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AN ECONOMIC REVIEW OF THE PATENT SYSTEM

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FOREWORD

This study was prepared by Fritz Machlup, Department of Political Economy, Johns Hopkins University, for the Subcommittee on Patents, Trademarks, and Copyrights as part of its study of the United States patent system, conducted pursuant to Senate Resolutions 55 and 236 of the 85th Congress. It is one of several being prepared under the supervision of John C. Stedman, associate counsel of the subcommittee.

The patent system has, from its inception, involved a basic economic inconsistency. In a free-enterprise economy dedicated to competition, we have chosen, not only to tolerate but to encourage, individual limited islands of monopoly in the form of patents. Almost 3 million of these have issued in the course of United States industrial history. This inconsistency has heen rationalized in various ways. It is pointed out that the patent monopoly is limited both in scope and time; that this monopoly is more than balanced by the inventive contribution; that patented inventions are not actually monopolistic in fact because they are subject to competing alternatives and substitutes; that such monopoly as does result is unobjectionable because the public is deprived of nothing it had previously possessed; and so on. Such explanations may render the conflict less serious, but they do not resolve it.

These unresolved issues have never caught the attention of economists, especially the modern ones, to the extent that one would expect. Professor Machlup is a welcome exception. In the present study, he has not only brought together, in well-edited and analytical fashion, the economic contributions of more than a century of thinking on the subject, but he has contributed his own penetrating and original analysis of the subject. The result is a highly readable review of the economic aspects of the patent system that adds up to a major contribution to the literature and thinking in this field. It should also provide real impetus to further discussion of this much-too-neglected side of the patent picture. Recognizing the difficulties in obtaining factual data in this field, Professor Machlup has made a further contribution by employing analytical tools to achieve his purpose that may hereafter enable us to evaluate patent matters that have heretofore been beyond our reach.

Professor Machlup is not a newcomer to the patent field. His extensive economic writings give careful attention to the effect of technological development, and the impact of patents, in the economic area. Among his writings that contain patent discussion are The Political Economy of Monopoly, of which he is the author, and The Patent Controversy in the 19th Century and A Cartel Policy for the United Nations, of which he is a joint author. As Chief of the Division of Research and Statistics, Office of Alien Property, from 1943 to 1946, he participated in formulating and administering

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No. 2. Frost, The Patent System and the Modern Economy (1956).
No. 3. Patent Office, Distribution of Patents Issued to Corporations, 1939–1955 (1956).
No. 4. Federico, Opposition and Revocation Proceedings in Patent Cases (1957).
No. 5. Vernon. The International Patent System and Foreign Policy (1957).
No. 6. Palmer, Patents and Nonprofit Research (1957).
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No. 8. Whinery, The Role of the Court Expert in Patent Litigation (1958).
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No. 15. Machlup, An Economic Review of the Patent System (1958).

AN ECONOMIC REVIEW OF THE PATENT SYSTEM

By Fritz Machlup

I. Introduction

Patent, the adjective, means "open," and patent, the noun, is the customary abbreviation of "open letter." The official name is "letters patent," a literal translation of the Latin "litterae patentes." Letters patent are official documents by which certain rights, privileges, ranks, or titles are conferred. Among the better known of such "open letters" are patents of appointment (of officers, military, judicial, colonial), patents of nobility, patents of precedence, patents of land conveyance, patents of monopoly, patents of invention. Patents of invention confer the right to exclude others from using a particular invention. When the term "patent" is used without qualification, it nowadays refers usually to inventors' rights.[1] Similarly, the French "brevet," derived from the Latin "litterae breves" (brief letters), is a document granting a right or privilege, and usually stands for "brevet d'invention."

Defined more accurately, a patent confers the right to secure the enforcement power of the state in excluding unauthorized persons, for a specified number of years, from making commercial use of a clearly identified invention. Patents of invention are commonly classed with other laws or measures for the protection of so-called "intellectual property" or "industrial property." This class includes the protection of exclusivity for copyrights, trademarks, trade names, artistic designs, and industrial designs, besides technical inventions; other types of "products of intellectual labor" have at various times been proposed as worthy of public protection. It has seemed "unjust" to many, for example, that the inventor of a new gadget should be protected, and, perhaps, become rich, while the savant who discovered the principle on which the invention is based should be without protection and without material reward for his services to society.[2] Yet, proposals to extend government protection of "intellectual property" to scientific discoveries have everywhere been rejected as impractical and undesirable.[3]

[1] These explanations might seem superfluous were it not for the confusion caused by the similarity between the adjectives in "open letter" and "disclosed invention." Thus, we are told that "the word 'patent' as a part of the grant entitled 'Letters Patent' was adopted to indicate that the invention was being disclosed to the public and that the patent right was a reward for such disclosure, namely, for making the invention patent to the public as distinguished from being latent." Gustav Drews, The Patent Right in the National Economy of the United States (New York: Central Book Co., 1952), p. 3. This etymological contention is without foundation.

[2] The granting of rewards for scientific discoveries has often been proposed. The so-called Ruffini proposals to this effect were adopted by the Council of the League of Nations in 1923. The problem was reviewed in C. J. Hamson, Patent Rights for Scientific Discoveries (Indianapolis: Bobbs-Merrill, 1930). See also the report on The Protection by Patents of Scientific Discoveries of the Committee on Patents, etc., of the American Association for the Advancement of Science, Science, vol. 79 (1934), supp. No. 1.

[3] In 1928, the Executive Board of the National Research Council, Washington, D. C., voted that "the protection by law of a scientist's property rights in his discoveries was not feasible, and was of doubtful desirability." See Lawson M. McKenzie, "Scientific Property," Science, vol. 118 (December 1953), p. 767.

and true inventor" of a new manufacture. It is this emphasis of the law, that only the first and true inventor could be granted a monopoly patent, which justified designation of the Statute of Monopolies as the "Magna Carta of the rights of inventors."

B. THE SPREAD OF THE PATENT SYSTEM (1624–1850)

The Statute of Monopolies is the basis of the present British patent law, and became the model for the laws elsewhere. Some of the Colonies were the first to follow: Massachusetts, for example, in 1641. To South Carolina goes the credit for enacting, in 1691, the first "general" patent law, as distinguished from authorization to the Crown to make patent grants.[10] The larger countries of Europe were much slower. An edict of King Louis XV of France, in 1762, did little more than prohibit permanent privileges and provide for inventors' patents limited to 15 years. In 1791, the Constitutional Assembly passed a comprehensive patent law, in which the inventor's right in his creation was declared a "property right" based on the "rights of man."

In the United States of America, the Constitution of 1787 had given Congress the power—

> 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.

Under this power, the Congress passed the first patent law in 1790 and amended it in 1793.

The next country to adopt patent legislation was Austria. In 1794, a Hofdekret (royal decree) announced the establishment of a patent system, and in 1810 such a law was enacted. Opposed to the doctrine of the inventor's "natural rights," it provided, and the amended act of 1820 repeated, that inventors had neither any property rights in their inventions nor any rights to patents; the Government reserved its prerogative to grant privileges to restrict what was called their subjects' "natural rights to imitate" an inventor's idea.[11]

Four different legal philosophies about the nature of the inventor's right were thus expressed in the patent laws of the various countries: the French, recognizing a property right of the inventor in his invention and deriving from it his right to obtain a patent; the American, silent on the property question, but stressing the inventor's legal right to a patent; the English, recognizing the monopoly character of the patent, and regarding it in theory as a grant of royal favor, but in practice regularly allowing the inventor's claim to receive a patent on his invention; the Austrian, insisting that the inventor has no right to protection, but may, as a matter of policy, be granted a privilege if in the public interest.

Regardless of these differences concerning the inventor's rights, in one form or another, the patent system, in the sense of a system of inventor's protection regulated by statutory law, spread to other countries. Patent laws were enacted in Russia in 1812; Prussia, 1815; Belgium and the Netherlands, 1817; Spain, 1820; Bavaria,

[10] South Carolina Laws of the Province, 21 (Trott ed.); cited from Burlingame, March of the Iron Men (New York: Scribners, 1938), p. 64.

[11] Paul Beck von Mannagetta, Das österreichische Patentrecht (Berlin: Heymann, 1893), p. 105. See also Anton Edler von Krauss, Geist der österreichischen Gesetzgebung zur Aufmunterung der Erfindungen im Fache der Industrie (Wien: Mösle und Braumüller, 1838), pp. 8–18.

The tide turned in 1873, when the antipatent movement collapsed rather suddenly, after a most impressive propaganda campaign by the groups interested in patent protection. The following reasons have been given for the sudden change: the great depression, the rise of protectionism that came with it, the rise of nationalism, and the willingness of the patent advocates to accept a compromise.

The free-trade idea had been the chief ideological support of the antipatent movement: patent protection had been attacked along with tariff protection. Now, "thanks to the bad crisis," public opinion had turned away from "the pernicious theory * * * of free competition and free trade" (Reichstagsabgeordneter Ackermann, opening the debate on the German patent bill in 1877).[19]

The strategic compromise was the acceptance of the principle of compulsory licensing—of compelling all patentees to license others to use the invention at reasonable compensation.[20] This idea had been proposed in 1790 in the United States Senate,[21] in 1851 in the House of Lords in Britain,[22] in 1853 by a German official,[23] in 1858, 1861, and 1863 at various conferences of British scientific organizations,[24] and now in 1873 at the Patent Congress held at the Vienna World's Fair.[25] The patent advocates and the free traders compromised on this general limitation on the patentees' monopoly power. (Despite the resolution of the Patent Congress, the actual adoption of compulsory licensing has been rather slow in some countries, and is still resisted in the United States of America.)

The defeat or disappearance of the opposition was reflected in the actions of the legislatures of several countries. In Britain the drastic reform bill that had passed the House of Lords was withdrawn in the House of Commons in 1874. In Germany a uniform patent law for the entire Reich was adopted in 1877. Japan, which had adopted her first patent law in 1872 only to abolish it again in 1873, enacted another law in 1885. Switzerland, more conservative than other nations, held out longer; a referendum in 1882 still rejected patent legislation, but a new referendum in 1887 enabled the legislature to pass a law. Patentability of inventions in the chemical and textile industries was limited by a requirement of mechanical models for all patented inventions. But this limitation was deleted from the law by an amendment in 1907, after Germany had threatened higher tariffs on certain Swiss products.[26] The Netherlands, the last bastion of "free trade in inventions," reintroduced a patent system in 1910, to become effective in 1912.

[19] Hermann Grothe, op. cit., supra, note 14, p. 52.

[20] It was widely held that the compulsory-licensing compromise "saved the patent system." Paul Beck von Mannagetta, Das neue österreichische Patentrecht (Vienna: Hölder, 1897), p. 17. "They wanted to eliminate the objection that a patent granted a monopoly." Franz Wirth, Die Patent-Reform (Frankfurt a. M.: 1875), p. 69. Cf. also Hermann Grothe, op. cit., supra, note 14, p. 37, and Al. Pilenko, op. cit., supra, note 14, p. 102.

[21] Record of the Proceedings in Congress Relating to the First Patent and Copyright Laws, printed by the Patent Office Society, edited by P. J. Federico (1940). Compulsory licensing in cases of suppression of inventions had been provided by the South Carolina Patent Act of 1784. See Pooling of Patents, Hearings before the House Committee on Patents on H. R. 4523, 74th Cong., pt. 4 (1935), pp. 3570-3571.

[22] House of Lords, Parliamentary Debates, 1851 (July 1, 1851).

[23] See Pilenko, op. cit., supra, note 14, p. 523.

[24] Transactions of the National Association for the Promotion of Social Science, 1858 (London: 1859), p. 148; Report of Joint Committee with British Association for the Advancement of Science, Transactions of the National Association for the Promotion of Social Science, 1861 (London: 1862), p. 230; Transactions of the York Meeting of the National Association for the Promotion of Social Science, 1863 (London: 1864), p. 664.

[25] Der Erfinderschutz und die Reform der Patentgesetze: Amtlicher Bericht über den Internationalen Patent-Congress zur Erörterung der Frage des Patentschutzes (Dresden: 1873). See English text of the resolution in Papers Relating to the Foreign Relations of the United States, pt. 1, vol. 2 (1873), p. 75.

[26] W. Stuber, Die Patentierbarkeit der chemischen Erfindungen (Bern: Stampfli, 1907), pp. 26 ff.

such as "not previously patented, published or used," is understood; but whether the reinvention of a forgotten art or the introduction or importation of a foreign art should be patentable [33] are controversial questions, depending on the purposes patent protection is supposed to serve. Questions such as the loss of novelty because of publication or commercial use of the invention by the inventor himself prior to his application for a patent, or because of his earlier application for a patent abroad,[34] are perhaps more in the nature of legal technicalities. On the other hand, whether an ingenious novel combination of well-known elements should be patentable is again a matter of policy depending on technological and economic analysis.[35] Considerations of justice, of legal convenience, as well as of economic analysis will be relevant in cases of simultaneous invention. Should priority be recognized of him who was first in getting the idea, or of him who was first in putting it into patentable form, or of him who was first in submitting it to the patent office? There are those who regard multiple invention as an argument against granting any patent at all, because in such cases the progress of the arts would not have depended on any one of the simultaneous inventive efforts.[36]

The problem of duplicate or multiple invention may also be treated under the heading of "utility." One might interpret utility in an economic sense and hold that the activities behind an invention which is actually or potentially supplied by more than one inventor have a "marginal utility" of nil: the relative abundance of supply makes the services of each of these inventors equivalent to "free goods." [37] Reasoning of this sort is not widely accepted. At any rate, the question of utility commonly refers not to the inventive services but to the industrial and commercial application of the invention, though even there the judgment of the utility is not always based on strictly economic criteria. Ethical judgments may enter, for example, when the patentability of inventions of products designed for "immoral purposes" is denied by the laws of most countries. Often the question of the utility of an invention can be decided only in relation to the social cost involved in granting a monopoly right for its use. Considerations of this kind have led to the recommendations, incorporated into the laws of some countries, that "trivial" inventions be denied patent protection; that "petty" inventions be eligible only for shorter periods of protection (e. g., the "utility models" in Germany); that "improvement inventions" be eligible, not for separate patents, but only for "improvement" or "supplementary" "patents of addition" of shorter duration, expiring usually with the primary patent on the invention which they improve. There is also the question of

[33] Many countries, particularly less developed ones, were chiefly interested in the establishment of new industries and, therefore, granted "patents of importation" or "patents of introduction" even though the inventions in question had elsewhere been patented to others. The 1791 patent law of France provided: "Whoever is the first to bring into France a foreign discovery shall enjoy the same advantages as if he were the inventor."

[34] The "right of priority" provided in the International Convention for the Protection of Industrial Property is in part designed to prevent the original filing of a patent application in one country from destroying the patentability of the invention in other countries. The inventor has a "priority" to apply in other countries within 12 months.

[35] The courts in many countries have considered that, regardless of the novelty and utility of the result of the combination, no patent may be granted where "no difficulty had to be overcome and the combination was obvious." Peter Meinhardt, Inventions, Patents, and Monopoly (London: 2d ed. 1950), p. 66.

[36] See, e.g., Sir Roundell Palmer, speaking in Parliament, on May 28, 1868. Quoted in R. A. M. [Macfie], editor, op. cit., supra, note 13, p. 97.

[37] "* * * since the social demand for an invention is always for just one (duplicate discoveries of the same idea being useless), if 2 or 10 or 100 inventors stand ready to supply the same invention, then the services of each one are valueless." S. C. Gilfillan, op. cit., supra, note 31, p. 619.

products or new medicines. Such exemptions raise fundamental questions relating to the economic justification of the patent system. If patents are regarded as means of stimulating technological progress, and if progress in the food and drug industries is not less desired than in other industries, why should these exceptions be made? Is the answer that monopolies in food and in medicine are intolerable, consistent with belief in the theory of the acceleration of progress through patent monopolies? Does it not reflect some doubt in the theory?

The desire to ensure fixed and unchanging standards of patentability [42] is probably inconsistent with the fact that, as science and technology progress, ever more can and must be demanded of the inventors' abilities. And it is after all the "difficulty" of inventing which determines the relative scarcity of invention and, consequently, provides the rationale for the policy of creating an extra stimulus for inventive effort.[43] This presupposes, however, as do most other problems under discussion, that it is invention rather than enterprising innovation which the patent system is supposed to encourage. If society aims at stimulating innovation and at attracting venture capital into pioneering investment, then the controversies about the nature of "inventions" are beside the point. After all, the innovators' risks are not proportional to the costs and results of the inventive efforts.[44]

The duration of patents has been determined by historical precedent and political compromise. The 14-year term of the English patents after 1624 was based on the idea that 2 sets of apprentices should, in 7 years each, be trained in the new techniques, though a prolongation by another 7 years was to be allowed in exceptional cases. There were all sorts of arguments in later years in favor of a longer period of protection: it should be long enough to protect the inventor for the rest of his life; to protect him for the average length of time for which a user of an invention might succeed in keeping it secret; or for the average time it would take for others to come up with the same invention; or for the average period in which investments of this kind can be amortized; and some pleas were made for eternal protection through perpetual patents.

Economists usually argued for shortening the period of protection: the bulk of inventions are not so costly as to require the stimulus provided by protection for such a long time, and not important enough to deserve the reward that it affords; a much shorter period would provide sufficient incentive for almost the same amount of inventive activity; the period should not be so long as to allow patentees to get entrenched in their market positions; "technology moves now with a speed once undreamed of—its swift march dictates a shortening of the life of a patent." [45]

In actual fact, the patent terms were lengthened to 15, 16, 17, and 18 years in most countries, and to 20 years in some. But the explana-

[42] "One of the greatest technical weaknesses of the patent system is the lack of a definite yardstick as to what is invention." National Patent Planning Commission, op. cit., supra, note 39.

[43] Gilfillan, op. cit., supra, note 31, pp. 618–619.

[44] That society should protect, and thereby stimulate, investment in innovation—not just invention—has been held by many; but few were as consistent in their conclusions as Joseph A. Schumpeter, who on these grounds favored permitting monopolistic practices of various sorts. He argued that temporary security from competition, through cartels, patents, or other restraints, would encourage firms to put more venture capital into innovating investment. Schumpeter, Capitalism, Socialism, and Democracy (New York: Harper, 1942), pp. 81–106.

[45] Walton H. Hamilton, Patents and Free Enterprise (TNEC Monograph No. 31, 1941), p. 157.

tion of a monopolistic market position based on the goodwill of a trademark associated with the patented product or process, where the mark and the consumer loyalty continue after expiration of the patent; [51] and (e) through licensing agreements which survive the original patent because they license a series of existing improvement patents and a possibly endless succession of future patents.[52]

The patentee may succeed in extending the scope and strength of the monopoly beyond that intended by the law—that is, beyond the control of the use of a single invention supposedly in competition with other inventions—to achieve control of an entire industry or of the markets of other goods not covered by the patent. Substantial control of an industry can be achieved by a "basic patent" (on a bona fide basic invention), by an "umbrella patent," where illegitimately broad or ambiguous claims, covering the entire industry, have been allowed and are not tested in the courts,[53] by a "bottleneck patent," [54] which is not basic but good enough to hold up or close the entire industry, by an aggregation or accumulation of patents which secure domination of all existing firms and effectively close the industry to newcomers,[55] or by the use of restrictive licensing agreements establishing domination or cartelization of the industry and exclusion of newcomers.[56] Control, sometimes, is extended to markets of products not covered by the patent, through the use of tying clauses in licensing agreements.[57]

Patent pooling agreements, sometimes necessary in order to permit the efficient use of complementary inventions controlled by different firms, have often been the vehicle for cartel agreements of the most restrictive sort. Indignant complaints have been raised against the use of patents for the oppression of weaker firms by harassing litigation or threat of litigation; against the use of license agreements for binding competitors or customers not to contest the validity of dubious patents; and against the taking out of patents, not to work the patented invention, but to keep others from working it, especially to "fence out" possible competing developments of the patented inven-

[51] In a case where a trademark was viewed as prolonging the monopoly created by a patent, the Supreme Court condemned the attempt "to retain in the possession of the company the real fruits of the monopoly when the monopoly had passed away." *Singer Mfg. Co.* v. *June Mfg. Co.*, 163 U. S. 169, 181 (1896). See also the safeguarding provisions in the 1946 Trade Mark Act, secs. 14 (c) and 15 (4).

[52] "The agreements applied to patents not yet issued and to inventions not yet imagined * * * They extended to a time beyond the duration of any then-existing patent." *United States* v. *National Lead Co.*, 63 F. Supp. 513, 524 (S. D. N. Y. 1945).

