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THE NATURE AND FUNCTION OF THE PATENT SYSTEM*

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THIS essay argues that the patent system performs a function not previously noted:¹ to increase the output from resources used for technological innovation. Recognition of this function makes it no longer possible to maintain that the patent inevitably reduces the output of the technology it subjects to exclusive control, but it does make more understandable what have heretofore been puzzling features of the patent system and reintegrates the patent institution with the general theory of property rights.

These ideas first crystallized in response to Barzel's essay, "The Optimal Timing of Innovations,"² where he points out that the exploitation of technological information has much in common with fisheries, public roads, and oil and water pools—all resources not subject to exclusive control. If the rule of first appropriation controls, there will be an inefficiently rapid depletion of the resource. Barzel suggested this problem could be solved if technological monopoly claims could be granted or auctioned off, giving their owner the exclusive right to develop the technological opportunity.³ What Barzel did

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¹ The literature is exhaustively reviewed and summarized in Carole Kitti & Charles L. Trozzo, *The Effects of Patent and Antitrust Laws, Regulations, and Practices on Innovation*, Paper P-1075 of the Institute for Defense Analyses Program Analysis Division 3 vols. (limited edition of 125 copies 1976) (available from the National Technical Information Service, Rep. Nos. PB252860, PB252861, and PB252862). More accessible but less comprehensive summaries are Ward S. Bowman Jr., *Patent and Antitrust Law: A Legal and Economic Appraisal* 15-32 (1973) and F. M. Scherer, *Industrial Market Structure and Economic Performance* 379-99 (1970). The classic work is Arnold Plant, *The Economic Theory Concerning Patents for Inventions*, 1 *Economica* 30 (1934), reprinted in Arnold Plant, *Selected Economic Essays and Addresses* 35 (1974). The state of the art is reviewed in Fritz Machlup, *An Economic Review of the Patent System*, Study No. 15 of the Subcomm. on Patents, Trademarks and Copyrights of the Committee on the Judiciary United States Sen., 85th Cong., 2d Sess. (1958) [hereinafter cited as Machlup].

² Yoram Barzel, *Optimal Timing of Innovations*, 50 *Rev. Econ. & Stat.* 348 (1968).

³ *Id.* at 352 n.11.

not realize is that a patent system can be such a claim system and, indeed, that it is a more sensible system than an auction system would be.⁴

In brief, the view of the patent system offered here conceives of the process of technological innovation as one in which resources are brought to bear upon an array of prospects, each with its own associated sets of probabilities of costs and returns. By a prospect I mean a particular opportunity to develop a known technological possibility. Each prospect can be pursued by any number of firms. Not only can any level of resources be used to develop the prospect, but the activities of any one firm need not be disclosed to the others. This process can be undertaken efficiently only if there is a system that tends to assure efficient allocation of the resources among the prospects at an efficient rate and in an efficient amount; if management of each prospect is in the hands of the entity best equipped to manage it; and if information found by one entity is communicated to other firms at an efficient rate. The patent system achieves these ends by awarding exclusive and publicly recorded ownership of a prospect shortly after its discovery. The patent system so viewed is closely analogous to the American mineral claim system for public lands. For expositional convenience, this view of the patent system will be called the prospect theory.

The conventional view of the patent system as a device that enables an inventor to capture the returns from his investment in the invention will be called the reward theory. The reward theory is not questioned on its own terms. Rather, it is argued that the reward theory offers an incomplete view of the functions of the patent system.

Economists formulated and extensively discussed their view of the patent system in the nineteenth century.⁵ The occasional discussions found in current literature are all based upon the conceptual structure developed then, although there is wide variation in judgments about the costs and benefits of the system. The patent is a reward that enables the inventor to capture the returns from his investment in the invention, returns that would otherwise (absent secrecy) be subject to appropriation by others. The existence of the reward tends to make the amount of private investment in invention closer to the value of its social product. To quote Pigou: "The patent laws aim, in effect, at bringing marginal trade, net product, and marginal social net product more closely together."⁶ Offsetting this benefit of the patent system is the fact that the patent subjects new technology to exclusive control and,

⁴ Because the patent creates private incentives for the identification and definition of claims and puts the claim identification and the claim development process in the same hands.

⁵ This literature is summarized in Fritz Machlup and Edith Penrose, *The Patent Controversy in the Nineteenth Century*, 10 *J. Econ. Hist.* 1 (1950).

⁶ A. C. Pigou, *The Economics of Welfare*, 183-85 (4th ed. 1960).

assuming that the demand curve for the technology has a negative slope, adversely affects social welfare, *ceteris paribus*.

The essay is divided into four major sections. The first section explores how the structure of the patent system causes it to work as a prospect system. The second section, for purposes of expositional clarity and later policy argument, develops a detailed institutional analogy between patents and mineral claims as they developed in the American West. The third section explains how the patent system, when viewed as performing both prospect and reward functions, enhances public welfare. The fourth section explores how consideration of the prospect function relates to a number of central questions of patent policy.

I. PATENTS AS PROSPECTS

This section simultaneously argues three separate points. First, any patent system will have some prospect elements.⁷ Second, the rules of a patent system can be adjusted so as to make the prospect function important. Third, the prospect function is a significant, if not the predominate, function of the American patent system as it has operated in fact.⁸ The argument focuses on the third point both because it encompasses and illustrates the first two and because it is the most difficult to sustain. The difficulty of making authoritative statements about the effects of a system as complex as the patent system is further complicated by the fact that the American patent system has changed over time. For instance, much of the antitrust law designed to confine the operation of the patent system to its "proper sphere" has been implicitly based upon the reward theory and may have affected the ability of the system to perform the prospect function. Consequently, the pre-antitrust, nineteenth-century patent system was probably more of a prospect system than the twentieth-century system has been.

The importance of the prospect function in the American patent system is argued from three features of the system. The first is the scope accorded to patent claims, a scope that reaches well beyond what the reward function would require. Second, there are rules, such as the priority, time-bar, and patentability rules, which force an early patent application whether or not something of value (and hence a reward) has been found. And third, there is the fact that many technologically important patents have been issued long before commercial exploitation became possible. These same three points

⁷ The existence of a prospect element has been noted by Steven N. S. Cheung, *Property Rights and Inventions: An Economic Inquiry* 17 (mimeo May, 1977). He calls the rights "development rights."

⁸ The discussion is largely confined to the American patent system because of my familiarity with it. My casual impression is that the features central to the argument are also found in the other major patent systems.

have played an important role in the antipatent arguments so recurrent in the economics literature, for each is troublesome under the reward theory.⁹

One reason the prospect function of the patent system may have been so long overlooked is that the “hornbook” rule is very misleading—the inventor may not claim more than he has invented, and the claim marks the outer bounds of his rights.¹⁰ We tend to think of an invention as the thing an inventor has made or accomplished, and the rule seems to imply the inventor is confined to that. But the rule is misleading, because the invention as claimed in the patent claims and the physical embodiment of the invention are two quite different things. “A claim is an abstraction and generalization of an indefinitely large number of concrete, physical objects.”¹¹ Thus to illustrate from a nineteenth-century case, an inventor could claim a process of separating fats into glycerine and stearic, margaric and oleic acids through the use of heat, pressure, and water at any temperature and in any apparatus that would work.¹² This is so even though the inventor himself had used only a few of the possible combinations that would work. Such a claim would cover the use of machinery later developed to carry out the process, even if that machinery were far superior to the first inventor’s.

