEMATICS MEETS TECHNOLOGY (1991); David Dennis & Jere Confrey, *Geometric Curve-Drawing Devices as an Alternative Approach to Analytic Geometry: An Analysis of the Methods, Voice, and Epistemology of a High-School Senior*, in DESIGNING LEARNING ENVIRONMENTS FOR DEVELOPING UNDERSTANDING OF GEOMETRY AND SPACE 297 (Richard Lehrer & Daniel Chazen, eds. 1998); Daina Taimina, *Historical Mechanisms for Drawing Curves*, in HANDS ON HISTORY: A RESOURCE FOR TEACHING MATHEMATICS (Amy Shell-Gellasch ed. 2007).

probably also those we imagine are not quite geometrical, i.e., not composed of infinitesimally thin lines meeting at infinitesimally tiny points."[511] In other words, "geometric diagrams are themselves physical objects. . . . The symbols are actually among the objects symbolized."[512]

Mathematics, described by Kant as "the most resplendent example of pure reason,"[513] is no less abstract for its reliance on the concrete objects of empirical reality; indeed, mathematics relies for its internal coherence on its empirical origins. As John von Neumann wrote in his essay on "The Mathematician,"

> Mathematical ideas originate in empirics, although the genealogy is sometimes long and obscure. But, once they are so conceived, the subject begins to live a peculiar life of its own and is better compared to a creative one, governed by almost entirely aesthetical motivations, than to anything else and, in particular, to an empirical science. There is, however, a further point which, I believe, needs stressing. As a mathematical discipline travels far from its empirical source, or still more, if it is a second and third generation only indirectly inspired by ideas coming from 'reality,' it is beset with very great dangers…. [A]t a great distance from its empirical source, or after much 'abstract' inbreeding, a mathematical subject is in danger of degeneration.[514]

In short, the freedom to make and use the fundamental empirical sources of mathematical intuition is necessary for the flourishing of mathematics. Concern for this freedom counsels against the issuance of any patent that claims every structural application of a kinematic property because, as I have shown, some mechanical structures are among "the basic tools of scientific and technological work."[515]

VI. CONCLUSIONS

This Article has not come close to conducting an exhaustive inventory of the patent system's metaphysical commitments. In a future article, I plan to explore the patent system's orientation to mental causation and the so-

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[511] *See* Nolt, *supra* note **Error! Bookmark not defined.**, at 202.

[512] Id. at 206.

[513] IMMANUEL KANT, CRITIQUE OF PURE REASON 630 (Paul Guyer & Allen W. Wood trans. 1999)

[514] John von Neumann, *The Mathematician*, in THE NEUMANN COMPENDIUM 618, 626 (F. Bródy & T. Vámos eds. 1995).

[515] Gottschalk v. Benson, 409 U.S. 63, 67 (1972).

called mind-body problem, which are perhaps the most enduring controversies in all of metaphysics.[516] The standard causal account of how the patent system "promote[s] the Progress of . . . useful Arts" seems unproblematically to traverse the boundary between mental and physical properties without engaging in any of these metaphysical debates: (1) the patent system hastens inventions and disclosures by offering patents as economic *incentives*[517] to (2) *inventors* who conceive,[518] reduce to practice,[519] and disclose their (3) *inventions*, which others can learn (at will) and use (as authorized by the patentee) to produce beneficial effects.[520]

It might be suggested that to foreground the implicit mind-body metaphysics within this account is to risk taking sides in a dispute the patent system lacks the time and expertise to adjudicate rigorously. For example, the doctrine conferring inventorship on one who conceives of an invention but relies on another to reduce it to practice[521] may appear to commit the

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[516] For a description of the philosophical controversies surrounding the mind-body problem, *see, e.g.*, THE OXFORD COMPANION TO PHILOSOPHY 608 (Ted Honderich ed. 2005) (describing the modern "mind-body debate" as focused on "the status of mental states, processes, and properties *vis-à-vis* physical states, processes, and properties"). The problem dates back to René Descartes in 1641. *See* RENÉ DESCARTES, MEDITATIONS ON FIRST PHILOSOPHY (Donald A. Cress tr. 1993).

[517] *See, e.g.*, Arnold Plant, *The Economic Theory Concerning Patents for Inventions*, 1 ECONOMICA 30, 32 (1934) ("[T]he purpose of patents for inventions is, by giving an inventor the control for a definite period over the disposal of his invention, to make it easier for him to derive an income from it. . . . [T]he ultimate aim is to encourage inventing.").

[518] Hybritech Inc. v. Monoclonal Antibodies, Inc., 802 F.2d 1367 (Fed. Cir. 1986) (quoting 1 ROBINSON ON PATENTS 532 (1890)) (defining conception as the "formation in the mind of the inventor, of a definite and permanent idea of the complete and operative invention").