[53] The patent on the idea of the automobile, the Selden patent, applied for in 1879 and granted after long delay in 1895, is the most famous example. Henry Ford had to litigate until 1911 to destroy this "umbrella." The patent on hardboard is another example.

[54] This term was proposed by Thurman W. Arnold, Hearings before the Senate Committee on Patents on S. 2303 and S. 2491, pt. 7 (1942), p. 3301.

[55] "Capital seeking to control industry through the medium of patents proceeds to buy up all important patents pertaining to the particular field. The effect of this is to shut out competition that would be inevitable if the various patents were separately and adversely held. By aggregating all the patents under one ownership and control, using a few and suppressing the remainder, a monopoly is built up that is outside of and broader than any monopoly created by the patent statutes. It is 'monopoly of monopolies' and is equivalent to a patent on the industry as such." Revision and Codification of the Patent Statutes, (Oldfield) Committee on Patents, H. Rept. No. 1161, 62d Cong. (1912), p. 5.

[56] A German electric-light-bulb manufacturer once commented on the American antitrust law: "* * * we have no reason to be excited about the American law * * * we could use all agreements with the Americans which are made on a perfectly legal basis, namely, as patent license agreements, to accomplish the now intended aim of the distribution of markets." Hearings, supra, note 54, pt. 3, p. 1318. It is now recognized that "industrywide license agreements * * * with the control over prices and methods of distribution * * * establish a prima facie case of conspiracy." *United States* v. *U. S. Gypsum Co.*, 333 U. S. 364, 389 (1948).

[57] After several court decisions which established the illegality of patent licenses restricting the use of unpatented products, the United States Patent Act of 1952 created new uncertainty on this score by inserting a provision which makes it a "contributory infringement", to a still undetermined extent, for anybody to sell an unpatented article (material, apparatus, machine part) designed for use with a patented machine or in a patented process. This provision seems to be intended to protect a patentee's control over the sale of such unpatented articles.—British law has moved in the opposite direction: the Patents Act of 1949 contains severe provisions against tying clauses and makes them definitely unlawful.

C. COMPULSORY LICENSING

Among the sanctions provided by various patent laws for "abuses" of patent protection are revocation of patents, refusal of judicial relief in infringement suits, and compulsory licensing. (The first statute providing for compulsory licensing in cases of "suppression" was probably the South Carolina Patent Act of 1784.) Compulsory licensing, however, is not always instituted as a penalty or remedy for "abuse"; in some countries it may be resorted to whenever deemed necessary to safeguard the public interest. Be it on account of "abuse," as in England, or "in the public interest," as in Germany, the issuance of a compulsory license may be requested by an interested party whom the patentee has refused to license, or may be proposed by a Government department. In Germany the most frequent reason for such actions has been the existence of dependent patents, that is, of patents covering inventions which could not be worked without license under a patent held by someone else.[64] In England insufficient use of a patent may in the future become a more frequent reason for compulsory licensing or for "licenses of right," especially since food products and medicines were made patentable by the most recent amendment of the Patent Act (1949) but with provisions facilitating the granting of compulsory licenses.[65] In the United States compulsory licensing has usually been ordered by the courts in cases where patentees have misused their patents in violation of the antitrust laws. Moreover, the amended Atomic Energy Act (1954), although liberalizing the law somewhat from the standpoint of patentees, still provides for compulsory licensing of patents on nuclear inventions and continues to forbid patents on inventions of atomic weapons.

The proposal to make all patents licensable under the law, not conditional upon judicial or administrative findings of "abuse" or "public interest,"[66] has been resisted almost everywhere, partly because of the administrative or judicial difficulties of determining "reasonable royalties," partly because of a fear that the incentive for innovative enterprise would be unduly weakened. Systems of general compulsory licensing—where everybody may obtain licenses under any patent—have been referred to as "monopoly-free" patent systems, because patents could no longer serve to exclude competitors willing to pay royalties.[67] Patentees, under such a system, could no longer hope for attractive monopoly profits, but only for such revenues as they would collect as royalties from their licensees and as "differential rents" due to the cost advantage over their royalty-paying competitors.[68] These revenues might not be smaller than the poten-

[64] A decision by the German Reichsgericht on January 6, 1916, declared it "intolerable * * * that two parties should be permitted to prevent each other and the public from using a valuable invention."

[65] While normally the applicant for a compulsory license must prove that the patentee has abused his monopoly, in the case of patents relating to food or medicine the burden of proof is on the patentee, who must show cause why the compulsory license should be refused.

[66] There is, of course, the possibility of declaring that patents in general or of specified type are "endowed with a 'business affected with a public interest' concept, connoting the common-law obligations of such a business to serve all without discrimination and at reasonable rates." This is mentioned, though not proposed, by Stedman, "Invention and Public Policy," Law and Contemporary Problems, vol. XII (autumn 1947), p. 679.

[67] Max Börlin, Die volkswirtschaftliche Problematik der Patentgesetzgebung (Zürich and St. Gallen: Polygraphischer Verlag, 1954), p. 201. It has been suggested that the omission of the word "monopoly" from the new English patent law "can only foreshadow a steady increase in the emphasis on licensing and a corresponding decline in the reliance upon exclusive monopoly in the administration of the patent system in this country." Sir Arnold Plant, "Patent and Copyright Reform," The Three Banks Review (September 1949), p. 16.

[68] On the possibility of setting "reasonable royalties" under compulsory licenses with a view to the expenses involved in making the invention, see Stedman, op. cit., supra, note 66, p. 668.

try that is acquired by "great aggregations of patents" by preventing acquisitions of alternative technologies by license or assignment and by requiring divestitures of patents or compulsory licensing; prohibit restrictive licensing in fields in which the patent owner does not operate.[75] If any of these provisions should seriously reduce the incentive to develop and introduce patented inventions, special measures should be taken "to provide incentives for development without tolerating serious impairment of market competition."[76]

A very different approach has been proposed by another writer who was convinced of the need for a patent reform other than the introduction of general compulsory licensing. In order to combine the advantages of "free accessibility of inventions to all," insured through general licenses of right, with the benefits of adequate incentives to investors in research and innovation, he proposed—

> to supplement licenses of right by government rewards to patentees on a level ample enough to give general satisfaction to inventors and their financial promoters.[77]

The rewards are to be fixed annually according to the "assessed values created by the invention,"[78] though with some gradations taking account of the "degree of invention and novelty" involved.[79] As a transition to such a system, the licenses of right might be voluntary—that is, the patentees may elect to register their patents as available for licensing—with sufficiently attractive rewards to patentees, the adequacy of the rewards being judged by the number of patentees accepting the scheme; in a sense, with these annual payments the government would "buy off" the exclusive rights which it had granted to the patentees.[80] Under another plan, instead of making annual "participation payments" to the licensors (in addition to the reasonable royalties received by them from licensees) the government would buy the patents outright and open them to all, free of royalty.[81] Still another proposal would give the government an option to purchase at a reasonable price any patent that it might wish to open up for general use.[82]

Proposals for systems of prizes and bonuses to inventors, as alternatives to patents, are almost as old as the patent system. In the United States, in the 1787 discussions of the powers to be reserved for Federal legislation, Madison proposed a premium system instead of a patent system.[83] In 1834, Russia established a commission to determine awards for inventors in lieu of exclusive privileges. And similar proposals were debated almost everywhere during the 19th century, but ran afoul of the fiscal limitations on earlier governments

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[75] Id., p. 246.
[76] Id., p. 248.
[77] Michael Polanyi, op. cit., supra, note 27, p. 67.
[78] Ibid.
[79] Id., p. 74.
[80] Id., p. 69. Polanyi's proposals have very recently received high praise from Prof. John Jewkes: "Professor Polanyi's case is argued so thoroughly, and the possible objections to it faced so squarely, that it is regrettable that it has not received more public attention." Jewkes believes "that Professor Polanyi's proposals would strengthen the position of the individual inventor in society." John Jewkes, David Sawers, and Richard Stillerman, The Sources of Invention (London: 1958), p. 254.
[81] This is by no means a new idea. Several States purchased Eli Whitney's rights in the cotton gin, an invention patented in 1793, and made the invention freely available to all their citizens. Walton Hamilton The Politics of Industry (New York: Knopf, 1957), p. 70.
[82] A similar proposal was made in 1858 by R. A. Macfie in an address at a conference. He proposed that "At any time during the currency of a patent, Government may purchase for the public an unreserved right to use the invention * * *". National Association for the Promotion of Social Science, Transactions, 1858 (London: 1859), p. 148.
[83] Nevertheless, the patent clause in the Constitution was unanimously approved. The Debates in the Federal Convention of 1787 Which Framed the Constitution of the United States of America (Hunt and Scott edition, 1920), pp. 420, 573.

where the outlay is too great, government might undertake it. Such a scheme would not be inconsistent with the laisser-faire principle of assigning to the government only—

> those public works which, though they may be in the highest degree advantageous to a great society, are, however, of such a nature that the profit could never repay the expense of any individual, or small number of individuals; and which it, therefore, cannot be expected that any individual or small number of individuals, should * * * maintain.[89]

If private enterprise under unlimited competition finds it not sufficiently profitable to undertake the amount of industrial research and development that society wants to be carried on in the interest of faster progress, society has several choices: to make research grants or subsidies to selected industries or special private organizations; to promise prizes or bonuses for useful inventions made by private individuals or groups; to promise monopoly grants through patents; or to maintain governmental research agencies. It seems that the largest countries have adopted more than one of these possibilities. The United States, for example, has not only maintained a very strong patent system but has also resorted to subsidized research and to Government research. The latter has long been a chief source of agricultural improvements and has lately assumed large proportions in many fields connected with national defense. The greater part of the total research expenditures in the United States is now financed by the Government. In 1953 the Federal Government contributed $2.8 billion or 52 percent of the total funds spent on research and development.[90]

E. INTERNATIONAL PATENT RELATIONS

The existence of national patent systems, in a world with expanding international trade, raised problems which soon suggested the desirability of international understandings. Patentees were interested in a geographic extension of their monopoly rights, and thus in a system that would make it easier for them to secure patent protection in foreign markets.[91] Advocates of industrialization were interested in domestic production and, therefore, opposed to a system that would protect the importer from the domestic producer, instead of the producer from the importer.[92] Internationalists found it preposterous that a patentee should be forced to forego the cost advantages of large-scale production and to manufacture in 20 or more different countries with compulsory-working provisions. Inventors found it intolerable that foreign patent offices should deny the novelty, and thus the patentability, of their inventions on the ground of "prior publication" involved in the patent applications at home. They found it even worse when countries denied them patents because someone else had quickly started to work their inventions; and worst of all

[89] Adam Smith, An Inquiry into the Nature and Causes of the Wealth of Nations (1776), book V, ch. I, pt. III.

[90] National Science Foundation, Reviews of Data on Research and Development, No. 1 (December 1956). The budget for the fiscal year 1957 provides for somewhat higher expenditures for research and development. National Science Foundation, Federal Funds for Science, V. The Federal Research and Development Budget, Fiscal Years, 1955, 1956, and 1957 (1956), p. 5.

[91] Edith Tilton Penrose, The Economics of the International Patent System (Baltimore: Johns Hopkins Press, 1951), p. 69.

[92] Hence the compulsory working provision in many patent laws, for example, in the earlier French law. In the international discussions it became very clear that many regarded the requirement of domestic working of patented inventions as a substitute for high import tariffs. See, e. g., A. Pillet, Le régime international de la propriété industrielle (Paris: Larose & Forcel, 1911), p. 294.

market which neither improve nor cheapen the goods available, develop its own productive capacity, nor obtain for its producers at least equivalent privileges in other markets. No amount of talk about the 'economic unity of the world' can hide the fact that some countries with little export trade in industrial goods and few, if any, inventions for sale have nothing to gain from granting patents on inventions worked and patented abroad." [95] This, however, is not an argument against the international convention, whose provisions more likely reduce than increase the cost which completely uncoordinated patent systems would impose on several nations through inducing uneconomic locations of industry.

The convention has been attacked as having been instrumental in the formation of international cartels and restrictive practices.[96] Undoubtedly, patent and license agreements have been used for cartelization and domination of international markets, but these opportunities were provided by the national patent laws and the absence of antimonopoly laws or of adequate prosecutions; the convention has neither furthered nor hindered the use of patent protection for international cartelization.

IV. Economic Theory

A. Early economic opinion: 1750–1850

The English classical economists accepted the traditional view that, in the words of Adam Smith (1776), monopoly was "necessarily hurtful to society," [97] but a temporary monopoly granted to an inventor was a good way of rewarding his risk and expense.[98] Jeremy Bentham (1785), comparing rewards by bonus payments with rewards by "exclusive privileges," held that the latter method was "best proportioned, most natural, and least burdensome"; "it produces an infinite effect and costs nothing." [99] The "protection against imitators" is necessary because "he who has no hope that he shall reap will not take the trouble to sow." [100] John Stuart Mill (1848) urged that "the condemnation of monopolies ought not to extend to patents." The inventor "ought to be both compensated and rewarded"; not to reward him would be "a gross immorality." [101] The temporary "exclusive privilege" was preferable to a governmental bonus because it avoided "discretion" and secured a reward proportional to the "usefulness" of the invention, a reward paid by the consumer who benefits from it.[102]

The German cameralists had reservations. Johann Heinrich G. von Justi (1758) was in favor of rewards and encouragements to inventors, but not "by privileges leading to monopoly positions." [103] Ludwig Heinrich Jakob (1809) approved of patents only for inventions

[95] Edith T. Penrose, op. cit., supra, note 91, p. 116. See also Raymond Vernon, op. cit., supra, note 94 pp. 12–14.
[96] Heinrich Kronstein and Irene Till, "A Reevaluation of the International Patent Convention," Law and Contemporary Problems, vol. 12 (1947), pp. 765–781.
[97] Adam Smith, op. cit., supra, note 89, book IV, ch. VII, pt. III.
[98] Id., book V, ch. I, pt. III.
[99] Jeremy Bentham, A Manual of Political Economy, Works (Bowring, editor), vol. III, p. 71.
[100] Ibid.
[101] John Stuart Mill, Principles of Political Economy, book V, ch. X.
[102] Ibid.
[103] Johann Heinrich Gottlobs von Justi, Staatswirthschaft oder systematische Abhandlung aller oekonomischen und Cameral-Wissenschaften, die zur Regierung eines Landes erfordert werden (Leipzig: 2d edition, 1758), vol. I, p. 209; vol. II, p. 613.

Patent protection for inventors is advocated on ethical grounds—in the name of "justice" or "natural right"—or on pragmatic grounds—in the name of "promotion of the public interest." In some views, ethical and pragmatic considerations are combined, largely because conduct is regarded as ethical if and because it benefits society. Others recognize the possibility of conflict between requirements of justice and material usefulness to society, and they may seek justice even at the expense of material benefits, or material benefits at the expense of justice.

The four best-known positions on which advocates of patent protection for inventors have rested their case may be characterized as the "natural-law" thesis, the "reward-by-monopoly" thesis, the "monopoly-profit-incentive" thesis, and the "exchange-for-secrets" thesis.

The "natural-law" thesis assumes that man has a natural property right in his own ideas. Appropriation of his ideas by others, that is, their unauthorized use, must be condemned as stealing. Society is morally obligated to recognize and protect this property right. Property is, in essence, exclusive. Hence, enforcement of exclusivity in the use of a patented invention is the only appropriate way for society to recognize this property right.

The "reward-by-monopoly" thesis assumes that justice requires that a man receive reward for his services in proportion to their usefulness to society, and that, where needed, society must intervene to secure him such reward. Inventors render useful services, and the most appropriate way to secure them commensurate rewards is by means of temporary monopolies in the form of exclusive patent rights in their inventions.

The "monopoly-profit-incentive" thesis assumes that industrial progress is desirable, that inventions and their industrial exploitation are necessary for such progress, but that inventions and/or their exploitation will not be obtained in sufficient measure if inventors and capitalists can hope only for such profits as the competitive exploitation of all technical knowledge will permit. To make it worthwhile for inventors and their capitalist backers to make their efforts and risk their money, society must intervene to increase their profit expectations. The simplest, cheapest, and most effective way for society to hold out these incentives is to grant temporary monopolies in the form of exclusive patent rights in inventions.

The "exchange-for-secrets" thesis presumes a bargain between inventor and society, the former surrendering the possession of secret knowledge in exchange for the protection of a temporary exclusivity in its industrial use. The presupposition again is that industrial progress at a sustained rate is desirable but cannot be obtained if inventors and innovating entrepreneurs keep inventions secret; in this case, the new technology may only much later become available for general use; indeed, technological secrets may die with their inventors and forever be lost to society. Hence, it is in the interest of society to bargain with the inventor and make him disclose his secret for the use of future generations. This can best be done by offering him exclusive patent rights in return for public disclosure of the invention.

be used by somebody else; by contrast, "an idea can belong to an unlimited number of persons" and its use by some does not prevent its use by others.[117] And so on. It is interesting that some French lawyers conceded that they preferred to speak of "natural property rights" chiefly for propaganda purposes, especially because some of the alternative concepts, such as "monopoly right" or "privilege," were so unpopular.[118]

The "reward-by-monopoly" thesis was strongly supported by English economists who, though opposed to all other kinds of monopoly, held that a temporary monopoly grant to inventors would be a just reward. Some opponents denied the need for reward: "Geniuses, just as stars, must shine without pay."[119] Moreover, "nearly all useful inventions depend less on any individual than on the progress of society" and there was no need to "reward him who might be lucky enough to be the first to hit on the thing required."[120] Others recognized the inventor's moral right to be rewarded, but held that the reward would come without government intervention. The head-start of the first user of a new invention would, as a rule, suffice to enable him to earn enough to cover a reward for the inventor.[121] Some economists, who conceded that competition worked too speedily in wiping out the innovators' profits, proposed that inventors be rewarded by prizes or bonuses according to the social value of their inventions.[122] They regarded patents as "the worst and most deceptive form of reward, causing more often losses than profits even to the inventors."[123] The contention that a reward in the form of a temporary monopoly would avoid bureaucratic discretion, would be commensurate to the usefulness of the invention, and would be paid by its beneficiary, namely, the consumers,[124] was countered by the charge that under the patent system the rewards rarely go to those who deserve them, are never in proportion to the services rendered, and are always combined with great injury and injustice to others.[125]

The "monopoly-profit-incentive" thesis is independent of the question whether or not a reward to inventors is called for in the name of justice. To be sure, the hope for a "just" reward may serve as an incentive, but often it will not be sufficiently attractive, and either more or something else may be needed to promote technological progress: a bait rather than a just reward. The profit expectations connected with the hope for a patent monopoly may induce inventive talents to exert their efforts, and venturous capitalists to risk their

[117] Michel Chevalier, in session of June 5, 1869, Annales de la Société d'Economie Politique, vol. VIII, 1869-70 (Paris: 1895), p. 114. Similarly, Coquelin, op. cit., supra, note 112, p. 217.

[118] DeBouffier, reporting the patent bill to the French Constitutional Assembly in May 1791. Quoted by Augustin-Charles Renouard, Traité des brevets d'invention (Paris: 3d edition, 1865), p. 103. Again, Vicomte Dubouchage in the debate on the new French patent law, Chambre des Pairs, séance du 24 mars, 1843. Le Moniteur Universel, No. 84, March 25, 1843, p. 542.

[119] Cited disapprovingly by Wilhelm Roscher, System der Volkswirthschaft, pt. III, Nationalökonomik des Handels und Gewerbefleisses (Stuttgart: 1881), p. 758.

[120] John Lewis Ricardo, M. P., in the hearings of the Select Committee of the House of Lords; reported by The Economist (London), July 26, 1851, p. 812.

[121] "The speed with which new ideas spread, the time interval involved which affords some priority in the commercial exploitation of the new ideas, may be very different for the different types of product." Albert E. F. Schäffle, op cit., supra, note III, p. 141; similarly, p. 150. Schäffle held that the headstart was insufficient in the production of books, but sufficient in the exploitation of inventions.

[122] See note 84, supra. See also The Economist (London), July 26, 1951, p. 812, and Viktor Böhmert, "Die Erfindungspatente nach volkswirtschaftlichen Grundsätzen und industriellen Erfahrungen," Vierteljahrschrift fur Volkswirthschaft und Kulturgeschichte, Siebenter Jahrgang, No. XXV (1869), p. 74.

[123] John Prince-Smith, "Ueber Patente für Erfindungen," Vierteljahrschrift für Volkwirthschaft und Kulturgeschichte. Erster Jahrgang, No. III (1863), p. 161.