To further illustrate the point, an inventor who is the first to combine an internal combustion engine with a drive train, wheels, and a steering mechanism may claim the combination (as Selden¹³ did in his controversial patent) although the particular combination is so slow and unreliable under actual conditions of use that horse-drawn vehicles are commercially superior. Subsequent inventors of superior automobiles will infringe that claim, even if their contributions to the design of automobiles are what, in fact, made them commercially practicable.

The inventor of a process of making copies by exploiting the interaction between metallic particles and magnetic fields can claim that process (as Carlson, the inventor of xerography did),¹⁴ even though he is able to practice

⁹ The first because the patent exceeds the contribution of the inventor; the second because the choice of the patentee does not take into account the quality of his contribution, which may be less than that of the unsuccessful claimants; and the third because the patent may expire before the invention is worth very much.

¹⁰ 35 U.S.C. § 112; Edmund W. Kitch & Harvey S. Perlman, *Legal Regulation of the Competitive Process: Cases, Materials and Notes on Unfair Business Practices, Trademarks, Copyrights and Patents* 640, 1045-46 (1972). [hereinafter cited as Kitch & Perlman].

¹¹ Peter D. Rosenberg, *Patent Law Fundamentals* 39 (1975).

¹² *Tilghman v. Proctor*, 102 U.S. 707 (1880); Kitch & Perlman, *supra* note 10 at 649-54.

¹³ In *Columbia Motor Car Co. v. C. A. Duerr & Co.*, 184 Fed. 893 (2d Cir. 1911), the patent was limited to the particular type of engine Selden had used. The story of the long litigation over this patent is told in William Greenleaf, *Monopoly on Wheels. Henry Ford and the Selden Automobile Patent* (1961).

¹⁴ John Jewkes, David Sawers, & Richard Stillerman, *The Sources of Invention* 407 (1959).

the process only to make poor copies of no use.¹⁵ Anyone else who makes a machine embodying that process, even though much superior due to its improvements, will infringe that claim.

An inventor of a substance useful as a lubricant has a patent on that substance, and if it is later discovered to be invaluable as a fuel additive, any such use of the substance infringes his patent even though he never suspected that it had those properties.¹⁶ This is a feature of the patent system important to the drug industry, where indications of one therapeutic use are used to obtain a patent on a substance that can then be examined for any therapeutic use.¹⁷

The patent on the diode vacuum tube, claiming two electrodes in an evacuated chamber, was held to include the triode, even though the triode could amplify and the diode could only rectify.¹⁸ In effect, the diode patent was a claim on any vacuum tube with two or more elements.

The second important feature of the patent system which makes it function as a prospect system are rules which force and permit application early in the development process. The most important forcing rule is the priority accorded to those first to file. In most patent systems, the patent is simply awarded to the first to file. In the American system, the patent is awarded to the first inventor, a technical status almost always obtained by the first to file. The patent application need not disclose a device or process of any commercial value, only a version of the invention that will work. Thus, the applicant can proceed from the first positive results to the patent office, and his failure to do so may cost him the patent.

The emphasis on early filing in the patent system is of great practical importance. Multiple inventions of the same thing are not rare. When technological developments bring something into the realm of the possible, it may be known to many and many may search. If their resources are similar, they will arrive at the goal at about the same time. Therefore, each searcher must fear that he will be second.

The rules of the American system that force early application are exten-

¹⁵ See, for example, *Land v. Regan*, 342 F.2d 92 (C.C.P.A. 1965), abridged in Kitch & Perlman, *supra* note 10 at 994-1005.

¹⁶ This feature of the patent system is described and criticized in Paul H. Eggert, *Uses, New Uses and Chemical Patents—A Proposal*, 51 J. Pat. Off. Soc'y 768 (1969), excerpted in Kitch & Perlman, *supra* note 10 at 719-21.

¹⁷ I criticized this feature of the patent law in Edmund W. Kitch, *The Patent System and New Drug Application: An Evaluation of the Incentives for Private Investment in New Drug Research and Marketing in Regulating New Drugs* 88-100 (Richard L. Landau ed. 1973) because of its failure to conform to the reward theory.

¹⁸ *Marconi Wireless Tel. Co. v. De Forest Radio Tel. & Tel. Co.*, 236 Fed. 942 (S.D.N.Y. 1916), *aff'd* 243 Fed. 560 (2d Cir. 1977). This patent was held invalid long after its expiration in *Marconi v. U.S.*, 320 U.S. 1 (1943). See generally W. Rupert MacLaurin, *Invention and Innovation in the Radio Industry* (1949).

sive. The person who is the first to file is, in the event of a second claimant, accorded the status of a senior party. Although he has no absolute right to the patent, he can be dislodged by the second to file (the "junior" party) only if the junior files not later than one year after the senior patent issues and can prove that he is the first inventor. This proof must be by the preponderance of the evidence, or if the junior party files after the senior party's patent has issued, beyond a reasonable doubt. The rules for establishing prior inventorship are quite demanding and rather metaphysical.¹⁹

In addition, there are "time-bar" rules that make a patent invalid if the application is filed more than one year after a commercial use, or after a publication describing the invention. Since the commercial use or publication may be by others, the bar is not within the inventor's control. And any move by him to make commercial use of the invention—for instance, a contract to sell output from a newly invented process—will activate the time bar.²⁰

These forcing rules, however, would be of little effect if a valid patent application had to disclose an invention in fully developed or commercially valuable form. It need not. The application need only disclose an invention that works.²¹ If the claim is for a battery, it must produce current—not much, not reliably, nor inexpensively. If the claim is for a copying process, the copies need not be legible, cheap, or useful, but they must in some sense be copies. Indeed, the application need not show that the inventor has actually made the invention work. If the instructions can later be followed and they work, the patent is good.²²

The combined effect of these rules is that whenever a technological innovation has been discovered, it is risky not to immediately seek a patent—even though the practical significance of the innovation may be but dimly perceived. Indeed, if the actual first discoverer is tardy, he may find someone else has the patent and he is not entitled to use his own discovery. These pressures to immediate application exist because the patent system does not

¹⁹ These rules are summarized in Kitch & Perlman, *supra* note 10 at 989-93.

²⁰ 35 U.S.C. § 102(b) Kitch & Perlman, *supra* note 10 at 112 (Supp. 1972). The leading decisions on this subject can be found in Kitch & Perlman, *supra* note 10 at 934-88.

²¹ The classic rule was Mr. Justice Story's: A useful invention is one "which may be applied to a beneficial use in society, in contradistinction to an invention injurious to the morals, health, or good order of society, or frivolous and insignificant." Note on the Patent Laws, 16 U.S. (3 Wheat.) 302, 308. The Supreme Court decision in *Brenner v. Manson*, 383 U.S. 519 (1966), abridged in Kitch & Perlman, *supra* note 10 at 710-22 (holding that a research use is not sufficient) is at variance with this tradition but has had little impact on patent practice. The *Manson* opinion is a good example of the influence of the reward theory on the Supreme Court.

²² And the patent application is called a constructive reduction to practice. See Kitch & Perlman, *supra* note 10 at 989.

require a finished, commercially relevant invention. It only requires something that works.