[519] Reduction to practice, whether constructive (filing a patent application) or actual (producing an embodiment of the invention in "physical or tangible form," *see* Wetmore v. Quick, 536 F.2d 937, 941 (C.C.P.A. 1976)), entails a physical act.

[520] *See, e.g.*, Diamond v. Diehr, 450 U.S. 175, 182 (1981) (quoting Corning v. Burden, 56 U.S. 252, 268 (1853)) ("It is for the discovery or invention of some practical method or means of producing a beneficial result or effect, that a patent is granted. . . .").

[521] *See* Burroughs Wellcome Co. v. Barr Labs., Inc., 40 F.3d 1223, 1227-29 (Fed. Cir. 1994) (stating that to be recognized as a joint inventor, each collaborator "must contribute to the joint arrival at a definite and permanent idea of the invention as it will be used in practice"; i.e., the conception of the invention). Constructive reduction to practice is typically completed by patent attorneys and agents, who do not thereby become co-inventors. *See generally* Solomon v. Kimberly-Clark Corp., 216 F.3d 1372, 1382 (Fed. Cir. 2000) (rejecting argument that patent attorney had become a joint inventor in the course of "defining [the client's] invention to obtain, if possible, a valid patent with maximum coverage").

The determination of *priority* of inventorship is a distinct issue, and is not based solely

patent system to mind-body dualism[522] (the view that the mind is not part of the physical world[523]), a stance that is under heavy siege from contemporary neuroscience[524] and has long fallen out of fashion among analytic philosophers.[525] More fundamentally, the interactions of minds, bodies and money in innovative processes are too complex and varied to be metaphysically subsumed under a single causal account of how the patent laws hasten innovation.[526]

A further difficulty with using the metaphysics of causation to delineate the "laws of nature" exception to patentable subject matter is that our knowledge of the physical laws that govern causality in the world is contingent and incomplete. For example, the Supreme Court in *Parker v. Flook*[527] cites Newton's law of universal gravitation as an unpatentable "scientific principle" that "reveals a relationship that has always existed."[528] But the relationship $F = Gmm'/r^2$ "exists" between two bodies, if at all, only where there are no forces other than gravitational forces at work.[529] Moreover, its status as a "fundamental truth" is subject to falsification by future contrary observations,[530] which will remain possible as long as

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on first conception. *See* 35 U.S.C. § 102(g) (providing that priority determination shall consider conception, reduction to practice, and diligence); *see also* Price v. Symsek, 988 F.2d 1187, 1190 (Fed. Cir. 1993) ("Although derivation and priority of invention are akin in that both focus on inventorship . . . they are distinct concepts.").

[522] *See* Dan L. Burk, *Feminism and Dualism in Intellectual Property*, 15 AM. U. J. GENDER SOC. POL'Y & L. 183, 186 (2007) (arguing that the conception-focused inventorship doctrine exemplifies a "striking pattern of dualism" in the patent system).

[523] *See* ANTHONY DARDIS, MENTAL CAUSATION 17 (2008).

[524] *See, e.g.*, W.W. Meissner, *The Mind-Brain Relation and Neuroscientific Foundations: I. The Problem and Neuroscientific Approaches*, 70 BULL. MENNINGER CLINIC 87, 89 (2006) ("For all practical purposes, modern neuroscientists are virtually unanimous in rejecting frank dualism.").

[525] *See infra* section ___; *see also* Stanford Encyclopedia of Philosophy, *Dualism* http://plato.stanford.edu/entries/dualism/ (describing dualism as "out of fashion" in philosophy since the publication of Gilbert Ryle's monograph THE CONCEPT OF MIND in 1949); *but see, e.g.*, DAVID J. CHALMERS, THE CONSCIOUS MIND: IN SEARCH OF A FUNDAMENTAL THEORY (1996) (offering a modern analytical defense of dualism, at least as to the non-physicality of mental properties).

[526] *See generally* Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1595-1630 (2003) (surveying "widely disparate explanations for the role of patents" in promoting innovation in general and in specific industries).

[527] 437 U.S. 584 (1978).

[528] *See id.* at 593 n.15 (citing P. ROSENBERG, PATENT LAW FUNDAMENTALS § 4, at 13 (1975).

[529] *See* NANCY CARTWRIGHT, HOW THE LAWS OF PHYSICS LIE 57-58 (1983).