[124] John Stuart Mill, Principles of Political Economy, book V, ch. X.

[125] Speech of the Rt. Hon. Lord Stanley, M. P., Chairman, Royal Commission on Letters Patent, House of Commons, May 28, 1868; reproduced in R. A. M. [Macfie] editor, Recent Discussions on the Abolition of Patents for Inventions (London: 1869), p. 111.

oped to a stage at which they can be reduced to practical use, the system encouraged secrecy in the developmental stage of inventions whereas, if there are no patents to be obtained, earlier publication of ideas might hasten technological advance on all fronts.[134] The only support for this argument was an analogy from basic research, namely, the pure scientists' urge to publish as early as possible.[135]

D. MODERN ECONOMIC OPINION: SINCE 1873

Up to 1873 the patent question had been a "hot" issue; economists had been arguing their cases with a sense of urgency, eager to convince the public and the government. The defeat of the patent abolitionists—which was interpreted by many as a victory, in the halls of government, of the lawyers and other "protectionists" over the majority of economists—changed the character of economic discourse and commentary on the patent system. The flow of books, pamphlets, and articles on the economics of patent protection came to a stop; economists had lost interest in the patent question and turned to other problems.

This does not mean that nothing was written about the economic consequences of the patent system—but lawyers, engineers, and historians were the chief writers. Economists authoring general economic texts could not help, of course, including some comments on the patent system; but the absence of references to the heated controvery of 1850–73 seems to indicate that they were not familiar with this literature and, instead, took their cues from the economic "bible" of the time, John Stuart Mill's Principles of Political Economy, at least for the first 50 years of the period here considered.

It is perhaps misleading to discuss all post-1873 literature under the heading "Modern Economic Opinion." But the first half of this period yields too meager pickings for a survey to justify separating it from the more recent decades. An integrated treatment will also be more suitable for an exposition which is not chronological but systematic according to the chief issues discussed in the literature.[136]

One of the issues most fervently debated before 1873 disappeared almost completely from the agenda: the question whether there is, can be, or ought to be a "property" in an invention, in a novel technological idea. Now that the controversy with lawyers had come to an end, it was no longer necessary for economists to argue against the legal constructions of "property rights" in inventions. This conception had been most popular in France and it is no surprise that a French economist seems to be the only one who mentioned it without rejecting it. This is what Leon Walras had to say on this point:

> Our analysis shows that monopoly is opposed to the best interests of society and that the intervention of the state is founded upon the interest of society. But, firstly, interest ought to give way to right, and, secondly, a greater interest ought to give way to a lesser one. One can imagine a case where a private monopoly would be right, if for example the manufacturer of our product were an inventor with complete control of his secret asking neither help nor support

[134] John Prince-Smith, op. cit., supra, note 123, p. 160.

[135] According to a modern view, not found in the last century, of the justification of patents in exchange for disclosure, publication at the time of the application for, or grant of, the patent would have social benefits long before the expiration of the patent: "The patent may be held invalid, opening up the invention to all who wish to use it. Aside from actual exploitation, the disclosure is useful in itself since it may stimulate others to activity in the same field." John C. Stedman, op. cit., supra, note 66, p. 666.

[136] In compiling quotations for this survey I was greatly aided by an unpublished essay by Edith T. Penrose on the Discussion of Patents in Economic Doctrine, prepared in 1943.

monopoly is of limited duration in order that (ultimately) society may succeed to the unlimited enjoyment of the invention. His invention is the successful outgrowth of a rivalry with others who were experimenting in the same direction as he. Social currents have carried him to his goal. Therefore, after a suitable period of grace, his achievement is once more thrown into the arena of free competition.[144]

Sometimes the monopoly character of patents is stressed without immediate declaration of its social propriety. Thus Lionel Robbins comments:

> The influence of tariffs in fostering monopoly is well known. Much less well known but not commensurately less important is the influence of patents. It is probable that even professional economists have greatly underestimated this factor. Yet a patent is an obvious monopoly; the patentee has exclusive rights and, where patented processes are involved, conditions are necessarily monopolistic. This influence has many ramifications * * *[145]

Robbins rejects the notion that the monopoly conferred by patents for inventions is something categorically different from all other kinds of monopoly. While he brackets patent protection with tariff protection, Sir Sidney J. Chapman brackets it with "trading or industrial privileges" which—

> have been conferred on certain persons with the object of promoting particular businesses, or for other reasons. Protection of this type frequently leaves the State with an awkward problem of control to solve.[146]

And Irving Fisher states that—

> The rise of trusts, pools, and rate agreements is largely due to the necessity of protection from competition, precisely analogous to the protection given by patents and copyrights.[147]

When they discuss the limited duration of the patent monopoly, not all economists think of the fixed term of the patent grant; some think rather of the development of substitute processes or substitute products which are going to supersede the protected ones. Simon N. Patten wrote:

> The gains of monopoly are temporary, due to sudden increases in productive power. But each generation will see its sphere reduced, for the power of substitution constantly works against monopolies, as it works adversely to rent, profits, and interest.[148]

For Joseph A. Schumpeter this kind of competition, by which new firms destroy existing ones, and new products replace accepted ones, is "the essential fact about capitalism." He belittles "the traditional conception of the modus operandi of competition"—centered around price competition, quality competition, and sales effort—because what counts is "the competition from the new commodity, the new technology, the new source of supply, the new type of organization," or what he calls "the process of creative destruction."[149] In "the conditions of the perennial gale," restrictions of competition as provided by patents, "monopolistic practices" or "restraints of trade of the cartel type" are merely "unavoidable incidents of a long-run process of expansion which they protect rather than impede."[150]

[144] Friedrich von Wieser, Social Economics (1927), p. 223. (First published in 1914.) Wieser goes on to say that the "grant is made on one condition, that the invention be put into actual use," a condition stipulated in several patent laws, but not in the United States.
[145] Lionel Robbins, The Economic Basis of Class Conflict (1939), p. 73.
[146] Sir Sidney J. Chapman, Outlines of Political Economy (London, 1911), pp. 353-354.
[147] Irving Fisher, Elementary Principles of Economics (1912), p. 331.
[148] Simon N. Patten, Essays in Economic Theory (Tugwell ed., 1924), p. 255.
[149] Joseph A. Schumpeter, Capitalism, Socialism, and Democracy (1942), pp. 83-84.
[150] Id., pp. 87-91.

a remark of Alfred Marshall (though it relates to a highly hypothetical, nonoperational principle):

> If it were possible to adapt the duration of each patent grant to its peculiar conditions, the public interest would call for a specially long period for patents relating to processes to which the law of increasing return applies strongly, but in which its effects are slowly developed.[165]

In other places Marshall had proposed that industries operating under "increasing returns" be given "bounties" (government subsidies) in order to induce them to expand faster than they would otherwise, and thus to realize greater economies of scale.

Either subsidies or extended patent terms are proposed by Corwin Edwards to take care of extraordinarily high development costs:

> Subsidies might be granted to help cover development expenses, either directly or by appropriate reductions in taxes. Where development expenses are heavy, the duration of patents might be extended.[166]

But for the general case Edwards does not think that the period of patent protection is too short. On the contrary, he holds that the enormously enlarged scale of patent holdings—the accumulation of patents—has made the present time limitation largely ineffective:

> The change of scale in acquiring and using patents has also destroyed the effectiveness of the time limitations which are attached to patent grants. Where technology progresses slowly and enterprises are small and patents are diffused, it is reasonable to suppose that there will be active competition in using technological devices upon which patents have already expired. Under modern conditions this often fails to take place. A concern that bases its business strategy upon patents is constantly engaged in applying for or purchasing new patent rights as its old ones expire. It attempts to avoid a situation in which it no longer enjoys patent protection * * *. Since technology is dynamic, the patentee is likely to acquire important new patents within the 17-year period and to use these to perpetuate its exclusive position or the limitations upon its competitors * * *. True, cases are on record in which the basic patents of an industry have expired and patent control has been broken; and there are other instances in which important new patents have been developed by concerns other than those that held the old ones, so that patent control has passed from one enterprise to another. Equally striking, however, are cases in which one enterprise has held control through patents for periods as long as half a century.[167]

Patent protection for such lengths of time finds no defenders in modern literature—the advocacy of perpetual patent rights having disappeared together with the belief in "natural property rights in ideas," of which it had been the logical derivate. Those who advance various economic justifications for patent protection have the traditional terms—between 14 and 20 years—in mind, even if they fail to say why this should be the right duration. Perhaps the "exchange-for-secrets" thesis comes closest to an implicit endorsement of a particular period of protection—on the basis of some sort of average length of time in which technological secrets could be detected and put to use by competing producers. Thus, Leon Walras held that if an inventor who was not sure he could guard his secret demanded—

> the protection of the state in the exploitation of his monopoly for a specified time on condition that, when the time was up, he would give the invention to the public, it could be in the interest of society to conclude such an agreement. In effect, it might be better for the consumer to have the product immediately, and reward the inventor with a monopoly for a few years than to await the discovery of his secret by some happy accident.[168]

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[165] Alfred Marshall, op. cit., supra, note 152, p. 407.
[166] Corwin D. Edwards, Maintaining Competition: Requisites of a Governmental Policy (1949), pp. 247-48.
[167] Id., p. 225.
[168] Leon Walras, op. cit., supra, note 137, p. 202.

Concerning the diversion from nonpatentable inventions to inventions "covered by the patent law," Plant first observes that—

A very great deal of invention goes on outside its range, without any inducement beyond that provided by the operations of the open market.[186]

But the diversion toward patentable inventions is unquestionably significant; and—

How can it be shown that the "patentable" class of innovations possesses so much greater usefulness than all these others that it should be specially encouraged by monopoly? [187]

According to Plant, it cannot be shown:

The existence of a monopoly, in fact, operates to divert the attention of inventors from what may well be the most fruitful field for further innovation. In the case of inventions which cannot be patented, a particularly useful device at once attracts the attention of other specialists who seek, maybe competitively, to refine and improve it and to adapt it to the widest possible use. The blocking effects of patent monopolies check these surely beneficial tendencies; competitors, instead of helping to improve the best, are compelled in self-preservation to apply themselves to the devising of alternatives which, though possibly inferior, will circumvent the patent. It is a particular case, but one which is very widespread, of the maldistribution of resources which is consequent upon the existence of monopoly.[188]

Many of the old arguments for or against the thesis that the patent system effectively stimulates inventive activity have become obsolete by the shift that has taken place, in the last half century or more, from individual enterprise to corporate enterprise and from individual inventors to collective invention by research teams employed by business corporations. A good many old arguments referred to the encouragements which the patent system supposedly holds out for the self-employed inventor and the leisure-time inventor, who would either turn entrepreneur in order to exploit his success commercially or would sell his patents to an entrepreneur. These arguments do not fit well the case, more typical today, of the employed inventor, the employee on the research and development staff of a large corporation. Thus, Alfred E. Kahn writes:

The transformation of technology and of economic society during the last century negates completely the patent law assumption as to the nature of the inventive process. The systematic, planned experimentation which characterizes modern technological method, swifter and surer than the old, has enhanced the interdependent, cooperative nature of invention. Technology has become so vast and so complex that the individual is more than ever dwarfed in relation to it. Invention has in addition become much more consciously cooperative. In the great modern research laboratories, tens, hundreds of men focus upon single, often minute, problems. With scientific organizations thus systematically mulling over all the known problems, inventions become increasingly inevitable. It becomes more than ever impossible to isolate any one contribution as the invention or any one man as sole inventor and rightful patentee.

This means, further, that invention today requires more than sound mechanical sense and a tool shop. It requires thorough specialized technical training and costly equipment. Barbers, ministers, art students (Arkwright, Cartwright, Fulton) can no longer be counted upon to give the world its great inventions. Nor is the garret any longer an adequate laboratory. Hence inventors are for the most part trained salaried professionals, hired to learn and to work in the great laboratories provided by those who can afford them. Patents are automatically assigned to the corporation which pays the salaries and provides the facilities. Because it takes the risks, the business takes the speculative reward. Because invention is consciously cooperative, the individual inventor cannot

[186] Id., p. 45.
[187] Ibid.
[188] Id., p. 46.

The problem is whether the expected headstart is long enough or too short to promise recovery of development costs. Without patents, inventors and innovators would be, according to Ludwig von Mises—

> in the position of an entrepreneur. They have a temporary advantage as against other people. As they start sooner in utilizing their invention * * * themselves or in making it available for use to other people (manufacturers * * *), they have the chance to earn profit in the time interval until everybody can likewise utilize it.[200]

But the headstart might be too short for most inventions. Hence—

> it is very probable that technological progress would be seriously retarded if for the inventor and for those who defray the expenses incurred by his experimentation, the results obtained were nothing but external economies.[201]

By "external economies" Mises means the economies and advantages accruing to others rather than to the innovators themselves.

Joseph Schumpeter, similarly, holds that—

> the introduction of new methods of production and new commodities is hardly conceivable with perfect—and perfectly prompt—competition from the start * * *. As a matter of fact, perfect competition is and always has been temporarily suspended whenever anything new is being introduced—automatically or by measures devised for the purpose—even in otherwise perfectly competitive conditions.[202]

Whether the "automatic" delay in the appearance of competitors is too brief for comfort and, in the interest of progress, should be supplemented by "measures devised for the purpose," such as the grant of patent monopolies, is the essential question. It brings us back to the issue of the "optimum" period of delay in the imitation of novel techniques—the issue economists have failed to examine. Needless to say, there will always be the possibility of very expensive developments that cannot be profitable even if a 30- or 50-year monopoly grant were promised; on the other hand, there will be innovations that can pay for themselves in less than a year; and there will be a spectrum of possibilities between these extremes. To try to encourage the most expensive innovations by promising very long patent monopolies for all innovations would involve an indefensibly high social cost. What general principles can be developed to shed light on the issue?

Since the relevant period of profitable exploitation of an innovation is a conjecture about the future—no matter whether the anticipation rests on the natural headstart or on the term of a patent grant or on the interval before the emergence of a substitute invention—what counts most in this respect is whether entrepreneurs, by and large, are optimistic or pessimistic. Fritz Machlup—the author of the present study—has written in an earlier book:

> For the pessimistic monopolist we can plausibly generalize that open avenues of technological advance will remain untried. Investment in industrial research, development and innovation will not appear promising in view of the supposedly imminent advent of competition. Inventions will be suppressed if the time for the amortization of the required new investments seems too short.
>
> * * * we may point to the possibility of the opposite error, the overoptimistic entrepreneur who underestimates the actual degree of pliopoly [i. e., newcomers' competition] and overestimates the safe period. He need not be an actual monopolist, nor even imagine that he is one; it suffices that he believes it will take his competitors—imitators or makers of substitutes—longer than it actually does to start competing with him. This optimism is the best promotor of technical progress. Progress calls for both innovation and imitation. If firms anticipate rapid imitation, they will not risk expensive innovations. But if imitation is

[200] Ludwig von Mises, op. cit., supra, note 138, p. 657.
[201] Id., p. 658.
[202] Joseph A. Schumpeter, op. cit., supra, note 149, p. 105.

Arthur R. Burns finds that patent protection works in general "only for large and well-financed corporations".[209] Frank Graham complains that "large corporations * * * tend to engross inventions and to retard their appearance."[210] Corwin Edwards describes how "patent control ceases to be typically the monopolization of a particular advantage in product and in industrial process" and "comes to be substantially monopolization of the industry itself."[211]

The charge of suppression of patents has been angrily rejected and persistently repeated. Michael Polanyi calls it a "fable"[212] and Ludwig von Mises regards it as unsupported and unrealistic.[213] Alfred Kahn believes that evidence of patent suppression has been presented,[214] and Floyd Vaughan cites cases of what he considers proved suppression.[215] Corwin Edwards discusses existing and proposed remedies for whatever suppression there may occur.[216] Arthur R. Burns examines the circumstances under which suppression is apt to occur[217] and John Maurice Clark does likewise in an analysis which should command the respect of experts on both sides of the issue:

> * * * there is still a suspicion that patents are bought for the purpose of putting them to sleep. Here, assuming the fact for purposes of analysis, we have overhead costs behaving strangely. A capital outlay is incurred, not to secure the aid of an instrument of production but to prevent it from being used, and from depreciating the value of existing processes by its competition. The act is essentially monopolistic, in that it involves control over the level of efficiency in the independent and supposedly competitive field of production.
>
> Would a concern ever put to sleep a patent on a more efficient process than the one the concern was using? Presumably not, if (1) the efficiency of the new process were known with absolute accuracy, and (2) the saving were enough to pay a fair return on the capital sacrifice involved in replacing existing equipment before its natural time. However, both these conditions offer a deal of latitude and uncertainty. Within this uncertain margin, the tendency of a secure monopoly is toward the conservative course, giving existing methods the benefit of the doubt, while that of the competing concern is toward taking some chances, since a standpat attitude is the most dangerous one a competing concern can follow. A monopoly owning a patent which is on the doubtful margin is very likely to let it slumber, though it might give a substantial sum to prevent someone else from developing it. Even a patent known to be inferior may be worth buying and putting to sleep, if it is better than the run of processes used by competitors.[218]

The charge of suppression of patented inventions is in a sense offset by the countervailing charge against the patent system, advanced by Sir Arnold Plant, that it contributes to an "increasingly rapid rate of obsolescence of industrial equipment."[219] Since avoidance of excessive obsolescence is the only plausible motive for the

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[209] Arthur R. Burns, op. cit., supra, note 156, p. 17.

[210] Frank D. Graham, Social Goals and Economic Institutions (Princeton: 1942), p. 211.

[211] Corwin D. Edwards, op. cit., supra, note 166, p. 224. Edwards presents a very instructive explanation of the effects of large accumulations of patents on the undisturbed validity of "weak patents," which in weaker hands would be invalidated in the courts.

[212] "The widespread allegations by popular writers that many important inventions are being left unexploited under capitalism may be counted among the fables of our all too credulous times. In 25 years of industrial experience I have not come across a single case of the alleged kind." Michael Polanyi, op. cit., supra, note 27, p. 70.

[213] "It would be more realistic to blame capitalism for its propensity to overvalue useless innovations than for its alleged suppression of useful innovation * * * Those alleging suppression of useful innovations do not cite a single instance of such an innovation's being unused in the countries protecting it by a patent while it is used by the Soviets—no respectors of patent privileges." Ludwig von Mises, op. cit., supra, note 138, p. 509.

[214] Alfred E. Kahn, op. cit., supra, note 159, p. 483.

[215] "The effect of suppression is generally harmful in that it hinders invention or restrains competition or both. Such suppression, like anything else which involves human intentions and speculation about possible results, is difficult to prove or disprove. Nevertheless, it exists according to the evidence available * * *." Floyd L. Vaughan, The United States Patent System (1956), p. 227. Vaughan then proceeds to examine the evidence with great care. Id., pp. 227-260.

[216] Corwin D. Edwards, op. cit., supra, note 166, pp. 238-241.

[217] He concludes: "Thus a law intended to encourage the improvement of methods of production is interpreted so as to permit the obstruction of the utilization of new knowledge in order to protect those who have committed themselves to methods now obsolete." Arthur R. Burns, op. cit., supra, note 156, p. 16.

[218] John Maurice Clark, Studies in the Economics of Overhead Costs (1923), p. 145.

[219] Arnold Plant, op. cit., supra, note 163, p. 51.

patents often preamble their apprehensions about the consequences of patent protection in our time with affirmations of faith in the achievements of the past:

> That the patent system established a century ago was designed to, and did measurably, serve both as a stimulus to invention and as a spur to enterprise, there appears little doubt. The question may well be raised, however, whether the changes which have taken place in our economic life—notably, in this instance, in the growth of capital concentration, and the increasing importance of institutional research in the development of inventions—require that adjustments be made in our fundamental attitude toward patent protection, or any specific phase of it, if the greatest gains are to be achieved.[224]

It is worth noting that some of the patent abolitionists of the 19th century prefaced their arguments with similar polite bows to the past,[225] although in the intellectual climate of the patent controversy of that time it was probably easier for an economist to oppose than to defend the patent system.

