HAS THE REASONABLE EXPERIMENTATION DOCTRINE BECOME UNREASONABLE?: RETHINKING THE REASONABLE EXPERIMENTATION DOCTRINE IN LIGHT OF AUTOMATED EXPERIMENTAL TECHNIQUES

MARK H. HOPKINS, PH.D.*

Domo arigato, Mr. Roboto, Mata ah-oo hima de.
Domo arigato, Mr. Roboto, Himitsu wo shiri tai.
The problem's plain to see: too much technology
Machines to save our lives. Machines dehumanize.[1]

INTRODUCTION

John Henry, a research chemist at the C & O Chemical Co., makes new chemical compounds the old-fashioned way: one at a time, thoroughly isolating, identifying and testing each new compound.[2] He discovers a new anti-viral compound that cures both AIDS and the West Nile virus and subsequently applies for a patent. His application is rejected by the Patent Office as being anticipated by[3] and obvious over[4] a patent assigned to the Steam Drill Chemical Co. The Steam Drill patent has three broad claims:

> 1. A library[5] comprising a plurality of compounds of Formula I:
> XYZ;

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* J.D./LL.M Candidate I.P., January 2004, The John Marshall Law School. Ph.D. Chemistry, University of California, Irvine, 1989, B.S. Chemistry, University of California, San Diego, 1983. The author would like to thank Professor Michael Hopkins, University of Chicago and Dr. James Hunter, DowAgroSciences for being true Joes not toady boys and the entire RIPL editorial board for their editorial assistance.

[1] STYX, *Mr. Roboto, on* KILROY WAS HERE (A & M Records 1983). Rough English translation of the Japanese: Thank you very much, Mr. Roboto, until we meet again. Thank you very much, Mr. Roboto, I want to know your secret. *Id.*

[2] IRWIN SHAPIRO, JOHN HENRY AND THE DOUBLE-JOINTED STEAM DRILL (1945). This hypothetical is loosely based on the American legend of John Henry as related by Irwin Shapiro. *Id.*

[3] The statutory requirement for novelty entitles a person "to a patent unless . . . the invention was . . . patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent. . . ." 35 U.S.C. § 102(a) (1994 & Supp. 1999).

[4] The statutory requirement of nonobviousness mandates:

> [a] patent may not be obtained . . . if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time of the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

35 U.S.C. § 103(a) (1994 & Supp. 1999).

[5] The term "library" as used herein refers to a collection of compounds, typically produced either as discrete compounds or as mixtures of compounds. *See* U.S. Patent No. 6,255,120 (issued July 3, 2001); U.S. Patent No. 6,037,340 (issued Mar. 14, 2000); U.S. Patent No. 5,874,443 (issued Feb. 23, 1999).

wherein X is a scaffold[6] and Y and Z are Markush[7] groups comprising hundreds of substituents.

2. A compound[8] of the Formula I:

XYZ;

wherein X is a scaffold and Y and Z are Markush groups comprising hundreds of substituents.

3. A method of making the library or compounds of claims 1 or 2 comprising the step of converting scaffold X to a further functionalized compound XYZ.[9]

This patent essentially claims millions of compounds and discloses an automated method to make these compounds. Although the patent provides some experimental data on thousands of these compounds, John Henry's compound was neither characterized or tested for a particular utility.[10]

The Patent Office awarded the patent to Steam Drill in order to stimulate technological progress in the pioneering area of "combinatorial chemistry."[11] The

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[6] The term "scaffold" as used herein refers to a structural part of a compound that allows it to be easily derivatized with diverse substituents; for example, to result in compounds with diverse topologies. *See* U.S. Patent No. 6,448,443 (issued Sept. 10, 2002); U.S. Patent No. 6,403,312 (issued June 11, 2002).

[7] *Ex parte* Markush, 1925 C.D. 126 (Comm'r Pat. 1925); MANUAL OF PATENT EXAMINING PRACTICE AND PROCEDURE (hereinafter "MPEP") § 2173.05(h) (8th ed. 2001). Chemical compounds and libraries are commonly claimed by using either the compound's official International Union of Pure and Applied Chemistry (IUPAC) name or the compound's chemical structure, often in generic, *Markush* form. *Id.* A *Markush* claim is a claim that creates an artificial group and recites members of that group as being "selected from the group consisting of." *Id.* A *Markush* claim is used when there is no single generic term available to describe all of what an applicant's invention includes. *Id.*

[8] The term "compound" is used herein in the traditional sense, referring to chemical material that has sufficient spectral or other structural data to allow for the identification of the same compound by another practitioner. This is sometimes referred to as "characterizing" the compound. The term "compound" as used herein is different than a mere "library member," which is any uncharacterized, physical product of the method to make the library. While "compounds" and "library members" are clearly differentiated in the academic chemical literature, patents often use these two terms interchangeably. *Preparation of Manuscripts*, J. COMBINATORIAL CHEM., 4, 12A, 13A (2002), *available at* http://pubs.acs.org/instruct/jcchff.pdf [hereinafter *Manuscripts*]. In addition, patent claims sometimes only refer to the part of the compound necessary for a particular use or function; for example, a structural feature that is associated with a particular advantage. Other parts of the compound are not particularly specified in the patent claim to leave room for further investigation and optimization. *See* U.S. Patent No. 5,648,458 (issued July 15, 1997).

[9] Examples of specialized reaction protocols, schemes, and reagents directed to combinatorial chemical libraries are disclosed in U.S. Patent No. 5,632,898 (issued May 27, 1997); U.S. Patent No. 5,670,480 (issued Sept. 23, 1997); U.S. Patent No. 5,605,616 (issued Feb. 25, 1997). Chemical, analytical, mathematical, or practical approaches to creating, manipulating, or assessing libraries or arrays are disclosed in U.S. Patent No. 5,670,054 (issued Sept. 23, 1997); U.S. Patent No. 5,604,097 (issued Feb. 18, 1997); U.S. Patent No. 5,573,905 (issued Nov. 12, 1996). Other combinatorial chemical methodology is disclosed in U.S. Patent No. 5,677,195 (issued Oct. 14, 1997); U.S. Patent No. 5,663,046 (issued Sept. 2, 1997); U.S. Patent No. 5,651,943 (issued July 29, 1997).

[10] The term "characterized" as used herein refers to a compound that was purified, isolated, and definitively identified by spectroscopic or other means. *Manuscripts*, *supra* note 8, at http://pubs.acs.org/instruct/jcchff.pdf.

[11] The term "combinatorial chemistry" as used herein refers to automated or semi-automated methods to synthesize, in parallel, more than one chemical compound. *See generally* Nicholas K. Terret et al., *Combinatorial Synthesis - The Design of Compound Libraries and their Application to*

Patent system attempts to balance putting the public in possession of the invention with awarding a temporary monopoly on new libraries, compounds, and methods claimed by inventors, such as those of Steam Drill.[12] The public is deemed in possession of an invention if the inventors' disclosure enables one of ordinary skill in the art, in this case an ordinary chemist, to practice the invention.[13] This disclosure then prevents future patents, such as one for John Henry's invention, from being issued, as they will now be deemed anticipated by the patent or obvious to those of ordinary skill in the art.[14]

This concept of enablement is the principal doctrine speaking to the sufficiency of an inventor's disclosure to receive a patent.[15] In rapidly developing arts such as combinatorial chemistry, where patentees seek the broadest possible patent claim scope, other researchers and patent practitioners, the Patent Office, and the courts[16] often struggle to correlate the scope of the enabling disclosure with the scope of the claims.[17] The emergence of specialized doctrines, such as the doctrine of

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Drug Discovery, 51 TETRAHEDRON 8135 (1995) (giving an overview of combinatorial chemical approaches); Jonathan A. Ellman, *Design, Synthesis, and Evaluation of Small-Molecule Libraries*, 29 ACC. CHEM. RES. 132 (1996) (describing how small-molecule libraries are made and analyzed); Sheila Hobbs-DeWitt & Anthony W. Czarnik, *Combinatorial Organic Synthesis Using Parke-Davis's DIVERSOMER Method*, 29 ACC. CHEM. RES. 114 (1996) (describing a particular combinatorial organic synthesis methodology); Lorin A. Thompson and J. A. Ellman, *Synthesis and Applications of Small Molecule Libraries*, 96 CHEM. REV. 555 (1996) (providing an overview of synthetic methods and uses of small molecule libraries); E. M. Gordon et. al., *Strategy and Tactics in Combinatorial Organic Synthesis: Applications to Drug Discovery*, 29 ACC. CHEM. RES. 144 (1996) (giving several examples of how combinatorial chemistry is being used in the pharmaceutical industry).