That many important inventions are patented early in their development serves only to illustrate how the prospect function operates in the context of specific technology. Many inventions, including many important ones, are patented in a commercially significant form, yet the patented form is trivial in significance as compared to the later derived and improved versions. Each significant innovation affects related aspects of the technology with which it interacts. A new industrial process may make possible changes in other phases of the process, in the nature of input materials, in the training and compensation of the work force, or in the geographic location of plants. As its introduction lowers the cost of the output, that output becomes suitable for purposes not previously considered, and so on. Thus each innovation generates shifts in the matrix of technological possibilities, and the realization of the possibilities may have a significance that dwarfs the original invention considered alone. A review of the invention case studies reported by Jewkes, Sawyer, and Stillerman²³ shows that the first patentable invention frequently occurs years before the first significant commercial product. Those case studies were developed to illustrate the important role of the individual in twentieth-century invention, not the proposition advanced here. Even though the summaries are somewhat ambiguous about the dates of patentable results and commercial product, a review illustrates the point. Table 1 is based on the summaries and dates the first patentable invention and the first commercial use for each case. The interested or puzzled reader will find it helpful to review the case summaries with the perspective offered by this essay in mind.

II. THE PATENT AND THE MINERAL CLAIM: AN INSTITUTIONAL ANALOGY

The mineral claim system that developed from custom, federal law, and judicial decision in the American West during the last half of the nineteenth century made it possible to pursue the two competing objectives of retaining government ownership of public lands while making it possible for private firms to efficiently find and extract the minerals they contained. In brief, the system that evolved permitted one who found mineralization on the public land to file a claim which gave him the exclusive right to develop the claim. The analogy works in considerable detail.

1. The claimant for the mineral claim need not show that the mineralization is of commercial significance. The mineralization showing required was of surface mineralization which could be found without extensive excava-

²³ John Jewkes, David Sawers, & Richard Stillerman, *supra* note 14 at 263-410.

TABLE 1

Invention	Page ^a	First Patent-ability	Com-mercial Product
Automatic Transmissions	263	1904	1937
Bakelite	266	1907	1910
Ball-Point Pen	268	1938	1945
Catalytic Cracking	269	1915	1930's
Cellophane	272	1910	1925
Cinerama	274	1937	1953
Continuous Casting of Steel	276	1890's	1950
Continuous Hot Strip Rolling	280	1892	1923
Cotton Picker	282	1850	1942
Crease-Resisting Fabrics	286	1926	1932
Cyclotron	290	1929	?
DDT	292	1874	1942
Diesel-Electric Rwy Traction	293	1890's	1934
Electric Precipitation	296	1884	1909
Fluorescent Lighting	298	1859	1933
Freon Refrigerants	301	1931	1933?
Gyro-Compass	303	1852	1908
Hardening of Liquid Fats	305	1900	1909
Helicopter	308	1912	1941
Insulin	312	1920	1924?
Jet Engine	314	1791	1944
Kodachrome	321	1910	1935
Long Playing Record	324	1944	1948
Magnetic Recording	325	1898	1939
Methyl Methacrylate Polymers	329	1877	1935
Neoprene	332	1921	1930?
Nylon and Perlon	334	1930	1939
Penicillin	338	1928	1944
Polyethylene	339	1935	1939?
Power Steering	342	1925	1931
Radar	345	1904	1935
Radio	350	1900	1915
Space Rockets	355	1920's	1944
Safety Razor	359	1895	1905
Self-Winding Wrist-Watch	361	1922	1928
Shell Moulding	363	1941	1944
Silicones	366	1904	1944
Stainless Steels	369	1904	1915
Streptomycin	373	1921	1944
Sulzer Loom	375	1928	1945
Synthetic Detergents	377	1900	1930's
Synthetic Light Polariser	381	1828	1935
Television	384	1905	1940
Terylene Polyester Fiber	388	1941	1953
Tetraethyl Lead	392	1924	1935?
Titanium	395	1880's	1950?
Transistor	399	1948	1955
Tungsten Carbide	402	1916	1926
Xerography	407	1937	1950
Zip Fastener	409	1891	1923

^a In John Jewkes, David Sawers, & Richard Stillerman, *supra* note 14.

tion.²⁴ Similarly, the patent applicant need not show that his invention has commercial significance.

When oil became a commercially significant mineral in the West, it created substantial problems for the mineral claim system because its presence was not associated with the usual forms of surface mineralization. This meant that searchers had to make large investments in drilling before the exclusive right could be claimed. This problem was finally solved by a federal statute that made it possible for the federal government to grant exclusive mineral leases prior to drilling.²⁵

2. Priority was awarded on the basis of the first to discover, stake, and file.²⁶ The “near miss” lost, without regard to the quality of his efforts nor to the extent of his investment relative to the first claimant. Similarly, the patent system makes no effort to assess the relative efforts of the claimants.

3. The mineral claim system restricts the area that can be claimed through rules that specify maximum boundaries in relation to the location of the mineralization.²⁷ In the patent system, the applicant must limit his claims to his invention.

4. The mineral claim system has a set of rules on staking requirements and boundary description²⁸ which forces the claimant to specifically identify the scope of his claim and distinguish it from the rest of the public domain. In the patent system, the applicant must delimit in “claims” his view of the

²⁴ There were two kinds of claims: lode claims and placer claims. The first required surface detection of an ore vein. The second required discovery of ore-bearing gravels. Of both types, the leading treatise said: “To hold that, in order to constitute a discovery as the basis of the location, it must be demonstrated that the discovered deposit will, when worked, yield a profit, or that the lands containing it are, in the condition in which they are discovered, more valuable for mining than for any other purpose, would be to defeat the object and policy of the law. . . . No court has ever held that in order to entitle one to locate [that is, establish rights to] a mining claim ore of commercial value, in either quantity or quality, must first be discovered.” Curtis H. Lindley, *A Treatise on the American Law Relating to Mines and Mineral Lands Within the Public Land States and Territories* 768-69 (3rd ed. 1914).

²⁵ Mineral Leasing Act of 1920, 41 Stat. 437 (1920), (current version with 1976 amendments is at 30 U.S.C.A. § 181) (1977). The act applied to deposits of coal, phosphate, sodium, potassium, sulphur, oil, oil shale, and gas. The developments leading up to the 1920 Act are described in Rocky Mountain Mineral Law Foundation, *The American Law of Mining I*, 71-86 (1976). “The Placer Act proved to be a misfit so far as oil locations were concerned. The mineral could be reached only at great depth and after tremendous expenditure of money. In line with earlier decisions applicable to mining of hard minerals, the courts held that an oil location was not perfected until actual discovery of oil through drilling.” *Id.* at 75.

²⁶ “Priority of discovery gives priority of right against marked location and possession, without discovery.” Curtis H. Lindley, *supra* note 24 at 765. See generally *id.* at 761-95.

²⁷ *Id.* at 823-71: “The Surface Covered by the Location—Its Form and Relationship to the Located Lode.”

²⁸ *Id.* at 871-91: “The Marking of the Location on the Surface” and *id.* at 891-933: “The Location Certificate and Its Contents.”

legal scope of his invention in a separate portion of the document that becomes the patent. If his claims exceed his invention, they are invalid.

5. The mineral claim system has rules designed to eliminate claims that prove unpromising and return them to the public domain. In order to keep a mineral claim in force, the owner must each year perform a certain amount of work on the claim.²⁹ If his evaluation of the value of the claim is less than the expense of this work, he will abandon it. This function is performed in the American patent system by the limited term and in other systems by additional requirements for maintenance payments.