The most outspoken critic of the patent system in modern times has been Sir Arnold Plant. At one point in his argument he refers to "exceptional cases" in which "special inducements" would be necessary to secure funds for "prolonged research and experiment" on specified, socially desirable inventions. He continues:

> A patent system applicable to inventions in general clearly cannot be justified, however, by exceptional circumstances of this kind. Economics, in short, has not yet evolved any apparatus of analysis which would enable us to pronounce upon the relative productivity of this particular infant industry—the production of inventions; nor does it provide any criteria for the approval of this method of special encouragement.[226]

After examining the case for general compulsory licensing as a reform designed to facilitate "the operation of competitive forces" within the patent system, Plant concludes:

> Expedients such as licenses of right, nevertheless, cannot repair the lack of theoretical principle behind the whole patent system. They can only serve to confine the evils of monopoly within the limits contemplated by the legislators; and, as I have endeavoured to show, the science of economics, as it stands today, furnishes no basis of justification for this enormous experiment in the encouragement of a particular activity by enabling monopolistic price control.[227]

John Jewkes, in a book published in 1958, pays his respect to Plant's "classic" study, which he recommends as "the departure point for any modern study of the patent system." [227a] Jewkes, who presents much evidence indicating the continued importance of the individual inventor, holds that—

> So long as the survival of the individual inventor is not utterly despaired of * * * and so long as nothing better can be suggested for the purpose, there is a very strong case for the retention of the patent system." [227b]

But Jewkes is far from eulogizing the system. This is what he has to say about it:

> It is easy enough to perceive the weaknesses, even the absurdities, of the patent system and the reasons why conflicting opinions as to its value are to be found. Its very principles are paradoxical. It is meant to encourage over the long period the widest possible use of knowledge, but it starts out by conferring upon the

[224] Leverett S. Lyon, Myron W. Watkins, and Victor Abramson, op. cit., supra, note 175, p. 151.
[225] See the statements by R. A. Macfie, Sir Roundell Palmer, and Hermann Rentzsch, cited in note 252, infra.
[226] Arnold Plant, op. cit, supra, note 163, p. 43.
[227] Id., p. 51.
[227a] John Jewkes, David Sawers, and Richard Stillerman, The Sources of Invention (London: 1958), p. 254.
[227b] Id., p. 251.

This is but one of the fundamental conflicts in the economics of the patent system. There is another, which is quite independent of any profits collected by the patent owners and of any monopolistic restrictions imposed on production. This second basic problem relates to the overall allocation of productive resources in a developing economy, and to the question whether at any one time the allocation to industrial research and development is deficient, excessive, or just right.

It is easy to conceive of the possibility that such allocation is too meager. But can there ever be too much? Is not more research and development always better than less? Is it possible that too much is devoted to the inventive effort of the Nation? This depends on what it is that is curtailed when inventive activity is expanded. More of one thing must mean less of another, and the question is, what it is of which there will be less. The best of the possibilities would be that there will be less "involuntary leisure"; that there have been unemployed talents waiting to be used, anxious to give up the leisure that had been imposed on them. This possibility, however, must be written off as an illusion if we are engaged in serious economic analysis. "Depression economics," based on the assumption of pools of unemployed resources ready to be put to work, has its uses, but only for what has been called an "upside-down economy." [228] Economic theory and economic policy for the "upside-up economy" would be badly vitiated by an assumption of ever-ready pools of productive resources that can be drawn upon at any time, to any extent, for any use.

The next best possibility would be that "voluntary leisure" is given up; that qualified people are ready, with some inducements, to devote more time to inventive activity, not at the expense of any other productive activity, but at the expense of some of their leisure time. Persons with a bent for tinkering and inventing, busy with other jobs during their regular hours, may be glad to use their free evenings and weekends for inventive activity. Others, employed in research and development, may be willing to work overtime. This second pool of potential resources may be of great importance for the implementation of "crash programs" of research and development in a national emergency. But long-run programs, not directed toward specific goals (like winning a war or an international race for a particular technical feat), but designed for "progress in general," cannot successfully be based on the continuous and continual supply of overtime labor. The other source of volunteer labor—the free time of amateur researchers and tinkerers—can probably be drawn upon regularly. (To have mobilized these "individual inventors" is perhaps one of the achievements of the patent system in times past.) But this is a very limited source of supply, perhaps already fully utilized; in addition, the role of the "evening-and-Sunday inventors" has become quite insignificant in our age of organized research and development. Thus, the possible sacrifice of leisure cannot be counted on to provide the labor for additional inventive activity.

[228] This colorful expression was used by Abba P. Lerner, Economics of Employment (1951), pp. 141–150. An "upside-down economy" is characterized by unemployment of all the productive resources that would be needed to produce increased amounts of goods and services. "Topsy-turvy economics is appropriate for an upside-down economy" (id., p. 142). It is upside down because such an economy would not be benefited by the things which contribute to the welfare of a normal economy, namely, economy, efficiency, and thrift, but, rather, by their opposites, wastefulness, inefficiency, and prodigality (id., p. 146). The prescription for upside-down economics is to print money and spend it. But when this prescription cannot lift the economy beyond a certain level of employment and activity, this level should be regarded as normal, and topsy-turvy economics should be shelved in favor of "ordinary economics," "concerned with the economical use" of scarce resources.

tive rather than absolute magnitudes: consumption can still increase absolutely, thanks to accumulation from preceding periods, even when productive resources are shifted to the production of equipment and knowledge. What happens there is that of the potential increase in the output of consumers goods a large part is "seized" when the consumption sector must give up resources to the other sectors. But that the expansion in one sector encroaches on the others is sometimes forgotten with a vengeance: the drive to increase at the same time investment and consumption, by more than the "inherited" increase in productivity would permit, shows up in inflation, which makes increased money outlays buy smaller quantities of real goods. Pushing forward more vigorously on one of the three fronts may force a pullback on one or both of the others.

Increased research and development in order to increase the stock of knowledge is a splendid thing for society; so is increased production of productive equipment; and both are valued so highly because they eventually allow increased consumption. Yet, these three—more research, more equipment, more consumption—are alternatives in the sense that, even though all three can increase when productivity increases, a greater increase of one means smaller increases of the others. At any one moment, an increase in the production of knowledge means less equipment and/or less consumption than might otherwise be available. A choice by society to increase research and teaching implies a choice, though usually unconscious, to have in the next years less productive equipment or less consumption, or less of both, than they might have had. Should a relative cut-back of consumption prove impracticable, the choice is between "knowledge" and "equipment."

As a matter of fact, things are much more complicated than this simple set of alternatives may suggest. Capital equipment is produced, it was said above, partly to maintain the stock and partly to increase it. One might conclude, as the statistician does, that "net investment" is simply the excess of total production of capital goods over depreciation, over the used-up part of the stock. But it is possible to increase the production of one kind of equipment and neglect the replacement of another. For example, one may push the production of hydroelectric and atomic powerplants and neglect the maintenance of the highways and of the roadbeds and rolling stock of the railways. On balance, there might still be "net investment" or "accumulation of capital," and yet the failure to replace transport facilities may one day cause so serious a bottleneck that total production may fall catastrophically. (In a competitive free-enterprise economy the danger of such an occurrence, in this writer's opinion, is minimal, but it may be very real in a war economy or in a centrally directed economy.)

The same difficulty may exist in the production of knowledge. The acquisition of new knowledge and the teaching of established knowledge to the young may be in competition with each other, especially if the teaching profession serves as a recruitment pool for industrial research personnel. One may regard education and training as the "replacement" part of the production of knowledge; and it is possible for industry, by providing more attractive job opportunities (not just for research and development, but for all sorts of occupations), to drain schools of the teachers needed for the instruction of the new

should be clear that there can be too much promotion as well as too little promotion of inventive activity.

Any particular distribution of resources may be less than the best; one can never be sure. Now if, thanks to the Nation's thrift, additional resources become available—i. e., are released from the production of consumption goods—where should they be put to work, in education, or industrial research, or capital equipment? To make more equipment is usually safe; one can know what contribution it should make to total product. To improve education may yield nothing but cultural values or, on the other hand, may result in a large increase in productivity and thus greatly contribute to an increase in material welfare. To undertake more industrial research may prove the most productive of all, though it will to some extent be a gamble since one does not know what will come out of it. Perhaps the mathematical theory of games can yield a solution.

No evidence has yet been presented to show that at a particular time industrial research and development is likely to pay off better for society as a whole than an improvement of education or an increase in the stock of capital goods would. If one puts education, training, research, and development all into one category, and sets it against investment in industrial plant and equipment, then one might possibly find some evidence for the contention that—in certain countries and over certain periods of time—the investment in knowledge has contributed more per dollar to the increase in labor productivity than the investment in physical industrial facilities. The bracketing of research with education seems necessary for several reasons; for example, the researchers and developers must previously have been educated and trained, and the utilization of new technical knowledge often requires degrees of dissemination and comprehension that cannot be attained without broad and general education.

If it should be possible to find statistical criteria for the identification of the contributions which "investment in knowledge" and investment in physical facilities have made to the increase in productivity, and thereby to obtain evidence for claiming "major credit" for the former—one would have to guard against the mistakes of regarding these findings as pertinent for other places, other times, and other allocations of resources. Particularly one would have to guard against the fallacy of confusing "total utility" and "average utility" with "incremental (marginal) utility." It is perfectly possible for research and education to deserve first prize in the distribution of merits for economic growth, and nevertheless not to deserve first claim on additional resources.[229]

If education, industrial research, capital goods production, and consumers goods production are considered as alternative uses of productive resources, this implies that resources are transferable. Does this mean that the same persons can engage in chemical research, in industrial toolmaking, and in shoe manufacturing? Such a narrow meaning of "transferable resources" is neither contemplated nor indicated. There may be administrative talents that can be

[229] If annual expenditures for education, research, and development were $25 billion, and annual net investment in physical capital were $20 billion, it would be conceivable (*a*) that the former contributed as a whole more than the latter to the economic growth of the Nation; (*b*) that the former contributed also more per dollar spent; and yet (*c*) that the last billion spent on the former contributed less than the last billion spent on the latter, or, in other words, that the Nation might be better off if 1 billion were added to physical investment at the expense of education, research and development. This is said here only to expound a principle, not to judge the present situation in the United States. (As a matter of fact, this writer's hunch points in the opposite direction, perhaps because he is himself engaged in research and education.)

had to forego their "natural privilege of labor" and were barred from using their own inventions.[230] The fact that there was competition in making new inventions was found to be healthy. But that he who lost the race to the patent office should be barred from using his own invention, and should have to search for a substitute invention, was found to be absurd.

What may appear absurd to a disinterested observer, or unjust and unfair to one who lost the right to use the fruit of his own labor and investment, must to an economist appear as sheer economic waste. Of course, one may regard this as an incidental expense of an otherwise beneficial institution, an unfortunate byproduct, an item of social cost, which, perhaps, is unavoidable and must be tolerated in view of the social advantages of the system as a whole. However, from merely defending the need of "inventing around a patent" as a minor item of waste, the discussion has recently proceeded to eulogize it as one of the advantages of the system,[231] indeed as one of its "justifications." [232]

The advantage is seen in the additional "encouragement" to research. If the competitors were given licences under the patent of the firm that won the race, they would have to pay royalties but would not be compelled to "invent around" it. Exclusivity, however, forces some of them to search for a "substitute invention." But why should this be regarded as an advantage? [233] The idea is probably that, if industrial research is desirable, more research is more desirable, and that it does not matter what kind of knowledge the research effort is supposed to yield. From an economic point of view, research is costly since it absorbs particularly scarce resources which could produce other valuable things. The production of the knowledge of how to do in a somewhat different way what we have already learned to do in a satisfactory way would hardly be given highest priority in a rational allocation of resources.

This same, or a still lower, evaluation must be accorded to the third form of "competitive research"—inventive effort for the purpose of obtaining patents on all possible alternatives of an existing patented invention just in order to "block" a rival from "inventing around" that patent. In this case inventive talent is wasted on a project which, even (or especially) if it succeeds exactly in achieving its objective, cannot possibly be as valuable as would be other tasks to which the talent might be assigned. When thousands of potential inventions are waiting to be made—inventions which might be of great benefit to society—how can one seriously justify the assignment of a research force to search for inventions that are not intended for use at all—but merely for satisfying a dog-in-a-manger ambition?

There is, however, another "justification" for this kind of "competitive research": it can be summarized in the colorful word "serendipity." This means "the faculty of making happy and unexpected

[230] Rev. J. E. T. Rogers, op. cit., supra, note 111, p. 125. Similarly, Robert Andrew Macfie, The Patent Question under Free Trade (London: 2d edition, 1864), p. 8; and several others.

[231] Statement by William H. Davis, Hearings before the Special Committee on Atomic Energy on S. 1717, 79th Cong., 2d sess., pt. I (1946), pp. 61–62.

[232] John C. Stedman, op. cit., supra, note 66, p. 675.

[233] "* * * exclusiveness may encourage research by compelling individuals to 'invent around' patents. Whether this *advantage* is sufficiently important to offset the substantial disadvantages that arise from denying others the opportunity to use an invention, even though they are willing to pay a toll for the privilege of doing so, is far from certain." John C. Stedman, op. cit., supra, note 66, p. 662. (Italic supplied.

now secret information; actual patenting practice, however, implies that others may be ready any minute to put the same information to work. Is the conviction that valuable technical information might remain secret for years, if not forever, fully consistent with the attorney's advice to his clients that they rush to the Patent Office lest someone else with the same idea beat them to it? If several inventors actually come up with the same idea, is it likely to be one that anybody could have kept secret? And is not society likely to lose, then, by restricting the use of such an idea for several years?

The contention that the first inventor has by "natural law" a "property right" in his invention does not go well with the provision (also enunciated in the French law of 1791) that whoever introduces a foreign invention should have the same rights as if he were the inventor. Nor does the notion of the inventor's "natural property right" in the invention—not to be confused with the property right in the patent—go well with the accepted principles that certain kinds of invention are not patentable, that all patents should expire within 14 or 17 years, and that they may be revoked earlier or licensed to others in case of an "abuse of the monopoly," for instance, through nonworking or insufficient use of the invention. A "natural property right" is just the opposite of a "limited, conditional, and revocable monopoly grant."

The problem of what are "natural rights," or rights under natural law, is one of legal and political philosophy, and controversies about it are usually moot. But the assertion that the recognition of anybody's exclusive rights in an invention, or in its commercial use, "takes nothing away from the public" is a fallacy which can be rebutted, and has been for centuries. The various "freedoms" or "rights" which individuals would enjoy if no exclusive rights were granted to patentees have often been listed.[236] In particular, those who independently develop the technological ideas already patented by someone else are barred from using the fruits of their own labor, and those who would have freely imitated these inventions are deprived of the right to imitate—which some regard as a "right" not less "natural" than any other. The suppression or restriction of these and other rights may be in the public interest, and one might perhaps say that patents take "little" from the public compared with the benefits that accrue to it. But to contend that they take "nothing" is simply wrong.

The meaning and object of "property" and "property rights" are shrouded by confusions, which, however, are more troublesome to lawyers than to economists. But it is almost embarrassing how often the controversial idea of a property right in an *invention* is confused with the noncontroversial idea of a property right in a *patent*.

A confusion which might encumber economic analysis if it were widespread is that between "property" and "monopoly." There is the idea that "property" and "monopoly" are one and the same thing from the economic point of view, and that the "owner" of an invention has a monopoly of its use just as the owner of a house has a "monopoly" of the use of the house.[237] This idea runs counter to the fact that anyone who builds a house exactly like one built earlier

[236] See, for example, William C. Robinson, The Law of Patents for Useful Inventions (1890), vol. I, pp. 40–49.

[237] The list of writers who have fallen victim to this confusion is long and distinguished; among the celebrities which it includes are an emperor of a great nation, a statesman of a great republic, and a dean of a great law school.

no social asset [240] and, again, somebody's right to keep others from using his invention should not be confused with the invention itself. To confuse an important invention with the patent that excludes people from using it is like confusing an important bridge with the tollgates that close it to many who might want to use it. No statistics of national wealth would ever include (domestic) "patent property." And the "destruction of patent property"—though it may affect the future performance of the economy—would leave the Nation's wealth, as it is now understood in social accounting, unimpaired. (An exception must be noted concerning foreign patent rights. One may regard domestic holdings of foreign patents as claims to future royalties and profits earned abroad and, hence, as assets; of course, foreign holdings of domestic patents, establishing foreign rights to future royalties and profits earned here, would then have to be counted among the liabilities and, therefore, as deductions from national wealth.)

The idea that social benefits may be derived from the operation of the patent system misleads many into assuming, without further argument, that social benefits can be derived from existing patents. If one accepts the theory that patent protection has the social function of serving as an incentive for inventive activity, one accepts, by implication, that the beneficial effects of this incentive system must flow, not from existing patents, but from the hope for future profits from future patents; this hope may induce people to undertake certain risky investments and useful activities—to wit, financing and arranging industrial research—which they might not undertake otherwise. Existing patents, on the other hand, restrict the use of inventions already known, and thus they reduce temporarily the full contribution these inventions could make to national output. These restrictions are neither "odious" nor unlawful, nor contrary to public policy; they are "necessary" if any profit is to be derived from the patents. But they are still restrictions, keeping output smaller than it might be otherwise. Consequently, existing patents impose a burden on society, a burden which it has decided to carry in order to hold out to people the chance of obtaining future profits from future patents on future inventions.[241] That existing patents are a social cost, not a social benefit, is most readily appreciated when the patented invention is of such extraordinary importance that society would not tolerate even a temporary restriction in its use. The great inventor of the polio vaccine, Dr. Salk, generously contributed his idea to society without applying for a patent. If he had taken a patent on his process and sold it to a company which exploited it restrictively enough to make high profits,[241a] would the American public have stood for it?

The preceding considerations concerning the social benefits derived from patents concerned the theory that the patent system is designed

[240] This does not mean that the enforcement of contracts, law, and order is not a great social benefit. But, it will be understood, an individual's right to police protection against assault and robbery cannot be regarded as an asset in national-wealth statistics.

[241] If society were to repudiate all existing patents, or to preclude their profitable exploitation, inventors and investors would lose confidence in any promises of the Government concerning its future performance under the patent system. Society honors its past promises, which is burdensome, in order to induce people to do what it regards as beneficial. Some people find it difficult to distingush between sacrifice and benefit when the former is a condition of attaining the latter. We need only imagine that the sacrifice may be "in vain" or that the benefit may be had "for free"—and we can readily see the logical difference between the negative and the positive items in the mental balance sheet.

[241a] This rhetorical question has been partly answered by an antitrust suit, brought after this study was completed, in which the companies producing the vaccine were charged with unlawful pricing practices.

terms just mentioned. (Economic theorists are invited to skip this section.)

There are no difficulties concerning "private cost" and "private value." Private costs are the money expenses which a producer has to incur in the production of his output. The amount by which his total private cost would be increased or reduced if output were slightly increased or reduced is referred to as "private marginal cost." Private value (or "revenue" or "revenue product") is the producer's total of money receipts from the sale of his output; that is, his sales proceeds or, alternatively, the aggregate price, in money, which the output could fetch in the market if it were sold. The amount by which the total money value would be changed if the quantity of output sold were slightly increased or reduced is called "private marginal value" (or "marginal revenue," or "private marginal product").[244]

The concepts of social cost and social value (or social product) are more complex. Beginning with social value, we may first ask why the private value of a producer's output should not be taken as the measure for the value of this output to society. The answer is that this would be quite all right in many instances, but not always. Often, society, or some members of society, will find that they can enjoy an incidental advantage for which nothing is paid to the producer. For example, if a building company constructs an especially beautiful house on our street, it gets paid from the buyer whatever it is worth to him, but receives nothing from the rest of us whose enjoyment is distinctly increased. (The opposite may occur too: if the house is ugly, the price paid for it by the buyer does not reflect the displeasure caused to the rest of us. This, however, is usually expressed by saying that the builder's private cost does not fully reflect the social cost, the latter including the discomfort suffered by those who have to stand the ugly sight.)

Thus, if the price received by a producer reflects only the value to the buyer, but not any incidental benefits to others (which do not have to be paid for), the social value (social product) will exceed the private value (product). Such discrepancies will occur generally when producers must lower their prices to all customers in order to find buyers for a slightly increased output. Total sales proceeds in such a case may rise very little, or may even fall; that is, private marginal value (private marginal product) may be very small or negative, whereas social marginal value (social marginal product) may be high.[245]

Private cost and social cost will differ when the producer's money expenses do not reflect the displeasures or sacrifices caused to others. If, as he increases his output, a producer employs a larger number of skilled workers and, in order to attract them, had to raise the rate of pay, his private marginal cost will include both the wages paid to the

[244] The terminology is not uniform, but economic theorists have no trouble with the slight variations in terms. Most of them use the term "marginal revenue" to refer to the change in total sales receipts due to a small change in the quantity of product sold, and the terms "marginal revenue product" or "marginal value product" (or simply "marginal product") to refer to the change in total sales receipts due to that change in the quantity of product sold which results from a small change in the input of some factor of production. The most widely used expression for comparisons between private and social values is "private marginal product." See, for example, A. C. Pigou, quoted supra, p. 40.