[12] *See generally* Rebecca S. Eisenberg, *Patents and the Progress of Science: Exclusive Rights and Experimental Use*, 56 U. CHI. L. REV. 1017 (1989) (discussing the "incentive to disclose" theory and other explanatory theories of patent systems). Courts frequently characterize the patentee's disclosure as the "consideration" for this contract with the public for the monopolistic patent grant.

> [An inventor] may keep his invention secret and reap its fruits indefinitely. In consideration of its disclosure and the consequent benefit to the community, the patent is granted. An exclusive enjoyment is guaranteed him for seventeen years, but, upon the expiration of that period, the knowledge of the invention inures to the people, who are thus enabled without restriction to practice it and profit by its use. To this end the law requires such disclosure to be made in the application for patent that others skilled in the art may understand the invention and how to put it to use.

United States v. Dubilier Condenser Corp., 289 U.S. 178, 186-87 (1933) (citation omitted). *See also* Timothy J. Douros, *Lending the Federal Circuit a Hand: An Economic Interpretation of the Doctrine of Equivalents*, 10 HIGH TECH. L. J. 321, 325 (1995) (discussing the goals of the American patent system).

[13] Under current United States law, enablement requires that "[t]he specification shall contain . . . the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same . . ." 35 U.S.C. § 112 (1994).

[14] *See supra*, text accompanying notes 3 and 4.

[15] *See* 35 U.S.C. § 112 (1994).

[16] The United States Patent and Trademark Office (USPTO), the patentee, and the patentee's representatives consider enablement during prosecution of the patent application before the USPTO to determine if it should issue. *See* MPEP, *supra* note 7, at § 2164. Other researchers, patent practitioners and the courts consider enablement when assessing the validity of issued patent claims. *See generally* 4 DONALD S. CHISUM, CHISUM ON PATENTS, § 7.03[4] (2000).

[17] For example, the Federal Circuit recently summarized the relationship between the public interest, enablement, and the scope of the claims as follows:

reasonable experimentation, complicates this task by allowing courts to supplement a patents literal disclosure with "what would be known to one of ordinary skill in the art without undue experimentation"[18] for reasons of equity.[19] All of these concepts are further taxed now that experimentation is easily automated.[20]

This Comment addresses whether the present formulation of the reasonable experimentation doctrine in the United States is appropriate in light of the use of automated experimental techniques, particularly in the area of combinatorial chemical synthesis and assessment of the resulting products. This Comment also further examines how this technology affects the policies of the patent system in encouraging the development and protection of important new products while maintaining appropriate disclosure requirements.

Part I.A explains the nature of automated experimental techniques by comparing traditional chemical synthesis with an example of combinatorial chemical synthesis. Part I.B addresses the establishment and acceptance of the reasonable experimentation doctrine by the United States' courts. Part II points out the problems in patent interpretation using the factors that determine reasonable experimentation pursuant to *In re Wands*. In Parts III and IV.A, this Comment justifies modifying and narrowing the reasonable experimentation doctrine. Finally, in Part IV.B, it proposes more stringent disclosure and claiming requirements, such as product-by-process claiming, that would more accurately reflect the scope of enablement.

> [t]he enablement requirement of § 112 demands that the patent specification enable "those skilled in the art to make and use the full scope of the claimed invention without 'undue experimentation.'" The enablement requirement ensures that the public knowledge is enriched by the patent specification to a degree at least commensurate with the scope of the claims. The scope of the claims must be less than or equal to the scope of the enablement. The scope of enablement, in turn, is that which is disclosed in the specification plus the scope of what would be known to one of ordinary skill in the art without undue experimentation.

Nat'l Recovery Techs., Inc. v. Magnetic Separation Sys., Inc., 166 F.3d 1190, 1195-96 (Fed. Cir. 1999).

[18] *Id.*

[19] In addition to the doctrine of reasonable experimentation, the doctrine of equivalents has also been a point of controversy for this same conflict between the policy of issuing patents to give notice to the public while simultaneously fairly protecting the inventor from routine copyists. The doctrine of equivalents affords the patentee changes from the literal interpretation which the court deems as "insubstantial." Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd., 122 S. Ct. 1831 (2002).

[20] Terret, *supra* note 11, at 8137-69.

I. AUTOMATED EXPERIMENTAL TECHNIQUES AND THE REASONABLE EXPERIMENTATION DOCTRINE

A. Traditional Versus Automated Approaches to Chemical Compound Synthesis

It is first necessary to understand the technology of automated experimentation to realize its impact on the doctrine of reasonable experimentation. As an illustration of automated experimentation, this Comment will compare how traditional chemical synthetic methods and combinatorial chemical methods make and test new chemical compounds.

In the traditional method of discovering a novel chemical compound, the goal of the inventor is directed primarily toward the synthesis of a single compound.[21] The inventor takes a known compound and modifies part of the structure of this starting compound using reaction conditions that have successfully transformed similar parts of other compounds to the desired motif.[22] To achieve this, the inventor conducts an experiment that involves: (1) combining the starting compound with the known reagent in solution in a single reaction vessel; (2) neutralizing or concentrating the reaction mixture; and (3) performing appropriate isolation techniques[23] to obtain the single new compound.[24] To prove that the new compound has in fact been made, the inventor must identify the compound, typically using spectroscopic techniques such as ^{1}H or ^{13}C nuclear magnetic resonance (NMR), infrared (IR), and high-resolution mass spectroscopy (HRMS).[25] To establish patentability, the inventor must establish some utility for the compound.[26] Such synthetic and analytical activities are labor-intensive, and an average chemist can perhaps make at most a few hundred compounds per year by this method.[27] By contrast, in order to develop a new commercial compound, usually thousands of compounds have to be prepared and tested.[28] This time-consuming approach has

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[21] *Id.* at 8138.

[22] *See generally* ROYSTON M. ROBERTS ET AL., AN INTRODUCTION TO MODERN EXPERIMENTAL ORGANIC CHEMISTRY 101-431 (2d ed. 1974).

[23] *See generally* JAMES W. ZUBRICK, ORGANIC CHEM LAB SURVIVAL MANUAL 117-360 (3d ed. 1992). Examples of appropriate isolation techniques include, but are not limited to, recrystallization, extraction or washing, distillation, sublimation, or chromatography. *Id.*

[24] *Id.*

[25] FRANCIS A. CAREY, ORGANIC CHEMISTRY 512-49 (3d ed. 1996). For the most part, present-day structure determination techniques are spectroscopic in nature. *Id.* All of these techniques identify the compound based on how the compound responds while in the presence of various energy sources. *Id.* NMR examines what happens to a compound when it is bombarded with radio frequencies of light in the presence of a magnetic field, IR examines what happens to a compound when it is bombarded with infrared light, and HRMS examines what happens to a compound when it is bombarded with electrons. *Id.*

[26] In order to be patentable, a claimed invention also must be useful. This requirement of utility is codified as, "[w]hoever 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." 35 U.S.C. § 101 (1994).

[27] *See generally* Terret, *supra* note 11.

[28] *Id.*

resulted ever increasing research and development costs which typically are passed on to the consumer.[29]

The need to improve the speed and reduce the cost by which new compounds are created, coupled with advances in robotics, have made possible the process or strategy which is commonly referred to as combinatorial chemistry.[30] Combinatorial chemistry uses automated machinery so that large numbers of chemical experiments are conducted simultaneously.[31] For example, if coupling starting material A with reagent B gives the new compound A-B, combinatorial synthesis can take a range of similar starting materials A_1-A_n (where A_1, A_2, A_3 . . . are different starting materials), sometimes referred to as "scaffolds," and react those with a single reagent B_1 or a range of reagents B_1-B_n (where B_1, B_2, B_3 . . . are different reagents) to make numerous novel compound combinations in only slightly more time as it used to take to make one compound. These methods have the potential to simultaneously produce large collections of new compounds collectively referred to and claimed as "libraries."[32]

The research and commercial goal of these activities is to find a "lead compound," a new compound with a particular utility, such as a pharmaceutical application. To accomplish this, the "libraries" of new compounds thus obtained are typically screened for potential utility before they are fully characterized. Screening experiments are also conducted in an automated, high-throughput format.[33] A few of the most useful compounds are even partially characterized.[34] Because these processes are automated, such activities allow for the synthesis, purification, characterization, and testing of hundreds of thousands of compounds per year.[35] Analogous automated experimental techniques are also used in the field of biotechnology.[36] Recent patents claim not only the chemical compounds themselves, but also "libraries"[37] as new compositions of matter as well as the methods used to create, manipulate, and test such compositions of matter.[38]

A patent can claim thousands to millions of compounds or other compositions of matter thought makeable and useful via these techniques.[39] A problem can arise,

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[29] *Id.*

[30] *Id.*

[31] *Id.*

[32] *See supra*, text accompanying note 5.

[33] *See* Terret, *supra* note 11.