6. The interests in a mineral claim can be transferred, both before and after the rights to the claim are established. The same rule applies in the patent system.

One of the functions of the mineral claim system on the public lands of the West was to create incentives for prospectors to pack their burros and walk off into the desert in search of mineralization. It is misleading to suggest, however, that this was the only, or indeed the principal, function of the system. Although the existence of the system tended to generate the socially optimum level of investment in prospecting, most would agree it is erroneous to suggest that its effect was to reduce the mineral output from lands made subject to exclusive ownership as the result of its operation.

This familiar result in the mining case is offered not as proof that the results of the patent system are the same, but as an analogy to assist the reader unfamiliar with the patent system in thinking about the prospect function. The mining case is usually seen as one with a horizontal demand curve for the mineral output—the standard competitive case. This model makes the efficiency results easy to see since there is no problem of monopoly constraint on production. Conversely, the patent case is always visualized as one of a demand curve with a negative slope and its attendant monopoly effects. In fact, the demand conditions faced by particular mines and particular patents vary widely. Demand conditions will depend upon the relationship of a mine's output to the total market supply, the market being defined in a way that takes into account the ore quality, mining cost, and geographic location of a mine. Many patents face competition from other processes or products. The question of whether the gains from unified control are greater than or less than the losses caused by the ability of the controlling entity to exercise market power is a question that could be examined in the case of each individual mine and each individual patent. A rule that changed the property rights in each individual case where the balance was adverse to society would entail heavy administrative costs and, because it would cast uncertainty over the ownership rights of the successful—and

²⁹ *Id.* at 1527-88: "Perpetuation of the Estate by Annual Development and Improvement."

hence economically important—cases, would significantly undermine the functions of the property right system. In both cases the effect of the property rights on social welfare cannot be assessed without examining the demand conditions actually faced by owners of the rights and assessing the output increasing efficiency effects of the property system.

III. THE VALUE OF A PATENT SYSTEM

This section evaluates the public welfare effects of a patent system serving both the reward and prospect functions in a quite specific context—the advantages of a patent system over a system of trade secrecy without patents. The dichotomies which have more traditionally attracted the interest of those writing on patent policy—the choice between a patent system and a prize system, or between a patent system with and without compulsory licensing—are reserved for later discussion. The proposition advanced here is that a legal system which has trade secrecy and a patent system will better serve the public welfare than a legal system with only trade secrecy. This is a point of importance and generality because it is difficult to conceive of a legal system without trade secrecy. A legal system might refuse to lend its assistance to the protection of trade secrecy, but it is difficult to imagine any system—absent the most draconian and costly measures—that would reduce the phenomenon of secrecy to an insignificant level. For purposes of the general points here, the precise details of the trade secrecy system need not be specified. I will later briefly address the question of what the proper role of trade secrecy is in a system that has patents.

Although the arguments emphasize the special features of technological information, they can also be offered in support of exclusive ownership of anything of value—say, for instance, forty acres of land.³⁰ This congruence of arguments has been ignored by students of the patent system for three reasons. First, the patent system appears quite distinctive. Unlike almost all other property rights the patent is for a limited term. Second, the literature has focused heavily on prepatent investment and postpatent use, while the general property rights literature has seen the function of property rights in the context of a continuous, interlocking process of both investment and reward. Third, the property rights literature has viewed the central problem as one of scarcity, while information has appeared to be an example of something that can be used without limit.³¹ There is, however, a scarcity of

³⁰ For a general discussion of the economic theory of property rights see Richard A. Posner, *Economic Analysis of Law* 27-31 (2d ed. 1977).

³¹ Thus Plant: "It is a peculiarity of property rights in patents (and copyrights) that they do not arise out of the scarcity of the objects which become appropriated. They are not a *consequence* of scarcity. They are the deliberate creation of statute law; and, whereas in general the institution of private property makes for the preservation of scarce goods, tending . . . to lead us

resources that may be employed to use information, and it is that scarcity which generates the need for a system of property rights in information. The advantages of the patent system are as follows.

First, a patent "prospect" increases the efficiency with which investment in innovation can be managed. As already noted, Barzel pointed out that technological information is a resource which will not be efficiently used absent exclusive ownership. Barzel concentrated on the time dimension, but the result is well known and applies to all dimensions of the investment process. But unlike fisheries, public roads, and the other types of goods usually considered, technological information can be used without signaling that fact to another. Fishing boats can be detected, and one who is considering entry can take into account the magnitude of his competitor's activities. And if the fishery is depleted, that fact is likely to be immediately telegraphed by the absence of working boats. But in the area of technological innovation, it is possible for a firm working in secrecy to enter upon a "prospect," investigate it extensively, and depart without a trace. Subsequent investigation of the same prospect by other firms can neither build on the knowledge obtained by the first searcher nor determine the efficient level and strategy of search based upon his failure. Thus the potential gains from exclusive ownership are particularly large. No one is likely to make significant investments searching for ways to increase the commercial value of a patent unless he has made previous arrangements with the owner of the patent. This puts the patent owner in a position to coordinate the search for technological and market enhancement of the patent's value so that duplicative investments are not made and so that information is exchanged among the searchers.

Second, the patent owner has an incentive to make investments to maximize the value of the patent without fear that the fruits of the investment will produce unpatentable information appropriable by competitors. This is important only if the development of patented inventions generally requires significant investments that lead to unpatented information a competitor can appropriate. Expenditures for such things as manufacturing plants that cannot be appropriated under basic property concepts by competitors need not concern us. In the case of many patents, extensive development is required before any commercial application is possible—for example the laser, the transistor, nylon, and xerography. The investments may be required simply to apply existing technology to the manufacture and design of the product and be so mechanical in their application as to be unpatentable. In any case, their patentability is impossible to predict in

to make the most of them; property rights in patents and copyrights make possible the *creation* of a scarcity of the products appropriated which could not otherwise be maintained." Arnold Plant, *Selected Economic Essays and Addresses* 36 (1974).

advance of their development. Nevertheless, they can be large and produce information as to product manufacture and design that would be appropriable by competitors absent the original patent.

Even in the case of an innovation patented in fully commercial form—as is the case with many relatively trivial patents—the firm must make significant investments to simply distribute and market the invention. But expenditures necessary to identify the market for the product and to persuade potential customers of its utility can easily be captured by competitive imitations. Absent a patent on the product, the incentives to provide information to purchasers about their need for a product as opposed to information about the particular characteristics of the seller's product are limited. The trademark law protects only the names and symbols identifying the seller's product; it confers no protection against imitators of the product itself.³² Thus competitors can ride on the demand for the product created by the first seller without incurring the expenses necessary to inform buyers of the advantages of the product.³³ Only in the case of a patented product is a firm able to make the expenditures necessary to bring the advantages of the product to the attention of the customer without fear of competitive appropriation if the product proves successful. This aspect of the cost of introducing innovations is stressed here both because managements find that marketing is a major cost in innovation and to illustrate that even in the case where nothing remains but to make and sell the patented invention, there are significant costs whose return could be appropriated by competitors.³⁴ Absent a patent, firms have less than the optimal incentive to invest in providing information about and techniques for using the new technology.