[245] Assume, for example, that a producer has been selling 2,000 units per day at $1 each, but after increasing his output to 2,100 units he can dispose of it only by lowering his price to $0.90. Total sales receipts for the increased physical product is only $1,890, or $110 less than for the smaller product. "Private marginal value product" is minus $110. The buyers, however, get increased satisfaction, though they pay less for it: they obtain "unpaid satisfaction."

produced with it, there will be all sorts of variable costs incurred in their production—for labor, for materials, for wear and tear of machines—but not another cent for the original invention. Thus, there will be no element of the cost of the invention contained in the marginal cost of producing the goods; that is, to repeat, the marginal cost of using the invention is zero, socially as well as private. If the invention is used competitively—by anybody who cares to, and without restraint or payment—the quantity of goods produced will be so large that the price at which they are sold will cover no more than the marginal cost; hence, the selling price will contain nothing for the use of the invention, no return on the sunk investment.

The same would happen with investments sunk in material things of unlimited durability and unlimited serviceability. Assume, despite the unrealism involved, that we were to build a bridge or a tunnel, lasting forever, requiring no maintenance, and usable for an unlimited amount of traffic. In this case, too, the marginal cost, long-run as well as short-run, private as well as social, would be zero. If the bridge or tunnel is to produce any return on the investment and is to have any private value at all, it will be necessary to restrict its use; this is actually done through the imposition of toll charges. The problem of the social waste caused by making a charge for something that can be had at zero "marginal cost" has long been discussed in welfare economics, chiefly under the heading "Marginal cost pricing."[246]

But the bridges and tunnels of the real world are not inexhaustible; they call for some maintenance, and they wear out eventually and have to be replaced. This fact changes the problem to some extent, because the long-run marginal cost of using these installations will then not be zero, even if the short-run marginal cost is.[247] (Thus, in view of the need for eventual replacement, the principle of "marginal cost pricing" may still allow some recovery of the investment cost of toll bridges and toll roads.) Inventions, on the other hand, once they have been made and developed, require no maintenance and no replacement.[248] The marginal cost of using them is zero even in the long run; and "perfectly competitive pricing" would not permit recovery of any part of the investment cost.

Competition of newcomers is never so "perfect" in actual practice as in a theoretical model designed to depict a position of "long-run equilibrium." In the real world, imitating newcomers, even if all technical knowledge were immediately available to them (and if there were no patents or any other barriers), would take some time to make plans, to start construction, to get into production, and to bring their products on the market; in the meantime the innovators would have earned some profits (in the nature of "quasi-rents"). If the "imitators" have first to find out about the newly invented techniques, the time until their competition can become effective will be even longer. If the invention is of a novel process of making a known product, competitors may not hear about it for a long time. Perhaps the only thing they notice is that one of the producers—the

[246] Harold Hotelling, "The General Welfare in Relation to Problems of Taxation and of Railway and Utility Rates", Econometrica, vol. 6 (1938), pp. 242-269; William Vickrey, "Some Objections to Marginal Cost Pricing", Journal of Political Economy, vols. XLVI (1948), pp. 218-238; Nancy Ruggles, "Recent Developments in the Theory of Marginal Cost Pricing", Review of Economic Studies, vol. XVII (1949-50), pp. 107-126.

[247] There may be a positive short-run marginal cost when the facilities get overcrowded.

[248] Inventions can of course be improved or adapted for special purposes. This will usually require additional outlays which, once they are made, become again "sunk costs."

be determined independently of the extent of use that is made of it; and the extent of use depends, among other things, on the royalty that is charged. In brief, it is not the usefulness which can determine the royalty rate; rather, the royalty rate will determine the use, and with it the usefulness, of the licensed invention, given the known substitute technologies and the demand for the product.[250]

The fuller the utilization of the invention the greater, of course, is its total usefulness to the consuming public; but the smaller also is its "marginal" usefulness. The more fully the invention is exploited, the lower will be the prices paid by the consumers for the final products. The height of the royalty rate will determine how far the producers can go in the utilization of the invention. As long as a payment for royalties can be squeezed out of the pockets of the buying public, one could go still further in satisfying its demand. Since the marginal cost of using any existing invention is zero, it follows that only when its marginal utility is zero will its total usefulness to society be maximized.[251]

Can this total social usefulness of an invention, whether it is used "fully" or "with restraint," be estimated? Certainly not by what is paid for the use of the invention. There is some possibility of estimating in money terms the social benefit rendered by a cost-saving invention. If, thanks to such an invention, fewer productive resources are needed than before to produce a given quantity of product of given quality; and if the productive resources economized by using the new process can be employed for producing either more of the same good or more of other goods, the Nation's total output will be greater. This increase in national product due to the invention can be estimated by the competitive prices of the resources economized in the production of the original output. For example, if an invention permits an annual net saving of $1 million worth of labor and material, and if there are uses for the released labor and material, one is safe in estimating that the invention has a social value of $1 million per year. There is little possibility, however, of estimating the social benefit of a quality-improving invention, and almost no possibility in the case of inventions of new products. That people are better off with the new products than they had been with what they used to buy, is generally assumed provided their choices are free. But any numerical index for translating a change in the composition of output into an increase in output would be quite arbitrary.

In any event, even if there existed ways of estimating the social value of new inventions, how is this connected with the issues with which we are dealing? Let us recall that we are not talking now about the value of patents, nor about the social value of the patent system, but rather about the *social value of inventions*. Again several different questions must here be distinguished: the social value of a particular invention; the social value of the annual crop of inventions,

[250] In this argument the royalty rate was the independent variable and the quantity produced (i. e., the degree of utilization of the invention) was the dependent variable. One can turn it around and make the quantity produced the independent variable, and the royalty rate the dependent one. This would be like asking how much the licensee could afford to pay for the permission to use the invention for a certain volume of output. There is nothing wrong with a statement that the usefulness of an invention to a licensee is reflected in the royalty rate he would be willing to pay for a fixed volume of output rather than do without a license. This would be equivalent to the statement that the usefulness of an invention to a licensee is reflected in the volume of production for which he would use it at a fixed royalty rate per unit of output. In both ways of looking at the problem the volume of output (or degree of using the invention) is crucial and must not be disregarded.

[251] Adepts of the differential calculus will easily recognize that total utility is a maximum when the first differential coefficient—marginal utility—is zero.

agrees on some system of counting, one must realize that there are highly important and altogether nugatory inventions, and that it would be silly to give them equal weight. Yet, when all this is said and done, one will still have to concede that it is not meaningless to say that some times have been more productive of new inventions than others, and that some conditions may be more conducive to inventive success than others; and what can this mean if it does not mean "more" inventions? If more people are put to work on industrial research and development, more inventions, important as well as trifling ones, will be produced. The exact meaning of the "more"—of the increment—may be in doubt. But we need not be so fussy, and may be satisfied with something less exact. Incidentally, since we are going to use the concept of the "quantity" or "amount" of invention only in a speculative analysis, we may proceed as if we were able to give an exact meaning to the concept.

The bulk of technological advances, especially the millions of small improvements in production techniques which probably account for a large part of the increases in labor productivity, have nothing to do with patent protection. This can probably be tested by examining the types of technological change made over recent years in many different industries.[253] Thus, only some part (of unknown size) of all increases in productivity is derived from patented inventions. Of these inventions, some might *never* come into being without the patent incentive; others might come *later;* and the rest might come in any case and at the *same time,* with or without patents. This means that the patent system is not to be credited with all patented technology, but only with that technology obtained "only with patents" and that obtained "earlier with patents."

Granted, that there results an increment in national product attributable to inventions that are generated, or whose application is accelerated, by the patent incentive. Against this, however, must be set the reduction in national product that is attributable to restriction in the use of those inventions which are patented but which would have appeared at the same time without patent incentive and would have been free for unrestricted use by anybody. The restrictive effects of the patent system are not confined to those immanent, or inherent, in the exercise of the patent monopoly; that is, to the relative underutilization of the patented inventions. Besides these "immanent" restrictions there may be "transcendent" restrictions associated with the increased strength of the patentees' general monopoly control in their markets.[254] Account should also be taken of possible

[253] Every plant superintendent introduces hundreds of small technical improvements every year. Most of these are quite trivial—relocating some machines; changing transmissions, conveyors, pipelines; readjusting temperature, light, pressure, rotations, water contents; using more suitable materials, fuels; avoiding waste; altering sequences of operations; rescheduling of repair and maintenance work—perhaps nowhere recorded, but they may add up to a substantial total effect upon productivity.

[254] The terms "immanent" and "transcendent" restrictions are introduced here in recognition of the prior rights which patent lawyers have in better-sounding phrases such as restrictions "inherent in the patent grant" and restrictions which are "unauthorized extensions of the monopoly" or go "beyond the scope of the patent monopoly." "Immanent" restrictions, in an economic sense, are not coextensive with "inherent" ones, and "transcendent" not with those going "beyond the scope of the monopoly grant." For example, a patentee using his control to compel his licensees-lessees to buy from him an unpatented material for use on the patented machine is illegally going beyond the scope of his patent monopoly; yet the imposed restrictions are still immanent in the exercise of his monopoly in the economic sense used here, because the (unlawful) actions restrict only the use of the patented technology (and the patentee could achieve the same effects by setting royalty rates in proportion to the amount of material used). On the other hand, the use of the general market power gained by the patentee as a result of his patent position may lead to transcendent restrictions, that is, limitations on the output of different commodities and, hence, in the use of different technologies; these restrictions could not be identified by the law as extensions of the patent monopoly. The choice of this new economic terminology, though it avoids infringement of prior rights in "words of art" used by lawyers, may involve an encroachment on the domain of Kantian philosophy—but philosophers take such matters philosophically.

activity has been pushed that far, it may mean that a further increase in the research staffs of all companies and institutes by, say, 10 percent may yield an increase in new workable inventions by only, say, 1 or 2 percent; and the increase in demand for research personnel may boost the research payroll by, say, 30 percent for an increase in the work force of only 10 percent. Thus, a relatively large outlay may be needed to produce a relatively small increase in the production of inventions. In addition, inventions are subject also to rapidly diminishing utility, because a greater volume of inventions will ordinarily include a higher proportion of multiple inventions, of substitute inventions, of process inventions for the production of products simultaneously made obsolete by new product inventions, etc.—and because the number of inventions that can actually be put to use is limited by the available supply of productive resources and capital, which will compel a more stringent selection from the inventions supplied.

The double action of diminishing returns and diminishing utility is particularly important in evaluating the social desirability of changes in the patent law, especially in the scope, strength, and duration of patent protection. It is sometimes assumed that the "best" patent law is the one that gives patent applicants the biggest chance of obtaining the safest protection for the longest time. This assumption is made without any attempt to examine how effective an extension of the scope, strength, or duration of patent protection is likely to be in inducing the desired technological advance.[256] Yet, such an examination is essential, and to make it the following questions must be answered:

(1) How much would a small increase in the length, strength, or scope of the patent monopoly increase the profit anticipations of those who invest in research, development, and actual innovation?

(2) How much would this increase in profit anticipations raise, at effective interest rates and risk allowances, the present value of the expected returns?

(3) How much would this increase in the present value of the expected returns increase the amounts of funds currently invested in research and development?

(4) How much would this increase in current investment in research and development increase the amounts of productive resources, chiefly human resources, allocated to research and development work?

(5) How much would this increase in the current input of productive resources for research and development increase the output of novel and useful technological ideas?

(6) How much would this increase in the output of technological ideas increase the rate of actual execution of innovations in production?

(7) How much would this increase in the actual rate of innovation in production raise the productivity of productive resources?

(8) How much would this increase in productivity of labor, land, and capital goods increase the national product?

(9) To what extent would this increase in national product be offset by the decrease in national product that would result from the output restrictions inherent in the extension of the patent monopoly?

[256] A few writers have stressed the effects of patent protection upon the rate of investment (and employment) more than the effects upon the rate of invention. If one assumes that there is no scarcity of investment opportunities, one may expediently restrict the analysis to the effects on technological progress, which is in conformance with traditional patent theory.

(9) This increase of h percent in the national product may be offset, partly, fully, or more than fully, by the 1-year extension of the patent monopoly in the use of all patented technology that would have also been invented and used under the shorter patent grants and could have become free for unrestricted use at the earlier expiration of all patents and would have permitted an increase in national product by i percent, or an increase in product valued at I dollars. (Again we neglect other cost items, especially the cost of invention, reflecting the withdrawal of productive resources from other lines of activity.)

Each of the steps in the "succession of transmissions" involves, of course, a complex set of probabilities, the magnitudes of which depend on a large number of circumstances, technological, sociological, political, cultural, psychological, economic. Each of the nine coefficients, from a to i, is the result of many unknown variables. If any one of the first eight coefficients is zero (or negative), h must be zero (or negative); in this case, and also if h is positive but smaller than i, the extension of the duration of the patent grant will inflict a continuing net loss upon the Nation.

This schematic presentation of the "succession of transmissions," connecting an extension of the duration of the patent monopoly with an increase or decrease in national income, is probably difficult to comprehend on first inspection. The a-b-c fashion of expressing the magnitudes of the various effects may have made the exposition more concise, but perhaps also harder to comprehend. A numerical illustration will perhaps facilitate thinking things through and visualizing what kinds of factors may determine the outcome at each stage of the process.

The numbers chosen for the illustration are arbitrary; no attempt is made here to guess what the equivalent numerical relationships might be in "reality." Hence, any similarity between the numbers chosen and the actual data for the United States or any other country is more or less coincidental. Some of the numbers will on purpose be chosen to exhibit a "shocking pessimism," which may be necessary to offset the unreasoning optimism or faith of most apologists of the patent system. The illustration is designed to evaluate the factors which may determine the effects of an extension of patent protection by 1 year, say from 16 to 17 years.

(1) The purpose of the extension is to lengthen the period during which patent owners can expect profits from the exclusive or restricted exploitation of new patented inventions. Each firm employing a research force for inventive activity may now hope to earn more, than without the extra year of protection, on all new inventions for which patent protection may be useful for the full period. The additional profits expected from the additional year may be (i) profits from inventions that would have been made, patented and utilized even without the extension, or (ii) profits from inventions that would not have been made without the extension, because the needed research and development cost seemed too high to be recovered in 16 years, but which will be made if the additional year of protection promises recovery of the cost.[257]

[257] There may be an intermediate category: profits from inventions that would have been made and patented but not utilized without the extension, because the investment outlays required for the actual exploitation seemed too high to be recovered in 16 years but appear recoverable and attractive with a 17-year protection.

At this rate the present value of the expected $200 million increase in future profits is $74 million. Assuming that the $5,000 million, the previously expected total profits from a new crop of patents, were anticipated to accrue over 16 years in a series of first quickly rising and then gradually dwindling installments, and that the present value of that series was approximately $2,500 million (which would imply an average length of profitability of between 11 and 12 years), the increase by $74 million would be less than 3 percent (i. e., $b=3.0$).

(3) If all firms had plenty of liquid funds; had no more attractive investment opportunities for them; were eminently "research-minded"; and were not bound by any rules-of-thumb concerning their research and development budgets, they should be willing to put up an amount not much less than the $74 million for additional expenditures. But the four conditions are contrary to fact. Even if we forget the possible scarcity and the competing uses of funds, we must not overlook that many firms adhere to some "standards" of research appropriation such as a fixed ratio to sales.[259] Since such rules are not very flexible, we cannot assume that all firms will respond to the $74 million increase in the present value of new patented inventions. There might also be other considerations preventing firms from increasing their research budgets in response to an increased value of patents; for example, they may know how difficult it is to obtain the specialists they would need, and they may prefer not to bother. For the sake of the argument, let us say that the increase in current research expenditures will be $50 million. If total expenditures for research and development had been, say, $2,000 million, they are now increased by 2½ percent (i. e., $c=2.5$).

(4) Research and development expenditures are made for salaries of scientists, engineers, and supporting personnel, and for the acquisition of facilities such as buildings, apparatus, machines, materials, and electricity. The supply of human resources of great skill and learning is the bottleneck in any attempts to expand research and development work. When firms have decided upon such an expansion, they may try to find the needed specialists among the teachers and advanced students in the universities, but they will also resort to raids on the research staff of other firms. In the course of their efforts to secure additional research men, to hold those on their staff who are offered better jobs elsewhere, and to replace those who leave, salaries will rise. The relative rise will depend on the possibility of attracting qualified scientists and engineers from other occupations. The elasticity of supply of qualified research personnel seems to be very small.[260]

Assume that the $2,000 million annually spent on research and development have involved the employment of 80,000 scientists and engineers, with supporting personnel and facilities; [261] and that one-

[259] "* * * many companies * * * reported also that their research expenditures have represented a relatively stable percentage of their sales for the past several years * * *. Officials of some companies pointed out that research directors submit a budget based on a proposed program but that the company's finance officers or top management apply a predetermined standard to the total. The type of standard most widely used is the ratio of research costs to sales." National Science Foundation, Science and Engineering in American Industry: Final Report on a 1953–54 Survey (1956), p. 47.

[260] "Among the factors reported to place limitations upon the expansion of company-financed research and development, the manpower situation appeared to be uppermost in the minds of research officials." Id., p. 42. "At least half of the companies reported that they were unable to hire enough research scientists and engineers to meet their needs * * *." Id., p. 53. (The last statement seems to indicate that many companies have preferred to "give up," rather than to raise their bids even further.)

[261] This figure is a reasonable approximation to reality. In 1953 the "average cost" of research and development, in American industry, was found to be $27,000 per scientist or engineer. Id., p. 32.

There is no reason why the proportion of inventions that are unworkable on economic grounds should increase as the total number of inventions increases. But there are good reasons why the proportion of multiple and substitute inventions should increase when the total increases. Every age presents its inventors with certain technical problems and, as the number of people engaged in inventive activities increases, the number of those who work on the same problems will increase. It is almost inevitable that an increasing percentage of the solutions will overlap.[262]

Another loss is likely to occur between the shelf of usable inventions and the shop or factory where they are supposed to be put to actual work. Firms, at any one time have limited financial, entrepreneurial, and managerial resources; if there are more inventions to choose from, this does not mean that more inventions will be reduced to actual use in production. Busy management cannot get around to doing all the things that might be done. On the other hand, perhaps when the innovators can be more selective the quality of inventions actually applied may be improved. And the emergence of new firms may be stimulated when people of entrepreneurial ability find that promising inventions remain unused.

Thus, with the proportions of multiple and substitute inventions increased, and the proportion of usable inventions actually introduced somewhat reduced, we must indicate that f will be smaller than e. We assume, for purposes of illustration, that the 0.5-percent increase in the number of usable inventions made and developed will be converted into an 0.3-percent increase in the number of inventions put to actual use in production (i. e., $f=0.3$).

(7) Now the stage is reached where the new technology at work can raise the productivity of resources. The magnitude of the contribution which improved products and new products make to the national product cannot be estimated, as was pointed out before. But the contribution of cost-reducing inventions can be estimated. For the sake of simplicity, we are now thinking only in terms of cost reductions; that is, in terms of increased output per unit of resources.

The new inventions developed and put to work will not affect productivity in all industries, let alone in all sectors of the economy. The effects will be concentrated in a few industries and, within these industries, in the production of some particular goods or services. The economies achieved may be very impressive in some of these instances, but their significance in the economy as a whole will, of necessity, be modest. Even a doubling of output per worker in the production of a few products is apt to show itself as a small change in the decimals of the growth rate of "average productivity" in the economy.

Let us assume that the annual increase of average productivity would have been 2 percent; that a large part of it is due to the increase in capital per worker; that the bulk of the increase that is attributable to technological progress is not related to patentable inventions; and that one-tenth of the total growth of productivity, 0.2 percent, can be attributed to patented inventions (bearing in mind that this figure is only a figment of our imagination). The increase of 0.3 percent in

[262] If it is assumed that both the proportion of unworkable inventions and the proportion of unexpectedly good inventions are approximately unchanged when inventive activity is stepped up, and if it is assumed that the "open problems" of the time are limited, the proportion of multiple and substitute inventions must of necessity increase as inventive activity is intensified.

and f could be zero even if all the preceding values were positive. The remaining two "beneficial" factors, g and h, are more likely to be positive if all others are.

One important moral of the argument is that no one who thinks it through can be very sanguine concerning the effects to be expected in "reality"; and, certainly, no one can be at all sure about any of these matters.