[34] *See generally Manuscripts*, *supra* note 8, at http://pubs.acs.org/instruct/jcchff.pdf (setting forth the requirements for publication of a manuscript containing partially characterized compounds).

[35] *See* Terret, *supra* note 11.

[36] Analogous automated experimental techniques in the field of biotechnology include: (1) oligonucleotide and peptide synthesis (a semi-automated process that can sequentially synthesize these biopolymers in any monomer sequence with very large molecular weights); (2) polymerase chain reaction (PCR) technology (a semi-automated process that selectively and exponentially multiplies a specific region of DNA, producing quantities of DNA sufficient for experimentation and analysis); and (3) sequencing by hybridization (SBH) technology (a semi-automated gene sequencing process that uses known complementary nucleic acid "probe" compounds to find the corresponding sequence in an unsequenced genetic fragment). *See generally* FREDERICK M. AUSUBEL, CURRENT PROTOCOLS IN MOLECULAR BIOLOGY, Vol. 1-4 (1999).

[37] *See supra* text accompanying note 5.

[38] *See supra* text accompanying note 9.

[39] *See supra* text accompanying notes 5, 6, and 8.

however, when only a small percentage of the members of a large library have explicit experimental support in a patent. To determine whether such a patent disclosure satisfies the enablement requirement in the chemical arts, a researcher, patent examiner, judge, or jury[40] must look to the disclosure to see if it enables "those skilled in the art" to make and use the full scope of the claimed invention without unreasonable experimentation.[41] As will be seen in the next sections, this is not easily determined.

B. The Common Law Evolution of a Broad "Reasonable" Experimentation Doctrine in the United States

There is nothing in the Patent Act that mentions the doctrine of reasonable experimentation.[42] The reasonable experimentation doctrine arises purely from caselaw[43] rather than statute.[44] Since 1916, United States patent jurisprudence has recognized the concept of an exception from literal deficiencies or insufficiencies in individual disclosures by allowing for some experimentation outside of the disclosure as long as it is not unduly[45] excessive.[46] This Section focuses on what the current common-law definition of reasonable experimentation encompasses.

In *Mineral Separation v. Hyde*, the Supreme Court departed from earlier decisions by establishing that the 35 U.S.C. § 112 enablement requirement[47] is still satisfied where a specification "is clearly sufficiently definite to guide those skilled in

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[40] If the issue of enablement is litigated, enablement is ultimately a question of law; however, there may be underlying factual issues involved. For examples of such underlying factual issues impacting enablement, see Moleculon Research Corp. v. CBS, Inc., 793 F.2d 1261, 1268 (Fed. Cir. 1986); Quaker City Gear Works, Inc. v. Skil Corp., 747 F.2d 1446, 1453-54 (Fed. Cir. 1984).

[41] *See* CHISUM, *supra* note 16, at § 7.03[4].

[42] *See generally* 35 U.S.C. (1952). The Patent Act of 1952 was a comprehensive effort to restate and codify patent law to that date. Despite numerous federal trial and appellate courts recognizing the existence of a reasonable experimentation doctrine, the commentary by a co-author of the 1952 codification of the Act does not even mention reasonable experimentation in the context of § 112. P. J. Federico, *Commentary on the New Patent Act*, 35 U.S.C. § 1 (1954), *reprinted in* 75 J. PAT. & TRADEMARK OFF. SOC'Y 161, 215 (1993) (stating that 35 U.S.C. § 112 ¶ 1"would include the defenses such as that the patented invention has not been made, used or sold by the defendant; license; and equitable defenses such as laches, estoppel and unclean hands" but nothing concerning reasonable experimentation).

[43] This concept was explicitly refuted in earlier opinions exemplified by Chief Justice Taney in *Wood v. Underhill*, 46 U.S. 1, 5 (1847). In discussing the issue, Chief Justice Taney stated,

> [t]he degree of certainty which the law requires is set forth in the act of Congress. The specification must be in such full, clear, and exact terms as to enable any one skilled in the art to which it appertains to compound and use the invention; that is to say, to compound and use it without making *any* experiments of his own.

Id. The concept of reasonable experimentation originated in the opinion of Justice Clarke in *Mineral Separation v. Hyde*, 242 U.S. 261 (1916), which courts gradually grew to accept.

[44] *See* 35 U.S.C. § 112 ¶ 1 (1994).

[45] The terms "undue" and "unreasonable" are used interchangeably in United States case law and literature describing disclosures that require further experimentation. *Compare* Amgen, Inc. v. Chugai Pharm. Co., Ltd., 927 F.2d 1200, 1212-13 (Fed. Cir. 1991) *with* Chemcast Corp. v. Arco Indus. Corp., 854 F.2d 1328, 1328 (Fed. Cir. 1988).

[46] CHISUM, *supra* note 16, at 7.03[4].

[47] *See supra* text accompanying note 13.

the art to its successful application" even "while leaving something to the skill of persons applying the invention."[48] Several explanations have been posited for Justice Clarke's expansive view. Some believe that there cannot be an effective patent system if a burden of literal disclosure is placed on the applicant for broad claims, especially for "pioneering" inventions.[49] To restrict patentees to what is literally disclosed would be a poor way to stimulate invention and encourage early disclosure because it would allow copyists to routinely design around patents.[50] Such a policy was considered both shortsighted and unsound from the standpoint of promoting progress in the useful arts, the Constitutional purpose of the patent laws.[51]

In the years following *Mineral Separation*, a number of federal trial and appellate courts recognized the existence of a reasonable experimentation doctrine,[52] which was qualitatively applied both in favor[53] as well as against[54] a patentee's disclosure. To add supplemental structure to this analysis, modern decisions have expanded the analysis to include more factual considerations than were previously assessed. A key case addressing the undue experimentation doctrine in the modern era is *In re Wands*,[55] which has attracted significant scholarly commentary.[56] The

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[48] *Mineral Separation*, 242 U.S. at 271. In *Mineral Separation*, the Court allowed for some variation of treatment as long as (1) it is within the scope of the claims, and (2) held that the certainty which the law requires in patents is "not greater than is reasonable, having regard to their subject matter." *Id.* at 271. Justice Clarke's dichotomy was adopted in subsequent decisions, and it remains part of the rule today. *See In re* Wands 858 F.2d 731, 736-37 (Fed. Cir. 1988).

[49] *In re* Hogan, 559 F.2d 595, 604 (C.C.P.A. 1977).

[50] *Id.*

[51] The U.S. Constitution enables 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." U.S. CONST. art. I, § 8, cl. 8.

[52] *See* Lever Bros. Co. v. Procter & Gamble Mfg. Co., 139 F.2d 633, 639 (4th Cir. 1943) (stating that "it is both impracticable and unreasonable to require [the patentee] to set out an extended list of precise combinations and formulae with specific designation of the exact characteristics [obtained]"); Franc-Stohmenger & Cowan, Inc. v. Arthur Siegman, Inc., 27 F.2d 785, 786-87 (2d Cir. 1928) (stating that it is not fatal if the disclosure is in terms of performance and result, or if "that an inventor must exercise independent choice . . . provided it gives the person of ordinary skill in the art an adequate or sufficient guide").

[53] *See* Utter v. Hiraga, 845 F. 2d 993, 998 (Fed. Cir. 1988) (finding that applicant's claims to scroll compressors were not unpredictable and nonenabled even though evidence showed the failure of a prototype with external pivot compressors); Atlas Powder Co. v. E.I.DuPont de Nemours & Co., 750 F.2d 1576, 1569 (Fed. Cir. 1984) (finding that a patent's claims to thousands of emulsions, some of which were prophetic or inoperative, were still enabled unless the number of inoperative combinations became significant); Alco Standard Corp. v. Tennessee Valley Authority, 808 F.2d 1490, 1495-96 (Fed. Cir. 1986) (relying on expert testimony that a patent taught a person of ordinary skill in the art how to inspect turbine rotors, detect discontinuities, and correlate and combine this information even though that information was not compiled in the patent); Precision Metal Fabricators Inc. v. Jetstream Systems Co., 693 F. Supp. 820, 814 (N.D. Cal. 1988) (holding that a patent was enabled despite its failure to disclose any depiction or description of a claimed feature in the patent).

[54] *See* Hormone Research Foundation v. Genentech Inc., 904 F.2d 1558, 1568 (Fed. Cir. 1990) (finding that just because purer and more potent forms of a compound were later produced did not mean that the patent specification did not provide an enabling disclosure as of the filing date of the application); *Chemcast Corp.*, 854 F.2d at 1328 (concluding that a determination that the specification meets the particularity requirement under 35 U.S.C. § 112 ¶ 1 may not support a determination that a claim meets the enabling requirement under 35 U.S.C. § 112 ¶ 2).

[55] Wands, 858 F.2d 731.