[530] *See generally* KARL R. POPPER, THE LOGIC OF SCIENTIFIC DISCOVERY 78-92 (1959) (introducing falsifiability as a scientific criterion).

physics is unable to provide a complete account of all phenomena.[531] If the Court's language in *Le Roy* and *Flook* is read as a permanent ontological commitment to Newton's law (and other laws of today's physics) as true descriptions of the natural world, then those precedents are untenable as a basis for a metaphysical characterization of the "laws of nature" exception.[532]

My tentative view is that both of the above difficulties are the avoidable result of reading problematic metaphysical commitments into patent doctrine where none need be found. The inventorship doctrine's account of mental causation does not entail mind-body dualism. The structure and function of the patent incentive are essentially teleological, not causal. Patent-eligibility doctrine can be grounded in today's laws of physical causation without committing the patent system to accept their truth should they be falsified in the future. I hope that this Article has demonstrated the potential value of such further inquiries into the patent system's metaphysical commitments, regardless of their ultimate outcomes.

This Article has offered the essential causation requirement as a definitive expression of patent law's abstract-ideas exclusion, about which the "machine-or-transformation" test provides only a "clue." As such, the requirement has much to commend it. The requirement and its corollary doctrine, the kinematic property exclusion, stand in contrast to the disparate strands of patentable subject matter doctrine that have developed around specific fields of invention, in that they may be addressed to all inventions claiming recognition as "useful Arts," including technologies from both "the age of iron and steel" and "a time of subatomic particles and terabytes."[533] As doctrines grounded in ontological rather than disciplinary boundaries, they are fully compatible with the TRIPS requirement that patents be available for inventions "in all fields of technology."[534] As doctrines that follow from the patent system's longstanding but previously

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[531] *Cf.* Alyssa Ney, *Physicalism as an Attitude*, 138 PHILOSOPHY STUDIES 1 (2008) ("If physicalism is taken to be the view that the world is the way *current* physics says it is, then it is false since current physics is incomplete and at this time is probably not in a position to give us a complete explanation of all that exists.").

[532] *See* Simon, *supra* note 28, at 2191 ("That laws of nature are Truths to be uncovered and mastered by reason is a notion that continues to hold deep intuitive sway. There is no way to disprove this conjecture. But that is a far cry from saying that it is a reasonable cornerstone of modern patent law.").

[533] *Cf.* In re Bilski, 545 F.3d 943, 1011 (Fed. Cir. 2008) (en banc) (Rader, J., dissenting) (arguing that the majority's "machine or transformation" test "links patent eligibility to the age of iron and steel at a time of subatomic particles and terabytes").

[534] Agreement on Trade-Related Aspects of Intellectual Property Rights, art. 27.1, Apr. 15, 1994, 33 I.L.M. 1997; 1869 U.N.T.S. 299.

unarticulated metaphysical commitments, they also conform to the guidance provided by the Supreme Court to the lower courts in *Bilski*: i.e., they provide "limiting criteria that further the purposes of the Patent Act and are not inconsistent with its text," without diverging from the "guideposts in *Benson*, *Flook* and *Diehr*."[535] Finally, as we have seen, the kinematic property exclusion can play a crucial role in protecting the freedom to make and use the fundamental empirical sources of mathematical intuition.

The argument in the present Article is also consistent with an argument by Kevin Collins in a recent article grounding patent law's printed matter doctrine in semiotic analysis.[536] As the term is used by Collins, a semiotic meaning is a product of the mental process of interpreting a "sign-vehicle" (i.e., a physical artifact that is capable of being perceived and interpreted).[537] According to Collins, "semiotic meanings are not intrinsic in worldly things…. [they] result from active processes of interpretation that occur in people's minds."[538] On this view, it follows that any physical reaction provoked in the acquisition of semiotic meaning is not physically caused by the sign-vehicle, but is mediated by the mind and mental states of the interpreter.[539] Collins argues that newly invented signs in which the inventive contribution resides only in the mind of an interpreter should be patent-ineligible under the printed matter requirement.[540] Such sign-inventions would also fail the essential causation requirement, at least on Collins's view of mental causation.

In closing his *Bilski* dissent, Judge Rader cited a quotation attributed to Einstein: "We still do not know one thousandth of one percent of what nature has revealed to us."[541] Rader's point was that the "machine-or-transformation" test unduly tied patent-eligibility doctrine to the macroscopic level of mechanism and change.[542] As a metaphysical doctrine, the essential causation requirement is equally valid at the macroscopic and microsocopic level, and does justice to research both in the "useful Arts" and in abstract ideas. It is a patent-eligibility doctrine for the age of Einstein.

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[535] Bilski, 561 U.S. at ___.

[536] *See* Kevin Emerson Collins, *Semiotics 101: Taking the Printed Matter Doctrine Seriously*, 85 IND. L.J. 1379 (2010).

[537] *See id.* at 1410.

[538] *Id.* at 1383.

[539] *See id.* at 1415.

[540] *See id.* at 1383.

[541] Bilski, 545 F.3d at 1015 (Rader, J., dissenting).

[542] *See supra* note 533.