L. INTRODUCING OR ABOLISHING COMPULSORY LICENSING

Many kinds of patent reform can be evaluated by this type of analysis. Not that numerical results can be obtained, but even "educated guesses" on the basis of intelligent impressions would be a great advance in the development of rational economic policy and of the appropriate legislative changes. This may be illustrated by some reflections on the merits and demerits of the proposal for compulsory licensing for all patents.

Compulsory licensing would probably reduce the incentive effects of a patent system, but increase the rate of utilization of the patented techniques that have proven themselves commercially successful. If the former is true, the latter must be true all the more, since it is only the expectation of an increased rate of utilization under compulsory licensing which reduces the returns expected by the owners of patents. If the owners fear more competitive utilization to arise, the analyst has no reason to assume that they are wrong.[263] Now, both effects, the different incentive to search for patentable inventions and the different utilization of patented inventions, have to be analyzed and compared; and a meaningful comparison must be in terms of final product available to the nation.

In this mental experiment, one might—to employ the technique of analysis developed in the preceding section—assume, first, that compulsory licensing is legally prescribed and, then, that it is abolished;[264] the abolition is an *extension of the degree of monopoly power* of the patent owner. If a patent owner can no longer be compelled to license others, those who invest in industrial research, development, and innovation may anticipate higher returns and, hence, they may invest more money. The other steps of the analysis will be the same as in the earlier case, except for the last step, which previously related to one additional year of output restriction but must now refer to a difference in output restriction under existing patents of all "ages"; the restrictions associated either with exclusive exploitation by individual monopolists or with cartelized exploitation regulated by restrictive license agreements must be compared with the restrictions associated with less monopolistic exploitation by nonexclusive and, therefore, less restricted licensees. In the absence of more information than we have we cannot expect this type of analysis to yield immediately a solution of the controversial problem, but it may aid in locating the exact points of disagreement, and in identifying the criteria on which the solution will depend.

[263] Entrepreneurs are not usually held to be pessimists. They are often described as overly optimistic; indeed, so much so that they virtually serve society for no compensation, speaking of the group as a whole. Pessimistic entrepreneurs would be expensive for society; the free-enterprise system rests largely on the optimism of private entrepreneurs.

[264] The reactions of entrepreneurs to the introduction of a measure should be the reverse of their reactions to its abolition if a high degree of rationality prevails. The assumption of rational behavior, perhaps, idealizes the situation too much. If so, the argument will have to be qualified accordingly.

tions and, without reciprocal licenses, might vigorously compete in the sale of their products. The situation is different where patents held by two or more firms cover complementary inventions, so that without cross-licensing none of the firms could produce efficiently. If firms refuse to license each other under patents on complementary inventions, or if firms refuse to license the owner of dependent patents, unless they are permitted to stipulate restrictions of use, output, markets, or prices, prohibition of restrictive licensing would interfere with efficient production [268]—except if licensing in such cases were compulsory. In many countries this is accomplished by compelling the issuance of licenses to any applicant who can show that his own patent cannot be worked without permission to use an invention covered by another patent under which he wants to be licensed, and who is willing to grant a reciprocal license.[269] Thus, the effects of outlawing restrictive licensing cannot be analyzed without considering, or making an assumption concerning, the status of patents which foreclose the use, or efficient use, of inventions patented by others.

Assuming then that licensing under such complementary and dependent patents is compulsory, the general prohibition of restrictive licensing would undoubtedly weaken the market control exercised by patentees who would agree on an amicable sharing of markets when they agree to the sharing of their inventions. Would this reduction of monopoly power substantially reduce the incentive effects of patents? To be sure, restrictive license agreements can increase considerably the profits of a patentee. But, much as this might affect the value of his patents, it would hardly be taken into account at the stage when he plans his investment outlays for industrial research and development work. The possibility of using patents as instruments of lawful collusion is in the nature of a windfall to the owner, and only rarely, or perhaps never, an effective anticipation for an investor in research and development directed toward eventually patentable inventions. At the time when a research project is formulated, neither the inventors nor the firm that finances them are likely to think of the restrictive license agreements that may be made under the hoped-for patents.[270] The increased profits from the increased strength of his monopoly position are imputed not to future patents on future inventions, but rather to existing patents. But the value of existing patents is irrelevant for the problem of technological progress.[271] What counts in this respect is the anticipation of profits from future patents, and these anticipations are unlikely to include the extra gains from making restrictive license agreements. Hence, whether such gains are actually possible or not possible—depending on the permissibility or prohibition of restrictive licensing—should make no difference for the incentive effects of the patent system.

This conclusion, if correct, has implications for patent law and policy. It strengthens the cases for forceful proceedings to remedy

[268] This statement presupposes that the patents are valid; otherwise those who were denied a license may defy the patentee and win in the suit for infringement. The possibility of "inventing around" the patents does not contradict the statement in the text, because the waste involved in this unnecessary activity makes it equivalent to inefficient production.

[269] Corwin D. Edwards, op. cit., supra, note 106, p. 242. Edwards recommends that such a provision "should be incorporated in American patent law." Ibid.

[270] If restrictive licensing really figured so prominently in the thinking of a company, they probably have some existing patents to use as a frame for the arrangement. It could probably be shown that restrictive licensing is usually done under a whole series of patents.

[271] The high value of existing patents may of course be a political-psychological aid in nurturing the anticipations that are supposed to be effective: the anticipated values of anticipated patents on anticipated inventions.

collections of technical knowledge could be compiled, perhaps no less efficiently, by special agencies in the absence of patents.[272]

Apart from any effects upon the size of the national income, the patent system affects the distribution of income. Indeed this is its purpose from the point of view of the "just reward" theory: to transfer some of the income increase produced by newly invented technology to the people responsible for it. The recipients of this income transfer are often pictured to be those ingenious, independent fellows called "garret inventors" or "basement inventors"; it was said that they would be helped by the patent system in their endeavors to go into business for themselves or to sell their rights to one of the several businessmen competing to acquire these rights for practical application of the inventions. Yet this is not how things work today. The majority of "inventors" are employees of corporations, many working on the staff of research departments of very big firms.[273] The income transferred from the consumers is received by the corporations to cover their research and development cost (if written off immediately), or as part of their profit either to be reinvested (perhaps in research equipment and innovations) or to be distributed to stockholders. Is what the consumers pay on this score (as part of the price of the goods and services they buy) more, or is it less, than the increase in real income which results—has resulted? will result?—from the corporate research and development work? If it is true that the total outlay for such work is increased under the patent incentive, this increase means more demand for research personnel and thus will raise the salaries of the entire staff, old and new, although it is only the additions to the staff that will increase the rate at which new technology is created. If the supply of research workers should be completely inelastic, there will be only increased salaries but not more inventing; and if the corporations should know this, or for any other reasons fail to increase their outlays for inventive and innovating activities, there will be only increased corporate profits resulting from the patent system. But one never can tell, perhaps the income redistribution accomplished by the system is only a modest portion of the increase in national product which the system induces and which would not occur without it.

The incentive effects of the patent system, which are supposed to yield the new inventions and innovations which in turn produce an increase in national output, are the result of profit expectations based on restrictions of the output produced with the aid of the patented inventions. These output restrictions are the very essence of the patent system because only by restricting output below the competitive level can the patent secure an income to its owner. There need not be any contradiction between the output restrictions and output expansions effected by the patent system. While each existing patent may restrict the utilization of a recently developed piece of technology and thus reduce the output of particular products in

[272] It is difficult to compare two methods of dissemination if one of them has not been tried. Would the "compilers" be able to get the cooperation of industry? Would the prestige of public recognition be an inducement for making information available to the compilers? It must be borne in mind that the present method of disclosure is not designed to inform and to instruct; on the contrary, patent applicants often try to disclose as little as possible, and only in terms of the claims of the patents. "Dissemination" might be more effectively achieved by different methods.

[273] From 1939 to 1955, 343,125 U. S. patents, or 58.51 percent of the total, were issued to corporations. (They *own* even a larger portion of all patents.) The degree of "concentration" is reflected in the fact that 104,110 of these patents were issued to only 38 corporations. Patent Office (Federico), Distribution of Patents Issued to Corporations (1939-55), Senate Patent Study No. 3 (1957).

elimination of profits" one might think that without patent protection it would not pay to invent and to innovate, and that firms could not afford to invest in research and development. On the strength of the theory of the "sufficiency of the innovator's headstart" one might think that many innovators would have enough time to recover their costs of innovation. But on the strength of the theory of the "nearly perfect competition from imitators" one might think that few innovators would get away without losses.

No conclusive empirical evidence is available to decide this conflict of theories. That the automobile industry developed partly despite patents (when it still had to overcome the barrier of the basic Selden patent) and partly independently of patents (since it refrained from enforcing the exclusive rights obtained) is some presumptive evidence against the theory of the need for patent protection. That in Switzerland and the Netherlands industrial development proceeded rapidly when these countries had no patent laws is not conclusive because, one might say, they shared the fruits of the patent systems elsewhere and profited from the free imitation of technologies developed abroad—an instance of sharing the benefits without sharing the cost. That experts in the chemical, electronic, and other industries testify that their firms could not maintain their research laboratories without patent protection may persuade some, but probably should be discounted as self-serving testimony. That countries with patent laws have made rapid technical progress does not compel the inference that their progress would have been slower without patent laws. None of the empirical evidence at our disposal and none of the theoretical arguments presented either confirms or confutes the belief that the patent system has promoted the progress of the technical arts and the productivity of the economy.

0. CONCLUDING REMARKS

The statements winding up the discussion in the preceding section look like a disappointingly inconclusive conclusion of a rather lengthy economic review of the patent system. Some explanatory remarks, therefore, seem to be in order.

It should be said, first of all, that scholars must not lack the courage to admit freely that there are many questions to which definite answers are not possible, or not yet possible. They need not be ashamed of coming forth with a frank declaration of ignorance. And they may make a contribution to knowledge if they state the reasons why they do not know the answers, and what kind of objective information they would have to have for an approach toward the answers.

The "inconclusive conclusion," it will be remembered, referred to an attempted "Evaluation of the Patent System as a Whole." The literature abounds with discussions of the "economic consequences" of the patent system, purporting to present definitive judgments, without even stating the assumptions on which the arguments are based, let alone submitting supporting evidence for the actual realization of these assumptions. No economist, on the basis of present knowledge, could possibly state with certainty that the patent system, as it now operates, confers a net benefit or a net loss upon society. The best he can do is to state assumptions and make

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guesses about the extent to which reality corresponds to these assumptions.

If one does not know whether a system "as a whole" (in contrast to certain features of it) is good or bad, the safest "policy conclusion" is to "muddle through"—either with it, if one has long lived with it, or without it, if one has lived without it. 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. This last statement refers to a country such as the United States of America—not to a small country and not a predominantly nonindustrial country, where a different weight of argument might well suggest another conclusion.

While the student of the economics of the patent system must, provisionally, disqualify himself on the question of the effects of the system *as a whole* on a large industrial economy, he need not disqualify himself as a judge of proposed *changes* in the existing system. While economic analysis does not yet provide a basis for choosing between "all or nothing," it does provide a sufficiently firm basis for decisions about "a little more or a little less" of various ingredients of the patent system. Factual data of various kinds may be needed even before some of these decisions can be made with confidence. But a team of well-trained economic researchers and analysts should be able to obtain enough information to reach competent conclusions on questions of patent reform. The kind of analysis that could form the framework for such research has been indicated in the present study.

particular industries, the system as a whole may promote the development and application of ever new technologies and thus permit an accelerated increase in national product. One is reminded of the famous analogy of the automobile brakes which permit motorists to drive with greater speed.[274] The patents are here likened to the brakes which the "drivers" (entrepreneurs) in the economy can apply and which are to give them the courage to accelerate its progress.[275] The "braking" is the direct and absolutely certain effect, the encouragement is only an indirect effect and not quite so certain, though rather plausible. The output restrictions based on patents are primary effects and testable; the incentive effects are secondary and more conjectural.

These incentives are supposed to generate technological inventions plus innovations—innovation being the first commercial application of a new idea. Invention without application is useless; practical application may depend on patent protection even where invention does not. Thus, even if the patent system were proved to be unnecessary for the promotion of invention—that is, if an adequate flow of inventions were forthcoming without patent incentive—patents might still be needed as encouragement for investment and enterprise to introduce untried techniques and products.[276]

To be eager to do something is not enough if the necessary funds are lacking. Some observers have placed less emphasis on the need for patents as an *incentive* for investment in industrial research, development, and practical innovation than on the need for them as sources of *finance* for such investment. They have argued that only the monopoly profits derived from existing market positions based on past patents can provide the funds for new incentive work and innovating ventures. This argument was perhaps suggested by the observation that the largest research laboratories are in fact maintained by corporations with the strongest patent positions and with high and stable earnings. This, however, does not mean that other firms, not drawing on patent-monopoly profits, could not afford to invest in research. What it probably does mean is that the patent system, because of certain scientific and technological developments of the time, favors certain types of industry, such as chemical and electronic, and that this occasions both the accumulation of masses of patents and the intensive search for new patentable inventions in these industries. But even this explanation probably exaggerates the role of patent monopolies in industrial research. It seems very likely that even without any patents, past, present, or future, firms in these industries would carry on research, development, and innovation because the opportunities for the search for new processes and new products are so excellent in these fields that no firm could hope to maintain its position in the industry if it did not constantly strive to keep ahead of its competitors by developing and using new technologies.

We find ourselves confronted with conflicting theories. On the basis of the theory of the "competitive compulsion to keep ahead" one might think that firms would invent and innovate even without patent protection. But on the basis of the theory of the "competitive

[274] Joseph A. Schumpeter, Capitalism, Socialism, and Democracy (1942), p. 88.

[275] The analogy has proved remarkably persuasive although it does not fit the patent story in two essential points: the motorist applies the brakes to *his own* car *when it runs too fast*, the patentee applies brakes in order to slow down or stop *others, regardless of how fast or cautiously they proceed.*

[276] Cf. the remark by Judge Frank in *Picard* v. *United Aircraft Corp.*, 128 F. 2d, 632, 643 (2d Cir. 1942).

"abuse of the patent monopoly," for vigorous antitrust prosecutions against restrictive contracts, and for a general prohibition of all restrictive licensing if this prohibition is coupled with provisions for compulsory licensing under complementary and dependent patents.

N. EVALUATION OF THE PATENT SYSTEM AS A WHOLE

A comparison, even though speculative, of the incremental benefits and costs associated with a little more or a little less patent protection, is more feasible than is an attempt to assess the "total effects" of the system. An economic evaluation of the patent system as a whole implies an analysis of the differences between its existence and nonexistence—perhaps a hopeless task. Nevertheless several different effects, some beneficial, some harmful, have been attributed to the operation of the patent system, and must be reviewed in an attempt at evaluation.

That the patent system succeeds in eliciting the disclosure of technological secrets is a claim widely asserted, though often denied. The chief question is whether, by and large, the period over which inventions could be kept secret, or in which the first invention would not be duplicated by other inventors, is longer than the period for which patents are granted. A negative answer is strongly suggested by the simple reflection that inventions probably are patented only when the inventor or user fears that others would soon find out his secret or independently come upon the same idea. It would follow that the patent system can elicit only those technological secrets which without a patent system would be likely to be dispersed even sooner than they become free for public use under patent protection.

This conclusion disregards the possibility that all the competitors who eventually find out about the novel technology or find it independently will try to keep it secret. However, this would be a "secret" shared by all whose knowledge really matters. For if there is enough competition among those who are "in the know," the interests of the community are safeguarded. But there is another advantage in prompt and full disclosure under the patent system, which is not secured through the process of individual detection or multiple invention. Disclosure of an invention through the patent grant may give "ideas" to technicians in other industries who would not, as a rule, go out of their ways to "find" the technical information in question but may be glad to take a hint when it is "thrown" at them through publication in the official gazette. In other words, dissemination of technical ideas to outsiders should be considered separately from the availability of the invention to those who would like to use it in competition with the first inventor.

The claim that the patent system serves to disseminate technological information, and that this accelerates the growth of productivity in the economy, is not questioned. In some countries, though not in all, the patent offices have collected and made publicly available the vast amount of technical information contained in the hundreds of thousands of patents, current and past. But, while this store of knowledge in public print is a very desirable byproduct of the patent system, it is not necessarily dependent on it; conceivably, similar

The argument sketched here was restricted to considerations of the comparative effectiveness of the system in stimulating *invention* and of the comparative rates of utilization of patented technology that has *proven* itself commercially successful. Thus, the argument did not extend to considerations of the comparative effectiveness of the system in stimulating *innovation* and of the comparative utilization of patented technology that has *not yet proven* itself commercially successful. Where there is still a long and difficult way from the patented invention to its first commercial application, where much investment at high risk is required before the invention can be reduced to practice, compulsory licensing may be a serious deterrent.[265] No technique of analyzing this problem has been found thus far. There is not even the legal presumption concerning the (constitutional) validity of the objective: to stimulate, not invention, but innovating enterprise based on invention. Nor have economic theories been offered to show that innovation based on patentable and patented invention is in any respect preferable, from the point of view of economic welfare or progress, to other kinds of innovation. If the assumption of chronic stagnation and continuous deficiency of investment opportunities in a free competitive economy is rejected, one has to present reasons why investment should be channeled away from other outlets and toward innovating enterprise centered on patent protection. If the reasons for this redirection of investment are accepted, perhaps the underlying theories will suggest the type of analysis suitable to examine the positive and negative effects of various compulsory licensing schemes.

M. PROHIBITING OR PERMITTING RESTRICTIVE LICENSING

Perhaps one can come closer to an answer regarding the similarly controversial question of the admissibility or prohibition of restrictive licensing. It is often denied that restrictive licensing can increase the monopoly power of the patentee.[266] Under his exclusive right he may—in the United States—produce and sell as much or as little as he wants and may price his products as he pleases. If he agrees to license others under his patents under conditions which restrict the uses of his inventions, or the volume of output, the market outlets, and the selling prices, is he extending his monopoly or is he relaxing it by letting others share in the use of his inventions?

No general answer is possible. Just as cartels and other coordinated oligopolies are sometimes more restrictive, sometimes less restrictive than "perfect monopolies," the restricted sharing of exclusive patent rights may be more restrictive or less restrictive than their exploitation by a single patentee. Court cases involving various industries in the United States have shown the use of patent agreements as instruments of very tight output and price cartels, domestic or international; in these instances restrictive licensing has undoubtedly strengthened the monopoly power of patentees.[267] This is particularly clear where different firms hold patents on substitute inven-

[265] Those who stress the need of protection of perfect exclusivity in order to attract the venture capital required for perfecting, adapting, and eventually applying a patented invention, implicitly admit that the invention as patented does not yet "work", or that the way it works it does not yet have "utility."

[266] For example, George E. Folk, Patents and Industrial Progress (1942), pp. 12, 16.

[267] Cf. Corwin D. Edwards, Economic and Political Aspects of International Cartels, Monograph No. 1, Subcommittee on War Mobilization of the Senate Committee on Military Affairs, 78th Cong., 2d sess. (1944).

patented inventions applied in actual production, if instrumental in enhancing average productivity at the same rate as the other patented inventions, would then contribute an 0.06-percent increase in average productivity (g).

(8) What would this mean in terms of total national product? This will depend on its current size, of course, and on the possibility of reemploying the economized resources in equally productive pursuits. Such a possibility may not exist. The productive factors displaced in one use may be employable elsewhere, if at all, only with reduced compensation because of reduced "value productivity." Moreover, account may have to be taken of an accelerated obsolescence of capital, of transfer losses of capital and transfer costs of labor, of losses in labor skills, etc.

For reasons such as these, we shall assume that the national product will increase by only 0.04 percent (h). If its size had been $300 billion—with this assumption we are, I am afraid, coming nearer to the United States national income than to that of any other country—its induced increase would be $120 million.

(9) We have reached now the item which is negative by hypothesis, since the whole incentive theory is based on it: the restriction of output in the 17th year of the patent monopoly. Here we encounter a timing problem: during the first 16 years after the 1-year extension of the patent grant becomes effective, the Nation would not incur the costs of additional restrictions (assuming that the terms of patents already issued would not be lengthened). Only after the transition period is over will the losses due to restrictions become effective. These restrictions would apply, of course, not merely to inventions made under the stimulus of the extension of the duration of patents (or under the stimulus of patents in general), but to all patented inventions in use. On the other hand, the fact that only a small percentage of inventions remain usable for the entire life of the patent limits considerably the size of the output loss during the added year of protection.