Wands factors to be considered in determining whether a disclosure would require undue experimentation include: (1) the quantity of experimentation necessary; (2) the amount of direction or guidance presented; (3) the presence or absence of working examples; (4) the nature of the invention; (5) the state of the prior art; (6) the relative skill of those in the art; (7) the predictability or unpredictability of the art; and (8) the breadth of the claims.[57] As the next section will discuss, the interrelationship among these factors is complex and sometimes ambiguous.[58] The emergence of automated experimentation further contributes to the difficulty in interpreting and applying the doctrine.

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[56] *See* Robert A. Hodges, *Black Box Biotech Inventions: When a "Mere Wish or Plan" Should Be Considered an Adequate Description of the Invention,* 17 GA. ST. U.L. REV. 831 (2001) (noting that unpredictability should be deemed on a case by case basis); Matthew D. Kellam, *Making Sense out of Antisense: The Enablement Requirement in Biotechnology After* Enzo Biochem v. Calgene, 76 IND. L.J. 221 (2001) (arguing that unpredictability, complexity, and broadness of an invention increases the need for examples); Margaret Sampson, *The Evolution of the Enablement and Written Description Requirements Under 35 U.S.C. 112 in the Area of Biotechnology,* 15 BERKELEY TECH. L.J. 1233 (2000) (stating that one *Wands* factor, the predictability of the art at issue, is particularly important for determining the scope of enablement); Alison E. Cantor, *Using the Written Description and Enablement Requirements to Limit Biotechnology Patents*, 14 HARV. J. LAW AND TEC 267 (2000) (remarking that the unpredictability of biotechnology is one of the primary factors that courts use in determining whether undue experimentation would be required in order to practice the invention); Emanuel Vacchiano, *It's A Wonderful Genome: The Written-Description Requirement Protects The Human Genome From Overly-Broad Patents*, 32 J. MARSHALL L. REV. 805 (1999) (noting that even in an unpredictable arts applicants do not have to disclose every species encompassed by their claims); Hugh McTavish, *Enabling Genus Patent Claims to DNA*, 2001 MINN. INTELL. PROP. REV. 2 (2001) (explaining that the enablement requirement is stricter for unpredictable arts than predictable ones); Brian P. O'Shaughnessy, *The False Inventive Genus: Developing a New Approach for Analyzing the Sufficiency of Patent Disclosure Within the Unpredictable Arts*, 7 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 147 (1996) (stating that a method of making a compound appears to implicitly satisfy the enablement requirement); Stephen G. Whiteside, *Patents Claiming Genetically Engineered Inventions: A Few Thoughts on Obtaining Broad Property Rights*, 30 NEW ENG. L. REV. 1019 (1996) (remarking that the *Wands* factors are often a difficult standard to meet when the invention comprises biological materials that are difficult to reproduce, such as certain cell strains).

[57] *Wands*, 858 F.2d at 736-37. The factors were first expressed in *In re Colianni*, 561 F.2d 220, 224 (C.C.P.A. 1977) and subsequently used in *Ex Parte Forman,* 230 U.S.P.Q. (BNA) 546 (B.P.A.I. 1986) and *Wands*.

[58] *See Amgen*, 927 F.2d at 1212-14 (Fed. Cir. 1991) (holding that it was not even necessary that a court review all the *Wands* factors to find a disclosure enabling). In fact, the court seemed to ignore a complete *Wands* factor analysis for several years in its discussion of enablement. *See In re* Wright, 999 F. 2d 1557, 1561 (Fed. Cir. 1993) (determining that specification was nonenabling without undue experimentation referred only to the state of art at time of patent application relative to the breadth of the claims); *In re* Goodman, 11 F.3d 1046, 1050-52, (Fed. Cir. 1993) (determining that specification was nonenabling without undue experimentation referred to the number of working examples and sufficient information, person of ordinary skill, and the scope of claims); *Genentech,* 108 F.3d at 1365 (determining that specification was nonenabling without undue experimentation referred to the number of working examples, level of skill in the art, and the scope of claims). However, the Federal Circuit returned to its use of the *Wands* factors in its decision in *Enzo Biochem Inc. v. Calgene Inc.*, 188 F.3d 1362, 1374 (Fed. Cir. 1999), in which all of the *Wands* factors were used in determining that two patent specifications were nonenabling without undue experimentation, while another patent specification was enabling without undue experimentation.

II. THE *WANDS* FACTOR ANALYSIS

This Section analyzes how courts would determine whether a patent claim to a library or to a class of compounds satisfies the enablement requirement under the *Wands* factor analysis of "reasonable" experimentation. This Section defines the issue by analyzing how one would interpret Steam Drill's patent claims and their accompanying disclosure under the *Wands* factor analysis.

As mentioned previously, a typical combinatorial chemistry patent claims thousands to millions of compounds. Many of these compounds will be minimally characterized, uncharacterized, or illustrated only with an exemplifying procedure in which the compound might be made.[59] The issue, therefore, becomes whether the disclosure enables one of ordinary skill in the art to practice the full scope of the claims. To determine whether a patent disclosure in the chemical arts satisfies the enablement requirement, a chemical researcher, patent examiner, judge, or jury must weigh at least some of the eight *Wands* factors. The eight factors are complicated to apply. Ultimately, the factor of predictability becomes the primary factor that courts rely on in determining whether undue experimentation is required to practice the invention.[60]

A. Breadth of the Claims and the State of the Prior Art

While the breadth of the claims is listed as a separate factor, patent examiners and courts usually balance this factor against the other *Wands* factors, such as the presence or absence of working examples[61] or the state of the prior art.[62] To determine the breadth of the claims, one follows the traditional rules of claim construction, considering: (1) the plain meaning of the claim language; (2) how claim terms are defined in the patent; and (3) the prosecution history of the patent.[63]

Few decisions have specifically addressed the state of the prior art as a significant factor. One of the few decisions to even mention this factor, simply stated that if a disclosure uses prior art materials or processes or something similar to prior

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[59] *See supra* notes 5, 6, and 9 (giving examples of combinatorial chemical patents).

[60] *See Wands*, at 736-37 (discussing that the predictability of the art is one of the primary factors that courts use in determining whether undue experimentation would be required in order to practice an invention).

[61] *See* Durel Corp. v. Osram Sylvania Inc., 52 U.S.P.Q.2d 1418, 1433 (D.Ariz. 1998) (finding that the inclusion of twenty-eight examples enabled the full breadth of the claims).

[62] *See id.* (finding that the use of prior art materials lessened what the patent needed to teach to enable the full breadth of the claims).

[63] Pickholtz v. Rainbow Techs, Inc., 284 F.3d 1365, 1372 (Fed. Cir. 2002). Only if doubt remains as to the meaning of a disputed claim term should "extrinsic" evidence, such as an inventor's testimony and the usage of particular terms in the art, be considered to resolve any ambiguities created by the patent specification, the claims and the prosecution history. *Id.* at 1372-73. If a patentee has not clearly disclosed a special meaning for a term in a claim, its ordinary and common meaning is applied. Johnson Worldwide Assoc., Inc. v. Zebco Corp., 175 F.3d 985, 989 (Fed. Cir. 1999). Claims should be so construed, if possible, so as to sustain their validity. ACS Hosp. Sys., Inc. v. Montefiore Hosp., 732 F.3d 1572, 1577 (Fed. Cir. 1984). While a patent examiner does not have a post-issuance prosecution history like the public, an examiner does have the applicant's representation of their invention from the applicant's arguments.

art materials or processes, then this decreases what the patent needs to teach to correlate with the breadth of claims to meet the requirements of 35 U.S.C. § 112.[64] Because combinatorial chemical processes have become increasingly established and use many of the prior art starting compounds and reagents as traditional chemistry, a more explicit disclosure would not appear to be required for combinatorial chemical patents when examining this factor alone.

B. The Relative Skill of Those in the Art and the Quantity of Experimentation Necessary

Other factors, such as the relative skill of those in the art and the quantity of experimentation necessary, weigh more prominently in the analysis. There is significant latitude in defining the relative skill of those in the art. Courts have generally found that the relative skill is that of a person of ordinary skill in the art.[65] The relative skill of those in the chemical arts has been established by the United States Court of Appeals for the Federal Circuit (Federal Circuit) as quite "high,"[66] which increases the quantity of experimentation, the next *Wands* factor, that may be considered reasonable irrespective of whether this experimentation is automated.[67]

The quantity of experimentation can be "considerable," [68] "tedious,"[69] "laborious,"[70] and "time-consuming,"[71] as long as the experiments are merely "routine."[72] For example, experimentation requiring only routine optimization or

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[64] *Durel*, 52 U.S.P.Q.2d at 1433; *see also In re* Fisher, 427 F.2d 833, 839 (C.C.P.A. 1970) (discussing that the amount of disclosure needed to provide enablement is inversely related to the amount of knowledge in the state of the art). From this one might infer that, at the very least, a patent specification does not need to teach what is already taught in the prior art.