Third, a patent system lowers the cost for the owner of technological information of contracting with other firms possessing complementary information and resources. A firm that has a design for a new product or process needs to be able to obtain financing, knowledge about or use of complementary technology, specialized supplies, and access to markets. Unless the firm already possesses the needed inputs, it must enter into contracts. The practical difficulties of entering into contracts concerning trade secrets

³² The Supreme Court has found product imitation absent infringement of a patent, copyright, or trademark to be a federally protected right which cannot be restricted by the states. *Sears Roebuck & Co. v. Stiffel Co.*, 376 U.S. 225 (1964), reprinted in Kitch & Perlman, *supra* note 10 at 526-30.

³³ And they can use the originator's trademark to explain that his product is the same or similar. *Smith v. Chanel, Inc.*, 402 F.2d 562 (9th Cir. 1968), abridged in Kitch & Perlman, *supra* note 10 at 518-25.

³⁴ Perhaps the simplest example of this is promotional pricing where the seller absorbs part of the learning costs of the buyer by charging nonremunerative prices early in the life of the product. Leases with an automatic return right and no significant front end payment may accomplish the same purpose. These strategies are feasible only if the seller can later gain from the learning he has subsidized.

are spelled out in the applied legal literature.³⁵ Disclosure of the secret imperils its value, yet the outsider cannot negotiate until he knows what the secret is. Disclosure under an obligation of confidence strengthens the discloser's legal position but may prove costly to the receiver, who must accept the obligation before he knows the secret. The patent creates a defined set of legal rights known to both parties at the outset of negotiations. And although the patent will seldom disclose the real value of the patent, the owner can disclose such information protected by the scope of the legal monopoly. Indeed, most know-how or trade-secret licensing takes place within the framework of patent rights,³⁶ the agreement involving both a license of the patent and an undertaking to disclose how to apply the technology efficiently. This reduced transaction cost increases the efficiency with which inventions can be developed.

Fourth, a patent system enables firms to signal each other, thus reducing the amount of duplicative investment in innovation. Once a patent has been issued, other firms can learn of the innovative work of the patent holder and redirect their work so as not to duplicate work already done. Indeed, the patent gives its owner an affirmative incentive to seek out firms and inform them of the new technology, even before issuance, if the most efficient and hence patent-value-optimizing way to exploit the invention is to license it. Under a regime of trade secrecy, the competitive firm might never learn of a competitor's processes and would not learn of the technology incorporated in a new product until it was marketed. During this period, the investments made in a search for technology already invented by others is wasted. This private incentive to disseminate information about the invention should be distinguished from the reward for disclosure theory traditionally discussed. That theory assumes that the disclosure effect of the patent system comes from the disclosure on the public record.

After a patent is issued, other firms have an incentive to invent substitute technologies even if the substitute technology is less efficient than the patented technology but can be produced more cheaply than the existing royalty rate. Even more efficient inventions should not, from a social point of view,

³⁵ The archetypal case involves idea submissions to large firms by volunteers. To protect themselves, such firms often require submitters to sign contracts severely limiting their rights, usually to a small dollar sum and whatever rights arise under the patent system. See Kitch & Perlman, *supra* note 10 at 586-601, esp. 600-01. The importance of the "transaction facilitating" function of the patent system has emerged from a study of contractual behavior in innovation headed by Steven Cheung at the University of Washington and funded by the National Science Foundation. Christopher D. Hall, *Selling Ideas* (unpublished ms. 1977).

³⁶ Christopher D. Hall, *supra* note 35 at 14, reports that of 45 technology licenses examined, only 8 were exclusively dependent on trade secret rights; 13 were exclusively patent rights; and 24 were mixed, with the patent rights dominant.

be produced unless the cost of producing them is less than or equal to their saving over the existing technology, absent any royalty on that technology.

To the extent that the holder of the original patent and his prospective competitor can agree on the likely prospects of the substitute technology, they can enter into an arrangement which will forestall the wasteful investment. Of course, the patent holder cannot offer discounts to everyone who threatens to look for a substitute. The patent system enables a competitor to show his seriousness by obtaining a patent, and the patent enables him to disclose sufficient information to enable the holder of the first patent to evaluate its prospects without destroying the value of his position. If both agree that a substitute innovation whose net cost is less than the existing royalty rate is sufficiently likely to make the investment worthwhile as long as the competitor is faced with the existing royalty rate, then they can agree to share the rents from the existing patent in a manner that eliminates the competitor's incentive to duplicate. To the extent the patent system facilitates these transactions, it reduces socially wasteful investment.³⁷ Such transactions are either more expensive or impossible under trade secrecy—where the potential entrant may not even know that the earlier discovered technological alternative exists.

Fifth, a patent system reduces the cost of maintaining control over technology. Under a trade secret system, the owner must control access to the technology and make specially tailored arrangements with those who must have access to it. These precautions can affect the cost of using a process or developing a product. Resources devoted to keeping the technology secret are saved, just as legal protection of property rights generally reduces the need for investment in self-help.

Sixth, a patent system improves the structure of the returns to innovation. Trade secrets create special incentives for processes that can be efficiently practiced in secrecy by a single firm. Other innovations are disfavored. A patent system covering all the useful arts provides a uniform structure of incentives without regard to the possibility of economic exploitation in secret.

In addition, a patent system provides a return based upon the economic value of the technology rather than speculation on its wealth distribution effects. Hirshleifer has pointed out that one way to profit from a discovery of a new technology is to acquire assets whose price will rise due to the technol-

³⁷ Compare the opposite results obtained by George L. Priest, *Cartels and Patent License Arrangements*, 20 *J. Law & Econ.* 358-76. Priest would prohibit pooling of the subsequently conceived competing invention on the ground that the pool deprives consumers of the benefit of the wasteful but sunk investment already made. The perspective offered here views the pooling as a way to stop what will otherwise be a wasteful and continuing investment process.

ogy and then disclose it.³⁸ Thus, he suggests Eli Whitney could have profited from the cotton gin by buying cotton-producing land or selling knowledge of this technological advance to someone in a position to undertake such speculation on a large scale. Because the speculation can be limited to assets with rising values, the profit can exceed the social value of the invention since the offsetting losses are borne by others. Hirshleifer assumes that these gains are additive to a patent system.³⁹ However, he overlooks the fact that patent royalties reduce the wealth-shifting effects of an invention and, indeed, that a perfect royalty discrimination system would nearly eliminate gains.⁴⁰ As a first-order approximation, the royalty for use of the cotton gin would be nearly equal to the cost saving and the price of cotton little affected. Thus, the structure of returns to investment in innovation is improved under a patent system.

IV. POLICY IMPLICATIONS

In this section the theory is tentatively applied to some basic issues of patent policy. The purpose is to both explicate the theory and to suggest further lines of analysis and inquiry.

The Test of "Invention"

A central problem of a patent system is to separate that which is patentable from that which is not. The dominant legal issue has been the standard of invention.

In a 1966 article,⁴¹ I developed the view that the principal test of invention in the American system, certainly until 1885, and perhaps as late as the 1920s, was that the claimed subject matter be new. The application of a novelty test is not without its difficulties. For instance, does a change in color or shape make something new enough to be patentable? The courts answered that it does not, that the invention must be substantially new to be patentable. The administration of a substantial novelty test presents problems, but at least it is always clear what question is being asked. Since the 1930s the courts have required something more than substantial novelty, but it has not been clear what new question is being asked. The Supreme Court,

³⁸ Jack Hirshleifer, *The Private and Social Value of Information and the Reward to Inventive Activity*, 61 *Am. Econ. Rev.* 561 (1971).