The assumption we make for the output loss due to the restrictions in the extra year will decide whether the total calculation comes out with a net gain for society or with a net loss. Despite the repeated insistence that these are not "estimates" but arbitrary assumptions, the danger of offending sensibilities is great; it may be averted by making two alternative assumptions: If the loss of products due to the restricted use of patented technology in the 17th year of the patent grant is one-fiftieth of 1 percent of the national product, it would amount to $60 million (or one-half of the increase credited to the extension of the grant); if the loss is one-twentieth of 1 percent, it would be $150 million (or a little more than the increase credited to the extension). It should be remembered that this negative factor (i) reflects only the cost of restrictions, not the other cost items, such as the cost of invention.

Summing up this lengthy exercise in "imaginary numbers," it may first be noted that only positive numbers were chosen for all coefficients from a to h: 4.0, 3.0, 2.5, 0.8, 0.5, 0.3, 0.06, 0.04 percent, respectively. A negative number, or zero, for a, though not unlikely at all, would have ended the story in its first chapter. A zero value for c would appear quite plausible, even with positive a and b. Another zero might be unavoidable at certain times for d. That e may easily be negative during transition periods has been pointed out,

half of the total was for professional salaries. Assume further that the additional expenditures of $50 million are divided in the same way, so that another $25 million became available for salaries of scientists and engineers. If the elasticity of supply is, let us say, 0.5 (which means that a 5 percent increase in manpower supplied would require a 10 percent increase in salary), an increase in the professional payroll by 2½ percent would mean a 1.6 percent increase in average salary and a 0.8 percent increase in the size of the professional staff. (Thus, $d=0.8$.) In absolute numbers, the average salary would rise from $12,500 to $12,700 and the number of scientists and engineers engaged in research and development would rise from 80,000 to 80,640.

(5) What results can be expected from this increase of the research and development staff by less than 1 percent? If transition periods are not neglected as pertinent for a practical evaluation of the case, the possibility must be faced that "output"—inventions—will be reduced instead of increased. Since the staff increase of many individual firms was partly achieved by raids upon other organizations, the turnover rate of personnel must have increased, with an associated loss in directly applicable information and experience. It is a fact that the first months, perhaps years, of a specialist on a new assignment may be nothing but a "learning period." In his old position, engaged in research on problems he has studied for some time, he might have come up sooner or later with new and useful ideas. This chance is likely to be lost when he moves to a new position, new problems, perhaps a field quite new to him.

There may be a partly offsetting advantage in this turnover: ideas developed in one area may turn out to be applicable in other areas, and the transfer of specialized knowledge may open up new technological vistas. Thus, the turnover of research and development personnel may in the long run be productive of new inventions. In the short run, however, it is sure to prove disruptive and to reduce the number of technological ideas developed.

Apart from the effects of staff turnover, the increase in staff may be expected to increase its output somewhat. There are indications that the law of diminishing returns operates also in the production of inventions, and probably quite drastically beyond some point, but whether that point has been reached is an open question. For the sake of this illustration let us assume that the 0.8 percent increase in the research and development staff will turn out a 0.5 percent increase in new inventions (i. e., $e=0.5$).

(6) A considerable proportion of all inventions are eliminated from the output of inventive activity as duplicate (or multiple) inventions: it happens frequently that two or more inventors or inventor groups arrive at the same invention approximately simultaneously; one of them is adjudged to be the first, the others are out. Another portion of new inventions is eliminated as inferior substitutes; they are patented, of course, but are doomed to remain "on paper." A third group of inventions, though novel and useful and therefore patented, are economically not workable. Is there a presumption that the distribution of new inventions among the various workable and unworkable categories remains approximately the same as investment activity is stepped up?

Assume that the "annual crop" of economically workable inventions has been expected, with the 16-year protection, to earn for the patent owners $5 billion over the lifetime of the patents. If all inventions and all patents remained good for the full duration of the patent grant, its extension by 1 year would mean a maximum increase of profits of the type (i) by 1/16, or 6.25 percent. But no one can be that optimistic. Even very excellent new products, new machines, or new processes may become obsolete much faster than in 16 or 17 years. Only a small proportion of all patented inventions can be expected to "live out" the duration of the monopoly grant. Let us then, rather arbitrarily, lower the expected increase in expected profits from 6.25 to 3 percent of the $5 billion, that is, $150 million (which still reflects an extraordinary optimism). Let us then add another $50 million for profits of the type (ii), that is, for profits from inventions that would have been too costly to be made without extended protection. Thus, altogether $200 million in new profits, or 4 percent (the coefficient $a=4.0$) of the $5 billion, will be expected, thanks to the extra year.

Strictly speaking, only the $50 million, and not the $150 million, may be a bait for new ventures in research and development; the $150 million of profits of the type (i) are more in the nature of windfalls than of spurs to action. But we shall make the heroic assumption that the entire $200 million increase in expected profits may fulfill the function customarily attributed to the profit motive.

There is at least one consideration which might compel a drastic reduction of this figure, perhaps even to zero or a negative magnitude. The desire of firms to develop or acquire new patentable inventions is partly influenced by their desire "to have something that others have not got." New patents often are wanted only to replace old ones that are expiring; in other words, some of the demand for patented inventions is a replacement demand. If the life of patents is prolonged, the replacement demand is reduced. Individual sources of monopoly profits must be replaced before they dry up; if they last longer, the replacement becomes less urgent and can be put off. To some firms, then, the value of the new patents of extended duration may fall, rather than rise, because they are wanted chiefly as substitutes—and substitution becomes less necessary.

Should this consideration weigh heavily with many firms, an increase in the number of patented inventions would not add to the profits expected from the hitherto planned crop of inventions; indeed a smaller crop might do.[258]

We do not want the train of our argument to come to a dead stop at the very first station of a long line. Let us then merely note the qualification, but neglect it in our calculations, and go ahead with our assumption that the profits expected from new patented inventions are increased by 4 percent, that is, by $200 million.

(2) These additional profits are expected to be collected in the last year of the life of the patents, that is 17 years from now. The present value of $1 due in 17 years is 51 cents if the interest rate is 4 percent, and 44 cents or 37 cents if the interest rate is 5 or 6 percent, respectively. There should really be a higher "discount" for risk and uncertainty—but let us assume that 6 percent is enough on all three scores.

[258] An offsetting consideration relates to firms waiting impatiently for the patents of their competitors to expire so that they can use the patented inventions. The longer the duration of patents the greater the inducement to "invent around."

(Such additional output restrictions would not be limited to the technology created under the incentive of the extended patent monopoly, but may involve all patented technology in use.) This possible decrease in national product constitutes item 4 of the six cost items previously enumerated. For a complete analysis one will also have to inquire which of the other five cost items may be increased, and by how much, as a result of the increase in the length, strength, or scope of the patent monopoly.

K. SHORTENING OR LENGTHENING THE DURATION OF PATENTS

The "succession of transmissions" or "transformations," beginning with an extension of patent protection and ending (if everything works out without a hitch along the line) with an increase in national product (and otherwise with a decrease), may be illustrated by sketching an analysis of the effects of an increase in the duration of patents, say from 16 to 17, or from 17 to 18 years:

(1) The increase in the duration of patents by 1 year may increase profits expected from new patents by A dollars to be received after 17 years, or by a percent of the total profits expected.

(2) This increase in expected profits by a percent, or by A dollars, to be received 17 years from now, will be equivalent, with appropriate discounting for interest, risk, and uncertainty, to a "certain" increase by B present dollars, or by b percent of the present value of the total profits expected from new patents.

(3) This increase of b percent in the present dollar value of future returns may, depending on the availability of funds and on the opportunity cost [256a] of using them for other purposes, induce an increase in current expenditures for research and development work by c percent or C dollars.

(4) This increase in research expenditures by c percent involves an increase in the demand for physicists, chemists, engineers, and all sorts of specialists, and may, depending on the supply of such human resources, lead to a transfer of manpower from various activities and thus to an increase in manpower allocated to research and development by d percent.

(5) This increase of d percent in the manpower allocated to research and development work may result in an increase of e percent in the number of new and useful technological ideas.

(6) This increase of e percent in new technological ideas will probably include an enlarged portion of duplicate or substitute inventions, or of otherwise unusable inventions, and hence may lead to an increase of only f percent in new technology reduced to actual use in production.

(7) This increase of f percent in new technology actually applied in production may permit an increase of g percent in the output per unit of productive services (hour of labor, acre of land, ton of coal, etc.) in particular uses (provided that in estimating this increase qualitative changes in final product are in some way quantified).

(8) This increase of g percent in the per-unit-productivity of certain services used in certain lines of production may permit an increase of h percent in the national product, or an increase in product valued at H dollars.

[256a] Cost is the value of forgone opportunities. If a firm can obtain up to x million dollars, though not more, in loan or equity capital at a rate of interest of 5 percent, but can use all of it for investments yielding at least 12 percent, any money outlay which the firm is considering would compel it to forgo a return of 12 percent; thus the "opportunity cost" of funds to the firm is 12 percent.

"obstructions and encumbrances" which patents may put in the way of others, to wit, potential inventors and innovators, and which keep them from engaging in industrial research in certain directions, from working on ideas the development of which seems blocked, or from undertaking innovations which, though not really infringing any patents, might incite harassing litigation. Thus not only is the use of existing technology restricted—this, to some extent, is intended by the patent system—but possible developments of new technology may be interfered with by existing patents.

Three other cost items also have to be taken into account: (1) the cost of operating the patent system, which means chiefly the input of administrative, legal, technical, and clerical ability in government, industry, and law offices; (2) the cost of inventing, which is primarily the use for industrial research and development work of scientific and engineering personnel withheld from other activities; and (3) the cost of innovating, which consists of faster obsolescence of capital goods and of losses due to more frequent transfers of human and material resources.

Thus, the benefits derived from the patent system consist in the increase in national product attributable to technological innovations which are "generated" by the system in the sense that they would not come into being without patent incentive or would arise only at a later time. The costs, or negative items to be set against the benefits, can be organized under six heading: (1) the operating cost of the patent system, (2) the cost of inventing, (3) the cost of innovating, (4) the cost of immanent restrictions in the use of patented inventions, (5) the cost of transcendent restrictions upon production as a result of general monopoly control strengthened through patent positions, and (6) the cost of obstructions and encumbrances to potential inventors and innovators. Most patent experts take it for granted that the "generating capacity" of the system is great, and that its restricting and obstructing effects, as well as the other cost elements, are negligible. Of course, no ready means of measuring the positive and negative effects are available, but one should expect at least some theoretical analysis to precede pronouncements on the largeness of net benefits.

To illustrate, one of the six cost items may be singled out at this point because it has a bearing on the most essential arguments: the cost of inventing. One must assume that beyond a certain volume of inventive activity the cost of inventions increases rapidly, because the "production of inventions" is liable to become subject to drastically diminishing (if not zero) returns [255] and, moreover, the supply of inventive talent is, beyond a point, highly inelastic. If inventive

[255] "Diminishing returns" in the sense used here mean that the "output" increases at a smaller proportion than the "input," so that the cost per unit of output increases. There is usually a phase of "increasing returns"—where output increases proportionally faster than input—before diminishing returns set in. It is quite possible, therefore, that a nation can still increase the production of inventions at increasing returns: that, for example, a 10-percent increase in the inventive talent employed for industrial research and development will produce a 20-percent increase in the flow of inventions. Moreover, it is possible that inventive activity at one time goes on under drastically diminishing returns, but then an important scientific discovery suddenly opens up such a wealth of problems of practical application that the production of inventions moves into another phase of increasing returns.

Even if a nation has allocated enough resources to the production of inventions to have pushed it far into the range of diminishing returns, this need not mean that too many resources have been so allocated. Indeed, economists can explain why production is most efficient under diminishing returns. Thus, it is not to charge wastefulness if it is said that the production of inventions is subject to diminishing returns. It may be well worth trying for a 2-percent increase in the flow of inventions at the expense of a 10-percent increase in the employment of research personnel. All that the possibility of "drastically diminishing returns" should mean to us is that we ought to watch the cost and not be deluded by the false hope that a given percentage increase in research staff will always yield the same percentage increase in inventions.

patented or unpatented; the social value of the annual crop of patented inventions; and, lastly, the social value of the annual crop of patent-generated inventions, that is, of inventions that would not have been made or developed had it not been for the incentives afforded by the patent system. This *increment of invention that is attributable to the operation of the patent system* is probably of relevance to an evaluation of the patent system as a whole. But there is yet another magnitude, perhaps even more interesting for the problems before us: the (positive or negative) *increment of invention that is attributable to certain changes in the patent system.* The possibility of analyzing these two increments will occupy us in the next sections.

J. THE COST AND VALUE OF ADDITIONAL INVENTIONS

The analysis of the "increment of invention" attributable to the operation of the patent system, or to certain changes in the patent system, can only be highly speculative, because no experimental tests can be devised to isolate the effects of patent protection from all other changes that are going on in the economy.

May we "dream up" some experimental testing of the differences between a world with patents and one without patents? Let us duplicate our world, so that we have two worlds identical in every respect, except that one shall have a patent system and the other shall not; and then let us observe, for 50 years or so, these identical twin worlds and see what happens. And let us also have identical twin worlds of the years 1700, 1750, 1800, 1850, and 1900, one of the twins always with and the other without a patent system. It is conceivable that such "experiments" would yield trustworthy results, especially if we were able to repeat them and control some of the other factors that might make a difference to the rate of technological progress. It is also conceivable that the findings would be somewhat inconsistent: For example, the worlds of 1700 and 1750 might show superior progress in the specimen equipped with patent systems; the worlds of 1800 might show no differences in the rates of progress; and the worlds of more recent vintage might show faster progress in the specimen without patents. Such findings would be in accord with the hunches of some writers of the late 19th century, who hypothesized that the patent system may have been useful in kindling the spirit of inventive ambition, but is unnecessary or harmful once industrial inventiveness is sufficiently developed.[252] Yet there is no use imagining the findings of the imaginary experiments. There are no real experiments that can answer our questions and we have to fall back on speculative analysis, on inferring conclusions from assumptions which, on the basis of common experience ("casual empiricism"), seem to be the most plausible.

One may be fussy and contend that it makes no sense to speak of an "increment of invention" (attributable to the patent system) because inventions can be neither counted nor weighed nor measured in any practical way. Perfectly true. Inventions can often be subdivided or fused, and hence counting is arbitrary; and even if one

[252] "The wisdom of our ancestors is not discredited when, now that circumstances have completely changed, we abandon a system of restraints that is no longer tenable. British manufacturers have outgrown the confinement and trammels of the nursery and go-carts, and demand freedom of action and fuller scope." Robert Andrew Macfie, The Patent Question under Free Trade (London: second edition, 1864), p. iv. "In early stages of industrial development patent protection may have been beneficial. Not in the present state of the economy." Hermann Rentzsch, "Patentwesen", Handwörterbuch der Volkswirtschaft (Leipzig: 1866), p. 634. Similarly, Sir Roundell Palmer [in the House of Commons] as reported in Westminster Review,new series, vol. XXXVI (July 1869) p. 125.

one who has the new process—can thrive on a price too low for them to make profits. Then they may start hustling and may eventually, chiefly through turnover of supervisory personnel, learn all about the superior process. Several years may have passed by then. If the invention is of a new product, or a new tool or machine, for sale in the market, the competitors may be able by examining the article to figure out how it is made. In this case they may be substantially faster in catching on and catching up, but it still may be years before their competition can become effective. The innovator may have used his headstart to develop a loyal clientele: customers may be distrustful of the imitations and may persist in patronizing the producer of the "original." Thus, the notion that only patent protection of new inventions can make the innovator's headstart last long enough for him to make some money is exaggerated, to say the least.

If the innovators are lucky and the imitators tardy, profits of the innovating enterprise—without patent protection—will vanish only after having paid for all the cost of invention and innovation, or even more. Instead of "luck" the innovating firms may rely on their generally strong position in the market—usually called imperfect competition—which may account for long delays in imitation and a considerable safeguarding of their headstart, without any patent protection. Only if the innovators have neither that strong position in the industry nor the luck of tardy imitators, that is, only if imitators are very quick, will prices come down and will the innovators' profits disappear before all of the cost of invention and innovation is recovered. Partly on such grounds has the need of artificial delays of newcomers' entry, through patents or other monopolistic road blocks, been questioned.[249] Needless to say, much depends on the size of the investment. If the costs of research and development are very high, the "natural" headstart will be insufficient for recovering the cost; but so may be a 17-year monopoly for that matter.

Some light, I hope, has now been shed on the question why—without a patent monopoly—the private value of an invention may be well below the private cost of making it. What can he said about its social value? Is there a way of estimating the value of a new invention to the economy as a whole?

As pointed out above, the principle that the social value of anything is measured by what people pay for it does not apply to a good many things, and inventions are among them. If they were publicly disclosed and open to any comer, no one would pay for an invention. But if they are patented and can be used only for a fee, would then the fee paid indicate anything about the value of the invention? That the answer is negative may be seen from the following argument. Assume for a moment that an invention is patented but that licenses are offered to everybody who wants to us it. If royalties are charged per unit of output produced, and if the royalty rate is relatively high, the licensees—given the demand for the product—will produce a smaller output and will charge higher selling prices to cover the high royalty rate. If the rate is low, the invention will be used more extensively, output will be larger, and selling prices lower. If the royalty rate is zero, the invention will be used with the least restriction. Thus, the "value" of the license to the licensee cannot

[249] See pp. 23–24, supra. An historically significant exposition of this argument was presented by Count Bismarck to the Bundesrat of the North German Confederation in December 1868. For an English translation, see House of Commons Sessional Papers, vol. 61, doc. 41 (London, February 16, 1870).

new workers and the increases in wages paid to the old workers. The cost to society, however, must be counted only in terms of productive resources employed; the social cost of the particular output increase is measured by the alternative output which the newly employed workers might have produced in other fields; it will not include the pay increase to old workers because this does not reflect any sacrifice of total national product (though it may affect its redistribution). In other words, private marginal cost, in this case, will exceed social marginal cost.

Now we are ready to put these concepts to work. Private cost and value will determine how the producer fares and what he will be induced to do. If the private marginal cost exceeds the private marginal value (product) he will decide to reduce his output. If his total private cost exceeds total private value (product) he loses money. If, at the output produced of any goods or service, its social marginal cost is less than social marginal value (product), the economist will deplore that not more is being produced, since increased output would be in the interest of society. If, on the other hand, social marginal cost exceeds social marginal value (product), too much of the good or service is being produced: economic resources are being wasted and had better be used for other purposes.

Now, how does all this apply to the production and use of inventions?

I. THE COST AND VALUE OF INVENTIONS

The production and use of inventions present problems for economic policy because of some crucial discrepancies between private and social costs and values.

New inventions are ordinarily the product of considerable inputs of productive services, of large expenditures of money. Thus, the social cost of producing inventions is high, and the private cost sometimes even higher. The private value of inventions, however, if the Government does not intervene by means of patent protection, is often much lower and may, after a short time if competition is vigorous, fall to zero. The social value of inventions is difficult to appraise; it may be very high, certainly much higher than the private value of nonprotected inventions. If private production cost exceeds private value, the producer of invention loses money and may stop producing. If the social value of inventions exceeds the social cost of producing them, inventive activity ought to be increased, not reduced, in the interest of society. Under these circumstances, the Government is called upon to intervene in support of the private value of inventions.

What causes these discrepancies? The explanation has sometimes been sought in the difference between manual and intellectual work or in the difference between material and intangible goods; but, despite all the philosophic disquisitions on these differences, they have nothing to do with the problem at hand. What really matters is the difference between "variable" and "sunk" cost. Since the costs sunk in the research and development work that leads to a new invention are independent of the use that later is made of the newly invented technology, *it does not cost more to use it more intensively.* That is to say, the "marginal cost of using the invention" will be zero. The invention cost is now "fixed"; it is not increased when greater use is made of the invented technology. As larger quantities of goods are

to stimulate invention. Other theories—not often clearly expounded—stress other incentives as the essential functions of the system: to stimulate innovation and to stimulate investment.[242] Inventing, innovating, and investing are different activities, though usually not properly separated in analysis. They may, of course, be interrelated; a big investment may be required to finance inventive activity; innovation also usually involves investment of capital; innovation, moreover, may be based on a patented invention, constituting, in effect, its commercial exploitation. But there need not be such relationships: innovation may be based on nonpatentable inventions or even on nontechnological ideas,[243] and investment may be for new though not novel plant and equipment. Now, under the theory that the patent system is designed to stimulate innovation, existing patents (and pending patents) will play a direct role in the realization of this objective. The point is that *inventive* activity must precede the patent, whereas *innovating* activity may follow it. But the justification of the patent system as an incentive for innovating enterprise and for entrepreneurial investment would call for different supporting arguments than the justification as an incentive for invention. These arguments might have to include a demonstration that innovations based on patentable inventions are socially more desirable than other innovations, and that the free-enterprise system would not, without monopoly incentives, generate investment opportunities to an adequate extent—propositions which the supporters of the theories in question might not be willing to entertain. Moreover, there would be the additional question whether the promotion of innovating enterprise and of entrepreneurial investment can be held to be subsumed in the promotion of "science and the useful arts" which the Constitution of the United States stipulated as the sole objective of patent legislation.