[65] Typically this is a person with a college degree and some additional experience in a particular field of research. *Durel*, 52 U.S.P.Q.2d at 1433-34 (finding that a person of ordinary skill in the art would be "a junior faculty member with one or two years of relevant experience or a postdoctoral student with several years of experience"). *See also Enzo*, 188 F.3d at 1374. This is done for practical reasons as the Court bases its determinations of skill on the background of the witnesses who may testify at trial, namely the people who conducted most of the research. *Id.* at 1373.

[66] *Durel*, 52 U.S.P.Q.2d at 1433-34. This is relevant only to the extent that a highly skilled artisan is not required to be an expert in every specialized field to which the invention pertains. *See also Enzo* 188 F.3d at 1373 (finding that the high level of skill in the art possessed by a post-graduate researcher does not require accounting for all of the specialized fields to which the invention pertains, and that they could hardly be characterized as mere laboratory technicians).

[67] *See Genentech*, 108 F.3d at 1367; *Durel*, 52 U.S.P.Q.2d at 1433-34.

[68] *Ex parte* Jackson, 217 U.S.P.Q. 804, 807 (B.P.A.I. 1982) ("[t]he test is not merely quantitative, since a considerable amount of experimentation is permissible, if it is merely routine.").

[69] *See Ex parte* Erlich 3 U.S.P.Q.2d 1011 (B.P.A.I. 1982) (observing that although a method might be 'tedious and laborious,' such experimentation is nevertheless 'routine').

[70] *Id.*

[71] U.S. v. Telectronics Inc., 857 F.2d 778, 785 (Fed. Cir. 1988) (explaining that the time and expense of the experimentation are only factors to be considered in assessing enablement and are not determinative).

[72] *See Erlich* 3 U.S.P.Q.2d at 1011 (defining "routine" experiments as those which use known methods in combination with the variables taught in the patent to achieve the expected, specific, patented result). This is the case even if certain terms may be vague. *See* Locklin v. Switzer Bros.,

screening has not been held to be undue experimentation.[73] The ability to automate experiments in a particular field would seem to reduce a patentee's duty of disclosure, as the primary purpose of automating most processes is to make repetitious work less tedious and laborious and more routine. To determine if experimentation is merely routine, courts have turned their analyses to other *Wands* factors such as whether (1) the direction, guidance, or working examples disclosed in the patent teach (2) one of ordinary skill in the art how to choose any (3) unpredictable aspects presented in the patent to practice (4) the full scope of the claims.[74] The use of the quantity of experimentation factor is troubling on two counts: (1) it can be completely defined by other *Wands* factors and therefore seems unnecessary; and (2) it reduces the requirements of disclosure for patents that involve automated experimental techniques, irrespective of the nature of those experiments.

C. The Amount of Guidance Presented and the Presence or Absence of Working Examples

Courts sometimes have trouble distinguishing between what is direction or guidance and what is a working example. While some courts have equated direction or guidance with the presence or absence of working examples,[75] other courts have looked at direction or guidance as any other suggestions, recommendations, or descriptions that are provided in the specification, especially as to how these suggestions teach one to choose any unpredictable variables that are involved in the invention.[76]

With regard to the presence of working examples, the actual number of examples is not determinative as zero, one, two, or more examples of a broad genus

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Inc., 299 F.2d 160, 166 (9th Cir. 1961) (finding that the phrase "sufficient melamine to render the resin substantially insoluble" provided a sufficient test of the limits for an ordinary chemist to perform without extensive experimentation). *See also Durel*, 52 U.S.P.Q.2d at 1435 (finding that a patent that states that a certain variable "may readily be determined through trial and error" may still be enabled).

[73] *See, e.g.*, *Wands*, 858 F.2d at 736-37 (stating that "[e]nablement is not precluded by the necessity for some experimentation such as routine screening"). *See Locklin*, 299 F.2d at 166 (finding that some preliminary testing is required does not render a claim invalid); Johns Hopkins Univ. v. Cellpro, 152 F.3d 1342, 1360 (Fed. Cir. 1998) (differentiating between the shortcomings of a disclosure and the shortcomings of certain technology by finding that repeating experiments to obtain success is not undue experimentation).

[74] *See Enzo*, 188 F.3d at 1372-73 (finding that three examples of genes regulated in *E. coli* did not provide sufficient guidance to as to how to practice the invention with other genes or in other cells).

[75] *See* Plant Genetic Sys. v. DeKalb Genetics Corp., 175 F. Supp. 2d 246, 265 (D.Conn. 2001) (finding that a patent provided little guidance when it provided only one example of one method to transform one type of plant and therefore did not enable others to transform all types of plants as was in the full scope of the claims).

[76] *See Durel*, 52 U.S.P.Q.2d at 1433 (noting that the patents at issue did not describe the particular variables that had to be adjusted but did indicate that a ratio may need to be adjusted depending upon the precursors used).

may *or may not* prove to be enabling.[77] In the academic combinatorial chemical literature, journal editors have tried to be more quantitative in their requirements of working examples to establish enablement. For example, the Journal of Combinatorial Chemistry requires that 5% of the compounds in a library be fully characterized for the library and its method of production to be considered enabled for fellow chemists.[78] Publishers have implemented this requirement because they recognize the unpredictability of chemical reactions.[79] With patents, the problem is whether a specification that sets forth any specific number of examples can be enabling of broad claims when the subject matter is considered to be unpredictable.[80] This is the case for both traditional and combinatorial chemistry. As developed in the next section, it is this factor of predictability that is really at the crux of determining what is reasonable experimentation for combinatorial chemistry applications.

D. The Predictability (or Unpredictability) of the Art and the Nature of the Invention

While the mechanical and electrical arts are generally viewed as "predictable,"[81] chemical reactions are often considered to be "unpredictable"[82] both by chemists[83] and by the courts.[84] It is unclear how courts would rule on automated

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[77] *Compare Goodman*, 11 F.3d at 1050-52 (holding that a patent was not enabled where the specification listed only one example of production); *Plant Genetic Sys.*, 175 F.Supp.2d at 265 (holding that one example of one method to transform one type of plant was not enabling for transforming all plants); *Enzo*, 188 F.3d at 1374 (finding that three examples of genes regulated in *E. coli* did not provide sufficient guidance as to how to practice the invention with other genes or in other cells) *with Johns Hopkins Univ.*, 152 F.3d at 1342 (holding that a single example of a method for production was enabling); Bruning v. Hirose, 161 F.3d 681, 686 (Fed. Cir. 1998) (holding that a single example of a method for production was enabling); *and* Shanks v. Scheffer, 204 U.S.P.Q.2d 1880 (B.P.A.I. 1979) (holding that while the applicant did not show a single working example, this was not the ultimate test).

[78] *See* Terret, *supra* note 11.

[79] *Id.* In fact, it is these more unpredictable areas that are the most prevalent areas of patentable research, because scientists and technologists don't fully understand the rules and must spend a significant amount of effort in trying to solve, predict, and exploit them.

[80] *See* CHISUM, *supra* note 16, at § 7.03[4].

[81] *Fisher*, 427 F.2d at 839 (observing that in cases involving predictable factors, such as mechanical or electrical elements, a single embodiment provides broad enablement in the sense that, once imagined, other embodiments can be made without difficulty and their performance characteristics predicted by resort to known scientific laws).

[82] In addition to chemistry, some areas of biotechnology have also been determined as unpredictable, including genetic engineering of plants. *Plant Genetic Sys.*, 175 F. Supp. 2d at 246 (demonstrating that plant transformation and antisense in the late 1980's were highly unpredictable arts).

[83] For example, the Journal of Combinatorial Chemistry notes that "[i]t is well-known that different batches of solid-phase synthesis supports can affect the success of reactions conducted on them. *Manuscripts*, *supra* note 8, at http://pubs.acs.org/instruct/jcchff.pdf. "To date, there is no rigorous solution to this source of variability, [and] in the combinatorial chemistry field, evidence of reagent failure in synthetic efforts is often significant, and authors are encouraged to include such material if they are confident of their findings." *Id.*

[84] Chemical reactions have been deemed as unpredictable. *See Fisher*, 427 F.2d at 839 (observing that in cases involving unpredictable factors, such as most chemical reactions and physiological activity, the scope of enablement obviously varies with the degree of unpredictability of

experiments that utilize electromechanical devices to perform chemical experiments.[85] Patent applicants in art areas currently deemed "unpredictable" are often allowed generic claims encompassing more than the particular species disclosed in their specification.[86] Further complicating matters, courts have also recognized that in view of the rapid advances in science, what may be unpredictable at one point in time may become predictable at a later time, although the decisions provide no real guidance as to how this is determined.[87]

A more useful factor is the nature of the invention. In contrast to the predictability of the *art,* courts have sometimes characterized this factor as the predictability of the *invention.*[88] For example, the *Durel* court noted that patents that deal with chemistry often contain a number of variables, the adjustment of which may create wide-ranging results. With such patents, any additional experimentation is not undue unless there is corresponding uncertainty accompanying the variables.[89] A showing that a person of ordinary or greater skill in the art cannot choose among the variables taught by the invention to successfully reproduce the full scope of the claims is one method to establish unpredictability and that a patent fails to satisfy 35 U.S.C. § 112's enabling requirement.[90] However, it is

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the factors involved). However, "[t]he mere presence in a chemical reaction of numerous variables is not enough to created a heightened requirement of disclosure to satisfy the enablement requirements of § 112." *Id.* A chemical reaction is not *per se* unpredictable; only if the corresponding adjustment in the variables of the chemical reaction creates unpredictable or uncertain results will experimentation be considered to be undue. *Durel*, 52 U.S.P.Q.2d at 1433-35.