³⁹ *Id.* at 572.

⁴⁰ The patent owner will attempt to control the rate of price changes so that resource reallocation takes place at the efficient rate. Thus he will not desire large, unanticipated shifts in factor prices.

⁴¹ Edmund W. Kitch, *Graham v. John Deere Co.: New Standard for Patents*, 1966 *Sup. Ct. Rev.* 293 [hereinafter cited as 1966 *Sup. Ct. Rev.*], reprinted in 49 *J. Pat. Off. Soc'y* 237 (1967).

in an opinion by Mr. Justice Douglas (whose concern about the output constraints of the patent system permeates his opinions), suggested that the invention must reveal a “flash of creative genius,”⁴²—whatever that is. Congress provided in section 103 of the Patent Act of 1952 that the standard is “non-obviousness.” The patented subject matter must not have been obvious to one skilled in the relevant prior art at the time the invention was made.⁴³ But the test is not particularly helpful. If obvious in this section were read to mean obvious—that is something that comes immediately and readily to mind—then the standard would vary little from a substantial novelty standard. But numerous inventions that were not easily and immediately obvious either to their inventors or to others have been held invalid by the courts. For instance a patent on an antenna design was held invalid because the method of searching for the design—not the design itself—was known to the art.⁴⁴ The only modern Supreme Court case upholding the validity of a patent involved a battery which was not only obvious to those in the field, but which was a battery that they positively believed would not work and refused to believe did after it had been demonstrated to them.⁴⁵

In my 1966 article, I attempted at length to explicate the mysteries of patentability law by turning to (among other sources) the reward theory of the economic literature. The focus of the inquiry, I reasoned, ought to be on separating those inventions that would have been made absent the incentives of the patent system from those that would not.⁴⁶ Low-cost inventions sufficiently rewarded by the innovator’s head start should not be patentable. Since these innovations would exist anyway, I reasoned, there is no reason to pay the cost of the patent monopoly. The courts should use the non-obviousness test, I wrote, “to evaluate the magnitude of the costs involved in a given innovation.”⁴⁷

Bowman⁴⁸ has pointed out, correctly, that to the extent my discussion implied the inquiry was to be focused on the conditions under which the invention before the court had been made, it was misleading. An inventor should not be penalized because he was a low-cost inventor. Bowman argued that the inquiry should be focused on the kind or type of innovation. But this is an impossible factual inquiry. How is a court to determine the hypotheti-

⁴² *Cuno Engineering Corp. v. Automatic Devices Corp.*, 314 U.S. 84, 91 (1941).

⁴³ 35 U.S.C. § 103, *Kitch & Perlman, supra* note 10 at 113 (Supp. 1972).

⁴⁴ *University of Illinois Foundation v. Winegard Co.*, 402 F.2d 125 (8th Cir. 1968), abridged in *Kitch & Perlman* at 767-69.

⁴⁵ *United States v. Adams*, 383 U.S. 39 (1966), abridged in *Kitch & Perlman, supra* note 10 at 745-53.

⁴⁶ 1966 Sup. Ct. Rev., *supra* note 41 at 301-03.

⁴⁷ 1966 Sup. Ct. Rev., *supra* note 41 at 338.

⁴⁸ Ward S. Bowman, *supra* note 1 at 4.

cal cost of a hypothetical marginal innovator of making an innovation he may or may not have made?

Another approach which might be derived from the economic literature is to separate those inventions that can be practiced in secrecy from those that cannot, and deny patentability to the former on the theory that the head start or secrecy incentive is more nearly equal to that offered by the patent system for the former than for the latter. Thus patentability would be denied to innovations on industrial processes. But the problem is that for all the reasons given above, the output constraint of a secrecy system is greater than that of a patent system. This is an easy point to see if the choice is between a seventeen-year patent and seventeen years of secrecy. It is more elusive if the choice is between three months of secrecy and a seventeen-year patent. But consider the impact over time if the diffusion of each succeeding technological advance were delayed three months.

Although my 1966 effort to derive a manageable standard from the economic literature was a failure (and that failure a motivation for the development of the theory here), I remain convinced that its reasoning accurately reflects the central problem that has bothered the courts.⁴⁹ The courts, influenced by the reward theory, view the patent system as a difficult problem of trade-offs between the incentive effects and the output constraining effects. They have reasoned that the system can be improved by weeding out the marginal patent—the patent offering the least net gain, which they tend to visualize as the relatively trivial invention enjoying significant commercial success. “He who seeks to build a better mouse trap today,” the Supreme Court said in its leading modern decision on patentability, “has a long path to tread before reaching the Patent Office.”⁵⁰ And in another important recent decision, the Court sought to encourage challenges to patent validity by holding that patent licensees are always free (whether or not the license provides differently) to challenge the validity of the licensed patent.⁵¹ The Court observed that “licensees may often be the only individuals with enough economic incentive to challenge the patentability of an inventor’s discovery,” and fashioned a rule designed to facilitate such challenges in light of “the important public interest in permitting full and free competition in the use of ideas which are in reality a part of the public domain.”⁵²

Intriguingly, there is a counterstrain in the cases. There are cases holding that the commercial success of a product subject to the patent is relevant

⁴⁹ The focus of that article was on explaining what the courts had done, not on developing a theory of the economic function of the patent system.

⁵⁰ *Graham v. John Deere Co.*, 383 U.S. 1, 19 (1966), Kitch & Perlman, *supra* note 10 at 732.

⁵¹ *Lear, Inc. v. Adkins*, 395 U.S. 653 (1969), abridged in Kitch & Perlman, *supra* note 10 at 610-27.

⁵² *Id.* at 670, Kitch & Perlman, *supra* note 10 at 619.

evidence in support of the validity of the patent.⁵³ In my 1966 article, I criticized these cases on the grounds that the subsequent commercial success of the innovation said nothing about the cost conditions of producing the innovation, and indeed that a rule stating that commercially successful patents were valid was a rule that said that all patents that mattered were valid.⁵⁴ It might be reasoned that the subsequent commercial success shows that a demand for the innovation existed, that this demand must have been perceived, and if the innovation was easy to make, it would have been made. But the innovator before the court may be simply the person who first responded to that demand. Once the prospect function is introduced to the discussion, the bearing of commercial success on the question of patentability becomes clearer. The fact that a product or process within the terms of the patent claim is commercially successful tells the court that the patent serves as the foundation for a series of now valuable contract rights. By announcing that the subsequent value of those rights will be taken into account if the patent leads to a successful product, the courts increase the security of the investment process necessary to maximize the value of the patent.

The problem can be illuminated by looking at a fundamental feature of the patent system. Most technological information is not subject to existing patent rights. The reader persuaded by the virtues of a property right in technological information by the earlier discussion might, in a burst of enthusiasm, ask: Why not property rights in all technological information? The short answer is that the arguments for a property right in technological information all depend on the assumption that investment in the search for ways to enhance the value of the information is needed. As to static, known information the proper incentives for its acquisition and use exist without a property right: The person who acquires the information obtains the benefit from having it. He is not entitled to more, because he did not create the information nor invest in its improvement.

To illustrate, consider the technology of hammers and nails. One who learns how to hammer, or to make nails, or to make hammers, will benefit from doing so in an amount that takes into account his comparative efficiency in learning and carrying out the activity. There is, of course, a need to improve the technology of hammers and nails, and any student of the modern fastener industry will realize that this is in fact a rapidly moving area of contemporary technology. But the minute novelty is introduced, a potential patent arises. If someone discovers that a change in the traditional

⁵³ See Kitch & Perlman, *supra* note 10 at 757-58; 1966 Sup. Ct. Rev., *supra* note 41 at 330-35. A closely related rule is that acquiescence of competitors in the value of the patent by accepting licenses supports the validity of the patent.

⁵⁴ 1966 Sup. Ct. Rev. *supra* note 41 at 332-33.

shape of the nail will increase the speed of driving, or improve the holding power, it may be patentable and further pursuit of that idea within the owner's domain. Thus, the patent system will generate property rights along the frontier of the technology while leaving the older core free for all to use. Since the advantages of the prospect function are confined to those zones where movement is taking place, this is a rational distinction.

The prospect function explains why a novelty test of invention is workable.⁵⁵ The concern of the system need not be focused on the appropriate reward: is this discovery worth a seventeen-year monopoly? Rather, the question can be: is this information whose significance should be further investigated? In the case of any substantially new technological information the answer to this question is yes because new information could not have been (by definition) previously investigated. Thus substantial novelty is an economically rational test of patentability.

The significance of this can be illustrated by a recent patentability case that reached the Supreme Court. The invention was for an automated system of cleaning waste from dairy barns. The Fifth Circuit, impressed by the fact that the system was novel, original, and complex, upheld the validity of the patent. The Supreme Court reversed.⁵⁶ If one looks at this patent from the perspective of the reward function, one sees an unimaginative application of the natural forces of water, controlled by known automation devices, to move cow droppings from one point to another. The Supreme Court conceived of the question to be decided as: Is this worth a monopoly? If one looks from the perspective of the prospect function, one sees all the problems of designing and marketing a reliable, durable, and efficient system for automatic barn cleaning. Imagine the reaction of the first dairy farmer approached with the suggestion that he should make a large investment to equip his barn with pumps, pipes, hoses, nozzles, automatic controls and specially designed sloping floors to keep it clean. Imagine the costs involved in designing a commercially acceptable system, proving its value to the dairy farmers of America, and inducing them to pay its cost? The investments to achieve these objectives will be more efficiently made if the patent is held valid.

The Patent Term

The length of the patent term is a closely related issue of patent policy. Absent the limited term, all commercially relevant technological information would in time be subject to patent rights. But how long should the term be?

The reward function seems to suggest a perpetual term. If the purpose is

⁵⁵ I was skeptical of the test in 1966. See 1966 Sup. Ct. Rev., *supra* note 41 at 298-301.

⁵⁶ *Sakraida v. Ag Pro, Inc.*, 425 U.S. 273 (1976), *rev'g* 512 F.2d 141.

to reward the inventor for his invention, then why shouldn't he be awarded all of the present value of his invention? The simplicity of this argument breaks down, however, if we take the view that the inventor's contribution is not the invention itself—which eventually would have been made by someone else—but the time of the invention. The patent should reward not for the whole value of the invention, but for the value of being first. This would suggest long patents for “big jumps” and short patents for “little jumps.”⁵⁷ But Barzel has pointed out that an invention can be too early and that a reward based on priority in time induces inefficiently early invention. Big jumps are by definition the early inventions. So that suggests cutting the term for “big jumps” to offset the incentive for inefficient haste. Perhaps the uniform term results from these two offsetting factors.

The prospect function suggests another approach to the selection of the patent term. Operation of the prospect function requires that the owner have most of the present value of the invention for the investment period. If this were about five years, the remaining twelve would give the owner a large part of the present value at reasonable discount rates.⁵⁸

Unification of Control

Industrial organization economists have tended to view the unification of control of patents that perform economically competing functions as a standard problem of horizontal merger.⁵⁹ Where the market share of the unified patents is significant, they have tended to see a loss of competition in an important factor of production.

Introduction of the prospect function greatly complicates this problem. The prospects generated by the patent system are largely shaped by technological history. Ownership of different parts of what can be most efficiently exploited as one prospect may be in different hands. The only way to obtain the efficiency gains of a prospect may be to permit the parties to rearrange control of the various patents involved.

To return to the mineral claim analogy, a claim system may generate separate ownership rights in areas that upon further development turn out to be subject to the most efficient exploitation under unified control. For instance, a single main shaft may be sufficient for all mines, or the works of one mine may threaten the safety of another. Unification of control may provide the most efficient solution. Similarly, two patents may be so closely related that it makes sense to look for improvements to both at once, or,

⁵⁷ This is the conclusion in William D. Nordhaus, *Invention, Growth, and Welfare: A Theoretical Treatment of Technological Change* 79 (1969).

⁵⁸ It has been suggested that the limited term is necessary to clear the patent register and reduce patent transaction costs. Richard A. Posner, *supra* note 30 at 54-55. But this begs the question, for the issue is what term is worth the costs.

⁵⁹ Ward S. Bowman, Jr., *supra* note 1 at 200-01.

conversely, the search for improvements to one may carry the risk that that improvement will infringe the other.

Consider the situation in the cracking patents case.⁶⁰ This technology developed without any single firm obtaining a dominant pioneering patent. Ownership of patents relating to numerous different but closely related cracking processes was dispersed in a large number of firms. Process innovations were occurring rapidly and all the firms were searching for improvements. If ownership of the patents was not unified, then each firm would have to shape its research program in relation to its patent position although that might not be the most efficient research strategy. Thus firm *A* would not look for improvements to the patented processes of firm *B*, and vice versa. These considerations did not escape the Court's notice. "An interchange of patent rights . . . is frequently necessary if technical advancement is not to be blocked by threatened litigation."⁶¹

These speculations suggest that examples of agreements of this type should be examined to determine how they address the problem of efficient management and coordination of effort by the firms to increase the value of the patents involved. One simple solution may be to simply make all patents available to all firms with an important position and let everyone begin again.

Pursuit of these speculations may clarify the process and conditions under which a monopolistic industry will be more efficient than a competitive one. Schumpeter argued forcefully but without analytic rigor that this is an important case in the modern world.⁶² From the perspective here, the phenomenon turns not upon the size of the firm, but its dominance over a fruitful technological prospect. Such a condition could be consistent with small firm size and the absence of a monopoly in present products. Efforts to study the validity of Schumpeter's hypothesis by looking at technological output by firm size may be missing the phenomenon involved.⁶³

Compulsory Licensing

Compulsory licensing is the patent reform most frequently considered in the economics literature.⁶⁴ The proposals are not always clearly specified or

⁶⁰ This case is summarized in George L. Priest, *supra* note 37 at 364-76.

⁶¹ *Standard Oil Co. v. United States*, 283 U.S. 163, 171 (1931).

⁶² Joseph A. Schumpeter, *Capitalism, Socialism, and Democracy* 100-06 (3d ed. 1950).

⁶³ See, for example, F. M. Scherer, *Firm Size, Market Structure, Opportunity, and the Output of Patented Inventions*, 55 *Am. Econ. Rev.* 1097 (1965). The matter is further complicated by the fact that patents as a measure of output may be systematically biased to favor small firms because of the transaction effect discussed *supra* p. 277-78. This extensive literature is summarized by Carole Kitti & Charles L. Trozzo, *supra* note 1 at 118-30, and by Morton I. Kamien & Nancy L. Schwartz, *Market Structure and Innovation: A Survey*, 13 *J. Econ. Lit.* 1 (1975).