[85] The use of automation should be largely irrelevant to this factor. While the probability of a particular result occurring is enhanced when the number of events attempting to achieve this result is increased, this is different from predictability, where the result occurs with each event. Therefore it is the nature of the experiment, not the tools used to conduct the experiment, that should determine predictability.

[86] *In re* Vaeck, 947 F.2d 488, 496 (Fed. Cir. 1991).

[87] *See Enzo*, 188 F.3d at 1374.

[88] *See Durel*, 52 U.S.P.Q.2d at 1433-34 (noting that if an adjustment in a variable created predictable result, there is no adverse impact upon the scope of enablement). However, if an adjustment in a variable creates unpredictable results, "the scope of enablement must necessarily require a higher correlation between the patent claims and the art it teaches to meet the requirements of § 112." *Id. See also Amgen*, 927 F.2d at 1214 (noting that the structural complexity of the product combined with the number of analogs and the uncertainty as to what utility might be possessed by these analogs increases the need to identify the various analogs that are within the scope of the claim, methods for making the analogs, and structural requirements for activity).

[89] *See Durel*, 52 U.S.P.Q.2d at 1433-34.

[90] *See Plant Genetic Sys.*, 175 F. Supp. 2d at 265 (holding that a person skilled in the art would have to engage in an undue amount of experimentation because of testimony that inventors could not practice invention until seven months to years after the filing date of the patent); *Durel*, 52 U.S.P.Q.2d at 1433-34 (holding that a person skilled in the art would not have to engage in an undue amount of experimentation because there was no evidence which illustrated the impact of adjusting the variables and the corresponding effect upon the predictability or unpredictability of the resulting reaction and product); *see also Enzo*, 188 F.3d at 1373 (finding that the amount of experimentation required to adapt the practice of antisense from *E. coli* to cells other than *E. coli* was quite high based on the inventor's own and other skilled scientists' failed attempts to control the expression of other genes or of other cell types using antisense technology following the patent's disclosure); *Johns Hopkins Univ.*, 152 F.3d at 1360 ("[a] party who wishes to prove that the claims of a patent are not enabled by means of a failed attempt to make the disclosed invention must show that the patent's disclosure was followed"); *Amgen*, 927 F.2d at 1214 (noting that the structural complexity of the product combined with the number of analogs and the uncertainty as to what

to show a contesting party's burden to prove by "clear and convincing evidence"[91] that one of ordinary skill in the art must engage in undue experimentation to reproduce the teachings found in the patent.[92] This unpredictability-in-hindsight test essentially requires a person contesting the validity of the patent, to actually perform all of the relevant experiments to determine whether they will work as described. Thus, the *Wands* analysis is troubling on several counts: (1) by being defined by other *Wands* factors, some *Wands* factors are completely unnecessary; (2) automating of experiments would seem to reduce the requirements of disclosure, irrespective of the nature of those experiments; and (3) the complex interrelationships and overall ambiguity of the *Wands* analysis impairs putting the public in possession of the invention by making it too difficult for a chemical researcher or patent practitioner to determine whether a patent claim is enabled or valid within the scope of its disclosure.

Perhaps because of the ambiguities of these factors, the United States Patent and Trademark Office (USPTO) has developed guidelines for its examiners in applying 35 U.S.C. § 112 for chemical and biotechnical applications.[93] The USPTO can make a scope of enablement rejection where the specification enables something within the scope of the claims, but the claims are not limited to that scope.[94] In addition, if the specification does not enable any subject matter within the scope of the claims, the USPTO may make a general enablement rejection that the specification does not teach one of ordinary skill in the art how to make or use the invention.[95] To evaluate whether the application complies with the enablement requirement of § 112, the examiner must determine: (1) what each claim covers as a whole; (2) how the applicant provides support for the claimed invention including each element and/or step;[96] and (3) whether there is sufficient[97] written description to

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utility might be possessed by these analogs increases the need to identify the various analogs that are within the scope of the claim, methods for making the analogs, and structural requirements for activity).

[91] *Johns Hopkins Univ.*, 152 F.3d at 1360.

[92] *Durel*, 52 U.S.P.Q.2d at 1433-34.

[93] *See generally* DEP'T OF COMMERCE, United States Patent and Trademark Office, "Training Materials for Examining Patent Applications with Respect to 35 U.S.C. § 112 ¶ 1 - Enablement Chemical/Biotechnical Applications," *available at* http://www.uspto.gov/web/offices/pac/dapp/oppd/1pecba.htm (last modified Nov. 5, 1996).

[94] *Id.*; *see also* MPEP, *supra* note 7, at § 706.03(c).

[95] *See* Guidelines for Examination of Patent Applications Under the 35 U.S.C. § 112 "Written Description" Requirement, 66 Fed. Reg. 1099, 1105 (2001).

[96] *Id.* The Guidelines state that such a review "should include a determination of the field of the invention and the level of skill in the art at the time the application was filed." *Id.* The Guidelines note that "there is an inverse correlation between the level of skill and knowledge in the art and the specificity of disclosure necessary to satisfy the written description requirement." *Id. Also see generally* DEP'T OF COMMERCE, Patent and Trademark Office, "Request for Comments on Interim Guidelines for Examination of Patent Applications Under the 35 U.S.C. § 112 ¶ 1 "Written Description" Requirement; Extension of Comment Period and Notice of Hearing, 63 Fed. Reg. 50887, 50888 (Sept. 1, 1998). However, some comments objected to the use of predictability in the written description requirement because it is an inquiry that should only be associated with the enablement. *See* Revised Interim Guidelines for Examination of Patent Applications Under the 35 U.S.C. 112 ¶ 1 "Written Description" Requirement, 64 Fed. Reg. 71427, 71430 (Dec. 21, 1999).

[97] *See* Guidelines for Examination of Patent Applications Under the 35 U.S.C. § 112 ¶ 1 "Written Description" Requirement, 66 Fed. Reg. at 1105-06. The Guidelines state that the sufficiency requirement may be satisfied with a "representative number of species." What

inform a skilled artisan that the applicant was in possession of the claimed genus at the time the application was filed.[98] While these guidelines are simpler, they utilize the same *Wands* definitions and provide little guidance to a chemical researcher. Like an inventor contesting a patent's validity, the USPTO bears the initial burden of establishing the insufficiency of a disclosure that necessitates undue experimentation.[99]

In the example of Steam Drill's patent, the public, rather than the applicant, bears the burden of an inventor's broad claim, false prophecy, and reduced burden of disclosure, which is surely an unsatisfactory result.[100] While a core goal of the United States patent system is to provide an economic incentive for technological advancement and investment in scientific research,[101] overly broad patents deter innovation in a field.[102]

In the next Part, this Comment argues that the reasonable experimentation doctrine should be modified. This Comment further proposes a "product by process"[103] claiming requirement that, while providing a more difficult standard for validity or

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constitutes a "representative number" is an inverse function of the skill and knowledge of the art. *Id.* at 1106. The first set of Interim Guidelines also stated this relationship as function of the "predictability in the art."

[98] *Id.* at 1105.

[99] *See In re* Angstadt, 537 F.2d 498, 503 (C.C.P.A. 1976) (holding that the PTO bears the initial burden of proving that a specification is insufficient, nonenabling, and requires undue experimentation).

[100] The problem with this approach is that most scientists and patent examiners must presume that claims contained within an issued patent are enabled and should have issued, unless there is a particular reason to doubt this fact for the library or set of compounds in question. *See In re Fisher*, 427 F.2d at 839. Thus, under existing law, the resulting published disclosure and patent, if the claims are allowed, discourages other groups from further investigating the compounds. This is the case for John Henry's anti-viral compound. *Id.* Even if John Henry discovers that his anti-viral compound is not readily made under the conditions described, under these hypothetical facts, the patentee may still be entitled to enforce his or her claims. For another research group to get a patent or escape liability for infringement if using a compound of the patent, the research group must overcome the statutory presumption of validity. *Id.* To do this they must persuade the fact finder, perhaps a lay jury, by clear and convincing evidence that the claim is not enabled. *Id.* Given the ease with which compounds are characterized using automated techniques and the high standard of proof, the defendant may not succeed. For a further discussion of aspects of patent infringement, see generally CHISUM, *supra* note 16, at §§ 16, 17[5].

[101] *See* Eisenberg, *supra* note 12, at 1024.

[102] *See* Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 884-908 (1990) (arguing that the breadth of a patent influences its economic significance; more specifically, that there is less incentive to develop improvements when they are subject to a blocking patent and the patent holder has less incentive to develop improvements, knowing that it will retain its rights even if another develops them); Janice M. Mueller, *No "Dilettante Affair": Rethinking the Experimental Use Exception to Patent Infringement for Biomedical Research Tools,* 76 WASH. L. REV. 1, 66 (2001) (arguing that transaction costs have become prohibitive on patents on research tools).

[103] *See* 35 U.S.C. § 101 (1994) (allowing an inventor to receive a patent on "any new and useful process, machine, manufacture, or composition of matter"). The USPTO views product-by-process claims as composition of matter claims. *See* MPEP, *supra* note 7, at § 2113. *See infra* Part III.C (discussing "product-by-process" claiming).

infringement, would appropriately result in the patenting of more prophetic materials.[104]

III. REASONABLE EXPERIMENTATION FOR FAIRNESS PURPOSES VERSUS NOTICE TO THE PUBLIC: MISSING MIDDLE GROUND

A. The Ambiguity and Breadth of the Wands *Factor Analysis Conflicts with the Intent of the Patent Act and Slows Academic and Industrial Research and Development*

This Part contends that the complicated, broad, and ambiguous *Wands* treatment of "reasonable experimentation for fairness purposes" versus "notice" as two polar extremes is no longer supportable.[105] This section first discusses some classical underlying policies of patent law. This section then goes on to show how these policies support the suggestion that the burgeoning caseload[106] and research environment in chemical and biotechnology research and development calls for a fundamental rethinking of the reasonable experimentation doctrine's very generous and ambiguous contours. Then, sections B and C consider possible solutions in: (1) a more literal reading of enablement in the specification and claims; and (2) product-by-process claiming.

The patent system encourages the dissemination of information important to spurring future technological innovation by awarding inventors temporary monopolies in exchange for inventors fully disclosing their subject matter to the public.[107] This "exchange-for-secrets" theory of patent law maintains that industrial progress will decrease if inventors do not give the public notice of their inventions.[108] Because automation decreases the traditional time barriers in the making and testing of new materials, notice[109] takes on even greater importance to the public.

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[104] The product in a product-by-process claim is not limited by the process set forth in the claim. Scripps Clinic & Research Found. v. Genentech, Inc., 927 F.2d 1565, 1583 (Fed. Cir. 1991). However, the process set forth serves as a limitation in determining infringement. Exxon Chem. Patents, Inc. v. Lubrizol Corp., 64 F.3d 1553, 1557-58 (Fed. Cir. 1995); Atlantic Thermoplastics Co. v. Faytex Corp., 970 F.2d 834, 846 (Fed. Cir. 1992).

[105] For a discussion of this conflict, see Karen S. Cannady, *The Wright Enabling Disclosure for Biotechnology Patents*, 69 WASH. L. REV. 455, 461-62 (1994) and Ellen P. Winner, *Enablement in Rapidly Developing Arts-Biotechnology*, 70 J. PAT. TRADEMARK OFF. SOC'Y 608, 608-09 (1998).

[106] *See generally* DEP'T OF COMMERCE, United States Patent and Trademark Office, "Information Technology Standards and Guidelines Program - Economic Analysis," *available at* http://www.uspto.gov/web/offices/cio/tsg/tsg_ea.pdf (last modified Oct. 1, 1998) (noting that the USPTO has been facing a ten to fifteen percent yearly increase in its caseload).

[107] *See* Eisenberg, *supra* note 12, at 1024.

[108] *See* Merges, *supra* note 102, at 884-908.

[109] The concept of notice has always been a prominent feature of the United States patent system. For example, Justice Story invoked disclosure requirements in an early case where he stated:

> It is therefore argued, that if the specification be materially defective, or obscurely or so loosely worded, that a skillful workman in that particular art could not construct the machine, it is a good defense against the action, although no

With the increasing number of patents issued that have claimed libraries[110] and the use of combinatorial chemistry techniques,[111] combined with the broad rights[112] conferred by the patents using these tools, there is a concomitant decrease in access to marketable intellectual property space.[113] While chemical species within a prior art teaching of a broad genus are sometimes separately patentable,[114]

> intentional deception has been practiced. And this is beyond all question the doctrine of the common law; and it is founded in good reason; for the monopoly is granted upon the express condition, that the party shall make a full and explicit disclosure, so as to enable the public, at the expiration of his patent, to make and use the invention or improvement in as ample and beneficial a manner as the patentee himself. If therefore it be so obscure, loose, and imperfect, that this cannot be done, it is defrauding the public of all the consideration, upon which the monopoly is granted. (Citation omitted). And, the motive of the party, whether innocent or otherwise, becomes immaterial because the public mischief remains the same.

Whittemore v. Cutter, 29 F. Cas. 1120, 1122 (C.C.D. Mass. 1813). In addition the concept of notice is a prominent feature of Trade-Related Aspects of Intellectual Property Rights ("TRIPs") compliant patent systems. Article 29(1) of the TRIPs component of the GATT agreement provides that: "Members shall require that an applicant for a patent shall disclose the invention in a manner sufficiently clear and complete for the invention to be carried out by a person skilled in the art." General Agreement on Tariffs and Trade: Final Act Embodying the Results of the Uruguay Round of the Multilateral Trade Negotiations, Apr. 15, 1994, 33 I.L.M. 1125, 1197 (1994). The preeminence of enablement has been plainly apparent in recent international negotiations. For example, Article 3(1) of the proposed Patent Law Treaty would have incorporated an enablement standard: "[t]he application shall disclose the invention in a manner sufficiently clear and complete for the invention to be carried out by a person skilled in the art." Draft Treaty Supplementing the Paris Convention for the Protection of Industrial Property as Far as Patents Are Concerned (Patent Law Treaty). WIPO Doc. PLT/DC3 (Dec. 21, 1990), *reprinted in Symposium: The Harmonization of International Patent Law*, 26 J. MARSHALL L. REV. 437, 669-703 (1993).

[110] It is also unclear how courts will handle compounds disclosed in "libraries" which are defined by selected compounds, physical properties, or procedures. While Courts have yet to thoroughly examine the scope of "library" claims, they were recently addressed. *See* Morphosys AG v. Cambridge Antibody Tech. Ltd., 158 F. Supp. 2d 84 (D.C. 2001) (ruling on the motions in an infringement suit concerning whether claims to methods of obtaining antibodies to specific human self antigens using particular phage display libraries encompassed the isolation of only "natural" antibodies or also encompassed the isolation of "synthetic" antibodies).

[111] While there were only 5 patents relating to expanding molecular diversity in the years 1980-1988, there were 3 in 1989 and 1990, 17 in 1991 and 1992, 30 in 1993, 34 in 1994, 44 in 1995, 29 in 1996, 88 in 1997, 124 in 1998, 202 in 1999, and 130 in 2000. M. Lebl & Z. Leblova, *Dynamic Database of References in Molecular Diversity, at* http://www.5z.com (last visited Sept. 18, 2002).

[112] *See* 35 U.S.C. § 154(a)(1) (1994 & Supp. 1999) ("[E]very patent shall contain . . . a grant to the patentee . . . of 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"); *see also* 35 U.S.C. § 271(a) (1994) ("[E]xcept as otherwise provided in this title, whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States or imports into the United States any patented invention during the term of the patent therefor, infringes the patent.").

[113] This has already become a problem in the field of biotechnology. *See* John H. Barton, *Patents and Antitrust: A Rethinking In Light of Patent Breadth and Sequential Innovation,* 65 ANTITRUST L. J. 449, 451 (1997) (discussing how a patent on a biological receptor useful in schizophrenia could prevent others from research in schizophrenia).

[114] For example, the Federal Circuit held that a generic formula that contained a large number of variables, estimated at more than 100 million compounds, did not suggest that one should select a particular set of variables that described a particular compound and could not be used as an

subsequent inventors, nevertheless, must sustain large transaction costs.[115] This restriction of intellectual space increases costs either through royalty obligations, heightened legal cost, or other transaction costs associated with acquiring the right to each new patent. These costs may be so high as to impede, postpone, or stop the development of important new products critical to the public.[116] The possibility that research will be delayed or foregone, or that it will be conducted without authorization and lead to subsequent litigation, is much greater where intellectual property space is limited.[117]

This dilemma of decreased competition when automated experimental technology is used suggests the importance of (1) re-conceptualizing the reasonable experimentation doctrine, as well as (2) requiring claims that are more commensurate in scope with their disclosures as a partial, if not complete, solution. Each of these solutions will be discussed in the next sections.