⁶⁴ Michael Polanyi, *Note on Patent Reform*, 11 *Rev. Econ. Studies* 61 (1943) is an early

argued, but the common theme is a desire to preserve the reward while reducing the output constraints of the patent system. Any form of compulsory licensing destroys the prospect function because the patent owner loses the ability to control who can use the patent. Third parties can search for ways to increase the value of the patent and when they find it force the owner to license the patent at the regulated rate.

Government Patent Policy

There has been a contemporary debate over whether the United States should make its patents available to all free of charge or offer exclusive licenses.⁶⁵ Students of that debate will recognize that the arguments for exclusive licenses have foreshadowed the synthesis of this essay.⁶⁶ The reward function suggests free use of inventions (viewed as already made). The prospect function suggests the granting of exclusive licenses of patents (viewed as in need of further development).

Patent Disclosure

The reward theory has tended to emphasize the disclosure role of the patent. In exchange for his invention, the inventor gets a seventeen-year monopoly. But this is only so if the disclosure of the invention in the patent is sufficient to enable others to use it; otherwise the inventor may have both the patent and secrecy. Thus the literature has been puzzled by the apparent failure of the patent system to perform this function.⁶⁷ This "failure" occurs because the patent system requires disclosure of the invention at the time of the patent application and, as we have seen, the application may occur years before the invention is commercialized.

This feature can be understood in light of the prospect function. The prospect creates an incentive in the owner to efficiently disseminate information about the invention himself. He will do this directly, not through the balky mechanism of a formal patent description. The purpose of the description in the patent is not to disclose the commercially relevant technology, but to provide a context in which the legal limits of the claim acquire meaning.

example. L. T. Taylor & Z. A. Silberston, *The Economic Impact of Patents* (1973) is a recent attempt to study the impact of compulsory licensing.

⁶⁵ See the brief summary of present policy in Peter D. Rosenberg, *supra* note 11 at 175-76. An agency by agency review is made in James A. Dobkin, *Patent Policy in Government Research and Development Contracts*, 53 Va. L. Rev. 564 (1967).

⁶⁶ These arguments are made at length by Howard I. Forman, *Wanted: A Definitive Government Patent Policy*, 3 Pat. T.M. & Copyright J. Research & Educ. 399 (1959).

⁶⁷ Nordhaus comments "Unfortunately, the disclosure regulations of the patent system are often evaded. . . . it is not clear why the abuses of the patent system in this area are not corrected." Nordhaus, *supra* note 57 at 89. This critical literature is reviewed in Canadian Dept. of Consumer and Corp. Affairs, *Working Paper on Patent Law Revision* 50-53 (1976).

This perspective throws light on the efforts, through statutory amendment or patent office procedure, to increase the amount of disclosure in patent documents in pursuit of the ideal of the reward theory.⁶⁸ The effect of such efforts is to raise the cost and complexity of patents without increasing the amount of economically meaningful information disseminated.

Trade Secrets

If the patent system is so much superior to trade secrecy, then why not eliminate legal protection of trade secrecy? This position was urged upon the Supreme Court in *Kewanee Oil Co. v. Bicron Corp.*⁶⁹ The reason why this position is wrongly conceived is that trade secrecy, operating in the context of a patent system, reduces the cost of the patent system. If patents cover the basic framework of the technology, then less important but nevertheless costly and valuable information can be protected by trade secrets but exchanged and disclosed within the protective framework of the patents. This reduces the incentive to apply for patents on this less important information and the reduction in the number of patents (for the same amount of technology) is a cost saving.

In addition, rules that permit the patentee to retain important information makes patents that can be infringed in secrecy more enforceable. Process patents can be infringed without alerting the patent owner to that fact. But if potential infringers must obtain information from the patent owner before they infringe, their ability to infringe without notice to the owner is greatly reduced.

Government Subsidy of Applied Research

Government subsidy of applied research has been seen as a way to create incentives for research while avoiding the output constraint of a patent. But if government subsidy brings with it a loss of the patent property system, it may have the effect of reducing rather than increasing the rate of technological improvement. Even if the government follows a policy of taking patent rights, it may identify and manage them less efficiently than a private firm. This problem could be solved by permitting the private, subsidized firm to identify and keep all patents. But then the danger is that the government subsidy will simply displace private expenditure.

The Organization of Basic Research

The patent system cannot perform the prospect function in the context of basic research because of the inability to fashion a meaningful property right

⁶⁸ S.1321 and S.2504, 93d Cong., 1st Sess. (1973) contained provisions to change 35 U.S.C. § 112 to increase patent disclosure.

⁶⁹ 416 U.S. 470 (1974), *Kitch & Perlman, supra* note 10 at 51 (Case Supp. 1975).

around an explanation. Yet basic research faces the same problems of coordination among searchers that applied research does.⁷⁰ Do alternative institutional mechanisms exist?⁷¹ For instance, is it an important virtue of “peer review” procedures for research grants that they feed early information to a key network of informed persons about experiments yet to be performed? Is it essential to the performance of this information function that real decision power rest in the “peers” in order to attract them to the function? Does effective operation of the process require an exclusive right in the “first proposer” to carry out the proposal? What are the limitations on this right? Were the customs relating to publication in scientific journals designed to facilitate efficient communication and coordination among basic researchers? Have they done so? Do they work that way now?

V. CONCLUSION

The leading economic review of the value of a patent system concluded that “if we did not have a patent system, it would be irresponsible, on the basis of our present knowledge of its economic consequences, to recommend instituting one. But since we have had a patent system for a long time, it would be irresponsible, on the basis of our present knowledge, to recommend abolishing it.”⁷² This tepid endorsement reflects a literature that has seen the patent system as a trade-off between the gains of the patent incentive and the output constraints of existing patents. In assessing the incentive effects, the literature has been troubled by the fact that the incentive is dissipated by the competition for it and that some patents are awarded for information that would have been developed anyway. The output constraints of the system have been seen as important, first, because the transmission of information between firms has been viewed as costless—the copying of a product available in the market involving no production know-how seems to be the implicit paradigm—and, second, because the reward theory has suggested that valuable patents must be the important class, implicitly assumed to have a demand curve with a negative slope.

Consideration of the prospect function suggests that patents facing competition from alternative approaches to the technological and market problem may in fact be the important class, and that such patents may perform a useful social function even though many are of little value to their owners.

⁷⁰ Robert Merton has extensively documented the phenomenon of “multiples” in basic research. See Robert K. Merton, *The Sociology of Science* 281-412 (1973).

⁷¹ Scientific “property” is briefly explored in the chapter on “The Protection of Property” in Jerome R. Ravetz, *Scientific Knowledge and Its Social Problems* 245-59 (1971).

⁷² Machlup, *supra* note 1 at 80. This study remains authoritative. See, for example, Canadian Dept. of Consumer and Corporate Affairs, *Working Paper on Patent Law Revision* 61 (1976).

Although authoritative assessment of the effects of the patent system remains a task beyond the ambition of this essay, the legal culture provides two kinds of data useful to the task. First, it shows how defined property rights in information significantly lower the costs of transactions concerning such information. And second, the frequency of interferences within the patent system indicates that the problem of duplicative search is not a negligible one in the development of technology.