IV. INCREASING COMPETITION BY MODIFYING THE REASONABLE EXPERIMENTATION DOCTRINE AND DEFINING THE SCOPE OF ENABLEMENT

A. Proposal for Modification of the Reasonable Experimentation Doctrine

One possible solution is for the USPTO and the courts to reduce the complexity and ambiguity of the *Wands* factors to a more manageable rule. A preferable two-part rule would involve (1) identifying the variables that are involved in the invention, and (2) determining whether the patent teaches a person of ordinary skill in the art, through examples, guidance, or suggestions, how to choose those variables to predictably result in practicing the entire scope of the claims. The rationale for this proposal is that: (1) it is consistent with previous judicial analyses; and (2) it is easier to implement and simpler for researchers, patent draftspersons, examiners, and other persons of ordinary skill in the art to understand the true scope

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obviousness reference against a claim to that particular compound. *In re* Baird 16 F.3d 380, 383 (Fed. Cir. 1994).

[115] *See* Merges, *supra* note 102, at 884-908.

[116] The problem of too many broad patents resulting in an impoverishment of intellectual property space is the same as the famous "tragedy of the commons" theorized by Garrett Hardin in 1968. Garrett Hardin, *The Tragedy of the Commons*, SCI., Dec. 13, 1968, at 1243-48. In Hardin's metaphor, the absence of restrictions on access to public lands resulted in a tragedy of over-grazing. *Id.* at 1244. Here the result is the issuing of overly broad patent claims resulting in the under-development of potentially important products such as commercial drugs or other therapeutic products. *Id.*; *see also* Peter Mikhail, *Hopkins v. CellPro: An Illustration That Patenting and Exclusive Licensing of Fundamental Science is Not Always in the Public Interest*, 13 HARV. J. LAW & TECH. 375 (2000) (discussing transaction costs in greater detail).

[117] Because industrial research tends to focus on short-term projects that can lead to proprietary, marketable products and avoids infringing subject matter, the reasonable experimentation doctrine as currently interpreted actually works against the prompt introduction of new products into the market place by restricting areas of research. *Id.*; *see generally* Mark A. Lemley, *The Economics of Improvement in Intellectual Property Law*, 75 TEX. L. REV. 989, 1053-55 (1997) (describing the significant transaction costs involved in licensing intellectual property).

of the patent. With the intellectual property field becoming more congested, it is especially important that practitioners simply look at a patent's claims and their accompanying disclosure to determine whether the patent is enabled and valid without much further analysis. This solution does not require one to examine such factors as the state of the art or the quantity of experimentation necessary that are too subjective. This solution also has the advantage in that it places some of the burden back on the patentees to prove that they have an enabling disclosure.

Some might argue that such a proposal would require that the specification must enable one of ordinary skill in the art to practice the invention without *any* experimentation, rather than just undue experimentation.[118] However, if patents are truly a form of public contract, this solution is more in compliance with traditional contract law, where the burden is on the draftsman[119] and not the public[120] to clearly establish the scope of the contract. Limiting the scope of these "equitable" doctrines also seems to reflect the more modern approach adopted by the both the Federal Circuit and the Supreme Court.[121] By providing more well-defined limits on the scope or validity of a patent, the USPTO and the courts would create stronger patents and provide subsequent inventors with sufficient notice to make well-reasoned analyses on how to advance a particular field without incurring either unnecessary costs or being unnecessarily restricted from exploring areas for both their and the public's good.

Based on this new rule, the USPTO could require that to meet the enablement requirement for a compound or a library, an inventor must either (1) provide sufficient characterization, or (2) establish prior art practices such that an independent researcher can determine if the compound was made or makeable and had some utility. As discussed previously, this is consistent with ACS guidelines and would make obvious whether undue experimentation was necessary to either make or use the compound. It also assures that the patentee has at least partially presented how the compound in question may be used. In this manner, the requirement would truly put both the inventor and the public in possession of the compound.

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[118] *See* Cannady, *supra* note 105, at 461-62; *see also* Winner, *supra* note 105, at 608-09.

[119] *See* RESTATEMENT (SECOND) OF CONTRACTS § 206 (1981) ("[I]n choosing among the reasonable meanings of a promise or agreement or a term thereof, that meaning is generally preferred which operates against the party who supplies the words or from whom a writing otherwise proceeds."). The rationale behind this rule is that a party who chooses the terms of a contract is more likely to protect his own interests than those of the other party, in this case the public. *Id.*

[120] *See id.* at § 207 ("[I]n choosing among the reasonable meanings of a promise or agreement or a term thereof, a meaning that serves the public interest is generally preferred.").

[121] *See Festo*, 122 S. Ct. at 1831 (reaffirming the doctrine of equivalents but limiting it to where the patentee can rebut that "at the time of the amendment, one skilled in the art could not have reasonably be expected to have drafted a claim that would have literally encompassed the alleged equivalent").

B. Proposal Requiring Heightened Disclosure Requirements and Restricted Claiming for Patents That Claim Compounds or Libraries

If sufficient experimental information or prior art is not provided by an applicant, then the USPTO should require that the prophetic chemical compound or library in question be claimed in a product-by-process claim.[122] Product-by-process claims describe the patented compound by describing the process envisioned to make it. While product-by-process claims have traditionally been used only when the structure of the product is unknown or difficult to determine,[123] the use of such claims is not limited to this situation. These types of claims protect inventors from the unauthorized use of their invention if the process results in the patented compound or composition of matter.[124] However, it will not protect the inventor if the process fails for the compound(s) of interest.[125] Requiring prophetic products to be described by the method of their production inherently recognizes the relationship between the process and the product (i.e., that the process is expected to produce the product) in unpredictable arts. An advantage of this solution is that an inventor can specifically obtain protection against use of the compound without unduly limiting the public from future research in the area. Based on these suggestions, the USPTO should not grant broad patent protection that encompasses whole chemical areas based on the characterization of only a few compounds within that area.

CONCLUSION

The current overbroad and ambiguous interpretation of the reasonable experimentation doctrine in United States patent jurisprudence creates uncertainty as to who is entitled to do research or commercialize a particular area. This problem is exacerbated now that many experiments are automated but is the same whether John Henry mans a hammer or a steam drill. As a result, a large amount of intellectual property space essentially becomes unavailable both to researchers and

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[122] *See* MPEP, *supra* note 7, at § 2113. The MPEP requires that the product itself meet the requirements of patentability. *Id.* (citing *In re* Thorpe, 777 F.2d 695 (Fed. Cir. 1985).

> [E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious form a product of the prior art, the claim is unpatentable even though the prior product was made by a different process.

Id.

[123] *See* CHISUM, *supra* note 16, at § 8.05.

[124] *See Scripps Clinic*, 927 F.2d at 1583 (holding that the validity of product-by-process claims are limited by the method by which the product is made). However, the product-by-process claims, if valid, are not limited by the method by which the product is made. It is the product, not the process by which it is made that determines the scope of the claim. *Id.* Thus, if the compound is made by the process disclosed in the patent, an alleged infringer can be held liable for infringement. For a discussion of infringement, *see generally* CHISUM, *supra* note 16, at §§ 16, 17[5], and Alfonso Garcia Chan, *A Proposed Defense to Patent Infringement*, 1999 COMP. L. REV. & TECH. J. 79 (1999) (discussing infringement in greater detail).

[125] *Scripps Clinic*, 927 F.2d at 1583. Thus, the product-by-process claims will protect the inventor from the unauthorized use of his invention only if the method results in the patented compound. *Id.*

inventors in a particular research area and to the public who benefit from their worth. A potential solution is to simplify the reasonable experimentation doctrine and to require "product by process" claiming for more prophetic compositions of matter. This allows for a more literal interpretation of enablement, which provides an easier standard for review. In addition, it provides the patent applicant or owner protection that is commensurate with the actual scope of the claims and that provides a better approximation of the true worth of the research to the public. At the same time, it ensures a standard of validity commensurate with maintaining incentives for the continued research, development, and patenting of new compositions of matter in two important areas. By alleviating the access restrictions, up-front costs, and risks currently associated with working in a patented area, as well as providing adequate notice to the public, this solution better serves the original intent of the patent system.

A PRACTICAL SOLUTION TO CLAIM CONSTRUCTION: STOPGAP MEASURES WHILE WAITING FOR REFORM

BY STEPHEN L. SHELDON

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