These remarks have been prompted by observations on the value of (existing) patents to society. Several other value concepts remain to be discussed. The relationships between them are sufficiently complicated to require a more patient discussion and exposition and, perhaps, an explanation of the basic economic concepts involved.

H. PRIVATE AND SOCIAL COST AND VALUE: EXPLAINING BASIC ECONOMIC CONCEPTS

Economists have developed for their analytical work two pairs of concepts which are very handy once one has become familiar with them: "private cost," "social cost," "private value," and "social value." These concepts can be so helpful in our discussion that it would be well worth while to become adept in their use. The same holds also for an adjective by which the four terms can be modified, the word "marginal." This sounds as if the discussion were to become highly technical and full of professional jargon. But I believe we can remain on the level of general intelligibility, save for the few

[242] "Finally, and of major importance, the patent system * * * encourages the exploitation and commercial development of the invention." John C. Stedman, op. cit., supra, note 66, p. 653. "The controversy between the defenders and assailants of our patent system may be about a false issue—the stimulus to invention. The real issue may be the stimulus to investment." Concurring opinion of Judge Jerome Frank in *Picard* v. *United Aircraft Corp.*, 128 F. 2d 632, 643 (2d Cir. 1942).

[243] Schumpeter distinguished five classes of innovation: new products, new methods of production, new market outlets, new sources of supply, and new industrial organization. Joseph A. Schumpeter, The Theory of Economic Development (1934), p. 66.

by someone else will be permitted to use it or sell it—even if he has copied it—whereas anyone who develops a technology exactly like one developed earlier by someone else will be prohibited, by the patent rights granted to the "first inventor," from using it or selling it—even if his work was entirely independent.[238]

An old fallacy relates to the "adequacy" of the "reward" to the inventor. The assertion has been made, and is still being repeated, that the "rewards" which inventors or their assignees earn through profits from exclusive use of the patented inventions are in proportion to the "social usefulness" of these inventions. There is no reason why this should be so, and in fact no such proportionality, or approximate proportionality, can possibly be shown. It is well known that several inventions which have later proved to be of immense usefulness to society were somewhat "ahead of their time" when they were made and patented, and have earned nothing for their creators. It is firmly established that patents on some trivial gadgets have earned millions for their owners while patents on technically highly significant processes have been financially unrewarding. In general, the profits made from the commercial exploitation of a patent depend in part on the degree of restriction on the output produced under the patent. It is more than probable that the socially most important inventions, say, of drugs or vaccines for the cure or prevention of cancer, would not be allowed to be exploited with the same monopolistic restrictions that are freely tolerated in the exploitation of patents on hair curlers, bottle caps, or television screens.

The most perplexing and disturbing confusions occur in discussions about the "value of patents." This is no wonder, what with the large number of possible meanings in the minds of the writers on the subject: they may be talking about (*a*) the value of patents to their owners, (*b*) the value of patents to society, (*c*) the value of the patent system to society, (*d*) the value of patented inventions to their users, (*e*) the value of patented inventions to society, (*f*) the value of patent-induced inventions to society.[239] But even this is not all, because the social value of inventions may depend on the degree to which they are used, and the value of patents to their owners on the way they are exploited.

Singling out, from this long list, (b) the value of patents to society—and making quite sure that this refers neither to the social benefits of the patent system nor to the social value of the inventions, which are altogether different matters—it is worth pointing out that existing domestic patents held by domestic owners cannot be reasonably regarded as parts of the national wealth or as sources of real national income. To regard them so is as fallacious as it would be to include in national wealth such things as the right of a businessman to exclude others from using his trade name, or the right of a (domestic) creditor to collect from his (domestic) debtors, or to include such things as (domestic) money, securities, damage claims, and lottery tickets. The right of a person to keep others from doing something is

[238] From an economic point of view, "property" and "monopoly" have almost nothing to do with each other. A seller who owns his wares has property—but no monopoly if many other people independently sell similar things in the same market. A seller who can control the price of what he sells, because no one seriously competes with him in the market, has a monopoly—but no property if he does not own what he sells. (For example, he may "sell" the products of cartel members or the labor of union members.)

[239] Not all patented inventions are "induced" by the hope for profits from a prospective patent monopoly; some inventions would also be made in the absence of a patent system. See, infra, pp. 63–64.

discoveries by accident." [234] The idea is that the research teams engaged in "inventing around patents," or in inventing to obtain patents to "block" other people's efforts to "invent around patents," might by sheer accident hit upon something really useful. In other words, the work of these research forces is justified by the possibility or probability that they might find something which they did not set out to find.

There is no doubt that these happy accidents occur again and again. But can one reasonably let an effort to produce something without social value take the credit for accidental byproducts that happen to be useful? Can one reasonably assert that research not oriented toward important objectives is more likely to yield useful results than are research efforts that are so oriented? Is it easier to find the important by seeking the unimportant?

There is good historical evidence for the truth in the old saying that "necessity is the mother of invention." The continental blockade in the Napoleonic War led to the development of beet sugar; the blockade in World War I led to the process of obtaining nitrogen from air; the U-boat blockade in World War II led to the invention of atabrine as a substitute for quinine; etc., etc. Does it follow that it would be a good idea to institute more blockades? Perhaps the necessity of seeking substitutes would help us find many fine things; "serendipity" might yield splendid results.

If the Nation had masses of unemployed scientists and a scarcity of research problems, a strong case could be made for encouraging research of any kind; even an assignment to duplicate inventions made in the past might yield accidental inventions of great usefulness. But the situation is different: there is a scarcity of imaginative scientists and there is no scarcity of unsolved problems. The use of scarce research resources for seeking alternative solutions to satisfactorily solved problems can hardly be justified under the circumstances—no matter how well serendipity works.

G. SOME CONFUSIONS, INCONSISTENCIES, AND FALLACIES

The discussions in the last section or two have been somewhat apart from the main stream of the debate on the traditional issues concerning the patent system. Some of these issues cannot be finally resolved inasmuch as they rest on unprovable articles of faith or morals. Others, however, involve confusions which can be clarified, inconsistencies which can be shown up, or fallacies which can be exposed. The arguments—the confuted or the confuting ones—will for the most part be recognizable as those advanced by a number of writers mentioned in the previous survey of economic opinion.[235]

A slight inconsistency can be discovered with regard to the bargain theory—that patent protection is exchanged for the disclosure of secrets. The theory asserts that great benefits are obtained for society by securing the general availability, after 17 years or so, of

[234] The word was "coined by Horace Walpole upon the title of the fairy tale The Three Princes of Serendip [the former name of Ceylon], the heroes of which 'were always making discoveries, by accidents and sagacity, of things they were not in quest of.'" Oxford Universal English Dictionary (Oxford: 1937), p. 1847. In a recent article entitled "Serendipity: the art of being lucky in a laboratory," it was stated: "Of course, significant chance discoveries are the blue diamonds of laboratory searching. They are as rare as they are unpredictable. Well-organized research along clearly defined lines is most often the method by which modern science achieves its goal." The Lamp (Standard Oil Co., New Jersey), vol. 35, No. 3 (September 1953), p. 20.

[235] I trust I shall be pardoned if I do not cite any of the writers who have fallen victim to what are here considered "confusions, inconsistencies, and fallacies."

shifted almost anywhere, and there may be engineering skills that are usable in all sectors. But what is chiefly necessary for transfers between sectors is that the youngsters in the schools and colleges, and in the graduating classes, can turn in one direction or another. The relative attractiveness of the job opportunities open to the new entrants into the labor force will ordinarily influence their choice of occupations and may bring about a considerable change in the allocation of human resources. This would be enough for the argument presented. Whatever transferability exists at later stages of human careers will increase the ease with which the shifts of resources between sectors are accomplished.

If resources were not transferable at all, neither in the short run nor in the long, then of course research could not encroach on alternative uses of resources. But in this case all incentives to research would be futile, for research could not be increased beyond the limits set by the number of research talents in existence. (Let us remember, the flexibility of the number of hours worked is important for "crash programs" in an emergency, but not for long-run programs.) With the number of researchers and inventors given and unchangeable, the case for the patent system, or for any other device to stimulate inventive activities, would be lost. Fortunately it is not so. While the supply of inventive talent and research brains may, in the short run and over a certain range, be relatively inelastic, it need not be so over all ranges and over longer periods. Research and inventive activities *can* be expanded—at the expense of other economic activities.

F. COMPETITIVE RESEARCH, WASTE, AND SERENDIPITY

Not only is research in general competitive with other economic activities, but research on particular problems and in particular fields is competitive with research on other problems and in other fields. This needs to be mentioned chiefly because in recent years another concept of "competitive research" has received increased attention: different firms and different research teams competing with one another in finding solutions to the same research problem in the same field.

Competition among rival firms which takes the form of a race between their research teams—a race, ultimately, to the patent office—may have various objectives: (*a*) To be the first to find a patentable solution to a problem posed by the needs and preferences of the customers—a better product—or by the technological needs and hopes of the producers—better machines, tools, processes; (*b*) after a competitor has found such a solution and has obtained exclusive patent rights in its exploitation, to find an alternative solution to the same problem in order to be able to compete with him in the same market—in other words, to "invent around" the competitor's patent; and (*c*) after having found and patented the first solution, to find and patent all possible alternative solutions, even inferior ones, in order to "block" competitor's efforts to "invent around" the first patent.

These forms of "competitive research" were described and discussed by antipatent economists during the patent controversy of the 19th century. Concerning the first form, there was much complaint that other inventors who discovered practically simultaneously "the same utility," but were not the first in the race to the patent office,

generation. No statistical technique is available to measure a "net increase in knowledge" when a high rate of output of new technical knowledge, inclusive of inventions, is accompanied by a decline in the performance of the schools. The time may come when a lack of adequately trained graduates of the schools creates a bottleneck, obstructing not only further progress in the arts but also the maintenance of the general productivity of the people. Since the production and reproduction of knowledge nowadays is almost completely a government concern, an imbalance cannot be corrected by free enterprise. Schools are maintained chiefly by local government; more than 50 percent of research and development is financed by the central government; and even the rest of industrial research is—according to many authorities—largely dependent on incentives held out by the governmental system of patent protection for inventions. Thus, whatever imbalance develops within the production and reproduction of knowledge as well as between it and the production of investment goods and consumers goods is not to be blamed on the competitive economic order but on the inadequacies of governmental planning.

These are not just academic speculations but very real problems of urgent concern to our democratic process. The high taxes needed to finance education and research cannot but impinge on the production of other things, and industry feels the pinch not a little. On the other hand, the neglect of education is becoming increasingly notorious and is partly attributable to the inflationary increases of wages and salaries in industry which have made the financial rewards to teachers and scholars inadequate for the maintenance of the required supply.

With these competing demands on the productive resources of the Nation, the problem of relative allocation deserves more thought than it has been given. According to their special interests, or often out of sheer enthusiasm, different groups try to promote increased outlays for capital investment, increased expenditures for education, increased disbursements for industrial research and development, and increased consumer spending, all at once—not just in times of depression (when it would make sense) but all the time. Of course, every one of these increases would be fine to have, but since they compete with one another we should first make up our collective minds regarding the comparative advantages. No matter whether an increase in industrial research is financed by the government or by private industry (under the patent system or with some other stimulus) the decision to increase inventive activities is fully rational only when it looks likely that productivity can be raised faster and maintained more securely by more new technical knowledge than by more education and more capital equipment. If the total amount of productive resources that can be withheld from the production of consumption goods is limited—as it must be—how much should be allocated to the production of capital goods and how much to the reproduction of established knowledge, and how much to the production of increased technical knowledge, is a matter of judgment. To allot *all* the resources that can be spared from the consumption sector exclusively to technological research would surely be foolish; if old capital equipment cannot be replaced by new equipment, newly invented techniques would do no good, and without proper education of the new generation the future of the Nation may be jeopardized. To allot *none* of the available resources to inventive activities would be stupid too. Thus, it

Just as one must not count on unemployed labor resources for the execution of long-run programs, one must not assume the availability of idle capital. Whenever permanent economic policies—not just war or depression measures—are discussed, sound economics must start from the principle that no activity can be promoted without encroaching on some other activity. More of one service or product must mean less of another. Assume, then, that the available productive resources are allocated among four uses: (1) The production of consumers goods, (2) the production of capital goods, (3) the production of knowledge, and (4) the production of security from invasion and revolution. Any increased allocation to one use reduces the allocations to some or all of the others. For example, if the threat of invasion or revolution increases, resources have to be withdrawn from the other uses; if that threat is reduced, resources can be transferred and larger allocations made elsewhere. Let us, for the sake of simplicity, hold the security allocation constant and forget about it. Let us also agree to dispose of the question of population growth, either by thinking of the whole allocation problem in terms of percentages (and in terms of output per head) or, alternatively, by assuming that population stays constant.

Capital goods are produced partly to maintain the existing stock of capital goods, partly to increase it. The production of knowledge may likewise be so divided, because trained people who retire or die must be replaced by young persons who have to be trained and educated, so that the maintenance of an existing stock of knowledge requires constant replacement, and only a part of the resources devoted to the production of knowledge can, through research and development, increase the stock of existing knowledge.

An increase in the stock of knowledge may lead to a rise in productivity and thus to increases in the output of consumers goods and capital goods. Similarly, an increase in the stock of capital goods may raise productivity and thus permit increases in production. This suggests that consumption can be increased if the accumulation of capital and knowledge is increased. But, alas, such accumulation presupposes the availability of resources, and from where can they come? If resources have been fully used, increased appropriations for investment in capital and knowledge imply reduced appropriations to the production of consumers goods. There is, therefore, a dilemma: The way to increased consumption is first to reduce it. Only after reducing the production of consumers goods by transferring resources to the production of capital goods and of useful knowledge can the increased stocks of capital and knowledge raise productivity and eventually enable the diminished resources that are allotted to consumers-goods production to bring their output back to tbe former level and above it.

These fundamental principles are sometimes forgotten, especially in rich economies or in economies with large pools of unemployed resources of some sort; yet they are essential to our understanding of economic development. It is so very difficult for an undeveloped economy to advance to higher levels because poor people would starve to death before they could accumulate enough capital equipment and useful knowledge to raise their productivity sufficiently to permit a substantial increase in their consumption. The same principles work also in highly developed countries, though usually by affecting rela-

inventor the power to restrict to himself the use of that knowledge. It grants statutory monopolies but it arose out of an act to curb monopoly. It flourished most vigorously in the 19th century, the great period of economic competition, and even now it is more robustly defended and embodies the most extensive monopoly rights in those countries which most tenaciously adhere to the competitive system of private enterprise. It is a crude and inconsistent system. It is based upon the assumption that the right and proper reward for the innovator is the monopoly profit he can extract in an arbitrarily fixed period. It offers the same reward to all inventors, irrespective of the intellectual merits of their inventions. It provides rewards for certain kinds of discoveries but usually confers no such rewards for other kinds of discovery, * * *. The standards of patentability, the patent period, the conditions attached to the patent have varied greatly from time to time in the same country and vary as between different countries.

The patent system lacks logic. It postulates something called "invention" but in fact no satisfactory definition of "invention" has ever appeared, and the courts, in their search for guiding rules, have produced an almost incredible tangle of conflicting doctrines. This confusion has led to extensive and costly litigation. Its critics have described the patent right as merely "something which has to be defended in the courts" and, because it may put the individual inventor at a disadvantage against the larger corporations, as "a lottery in which it is hardly worthwhile taking out a ticket."

The system, too, is wasteful. It gives protection for 16 years (or thereabouts) whilst in fact over nine-tenths of the patents do not remain active for the whole of this period. It is dangerous in that the monopoly it confers can often be widened by its owner into fields and forms which it was never intended he should possess.

It is almost impossible to conceive of any existing social institution so faulty in so many ways. It survives only because there seems to be nothing better.[227c]

E. SOME BASIC ECONOMIC QUESTIONS

Patents, by giving their owners exclusive rights to the commercial exploitation of inventions, secure to these owners profits (so-called "quasi-rents") which are ultimately collected from consumers as part of the price paid for goods and services. The consumers pay; the patent owners receive. Are the consumers—the non-patent-owning people—worse off for it?

"No; they are not," says one group of economists. Patents are granted on inventions which would not have been made in the absence of a patent system; the inventions make it possible to produce more or better products than could have been produced without them; hence, whatever the consumers pay to the patent owners is only a part of the increase in real income that is engendered by the patent-induced inventions.

"Wrong," says another group of economists. Many of the inventions for which patents are granted would also be made and put to use without any patent system. The consumers could have the fruits of this technical progress without paying any toll charges. Even if *some* inventions are made and used thanks only to the incentives afforded by the patent system, consumers must pay for *all* patented inventions and, hence, lose by the bargain. Moreover, if patents result in monopolistic restrictions which hold down production and hinder the most efficient utilization of resources, it is possible that total real income is less than what it would be without the patent system. Of course, there is impressive technical progress and a substantial growth of national income under the patent system, yet perhaps less so than there would be without patents.

[227c] Id., pp. 251–253.

suppression of patented inventions, the alleged evil of suppression would simply reduce the supposedly ill effects of the accelerated obsolescence that is attributed to the patent-generated advance of technology. The complaint of excessive obsolescence does not go well with a number of additional indictments of the patent system on charges that it may impede the improvement of existing patented techniques [220] and "seriously retard continued research." [221] Sir Josiah Stamp, among others, makes the point that existing patents may hinder the development of important inventions, and he illustrates the point by referring to James Watt's invention of the steam engine and the 7-year extension granted for his patent:

> While, having regard to the first-rate importance of the invention, the monetary reward of the patentees was not excessive, it seems pretty clear that the extension was too great and that it hindered the development of the steam engine in this country. Boulton and Watt, from the first, had refused to grant licences to other engineers to work under the patent; the patent blocked the way of other inventors, and Watt himself had come to the conclusion that there was nothing to be gained by trying new schemes.
>
> From the point of view of being profitable the industrial gestation of Watt's steam engine was short. But if judged by the *spread* of the invention on the widest possible scale, it was prolonged by the inventor's own act. But the same might be alleged of many patents, and we cannot judge fairly by what would happen if there were no patent system.[222]

The emphasis which Stamp and other economists have put on the "negative results" of the patent system does not imply that they regarded the negative results as overbalancing the positive ones. The emphasis has been necessary because so many defenders of the patent system in their enthusiasm have made it out as a blessing without any cost to society. Several economists have pointed to certain cost items, but have assumed that the costs are safely below the gains attributable to the system. This, for example, is the opinion of John Bates Clark:

> It is of course true that a patent may often be granted for something that would have been invented in any case, and patents which are granted are sometimes made too broad, and so cover a large number of appliances for accomplishing the same thing. In these cases the public is somewhat the loser; but * * * this loss is far more than offset by the gain which the system of patents brings with it.
>
> The gains of the inventor cannot extend much beyond the period covered by his patent, unless some further and less legitimate monopoly arises. [In such cases] the public pays more than it should for what it gets; and yet even in these cases it almost never pays more than it gets. The benefit it derives is simply less cheap than it ought to be.[223]

Others have not been so sure and, in the absence of conclusive evidence, raised doubts and reserved judgment.

It seems to take courage even to register doubts about the net benefits of the patent system. Some of the faithful, ardent believers in the patent system in its present form as an inherently moral institution, as a necessary component of a system of private property, as an integral part of a free-enterprise economy, and as an indispensable spur to economic progress, have been quick to bear down on unbelievers with invectives and innuendos. Perhaps this sort of pressure has something to do with the fact that agnostics on the economics of

[220] Richard T. Ely, Outlines of Economics (5th ed. 1930), pp. 561–562.
[221] Alfred E. Kahn, op. cit., supra, note 159, p. 482.
[222] Josiah Stamp, Some Economic Factors in Modern Life (London: 1929), p. 102. In the first of the two paragraphs Stamp reproduces a passage from Henry W. Dickenson and Rhys Jenkins, James Watt and the Steam Engine (Oxford: 1927), p. 6.
[223] John Bates Clark, op. cit., supra, note 151, p. 362.

rapid while the firms expect it to be slow, society will get the benefit of innovation as well as of rapid imitation.

To buy innovation by paying with unnecessarily long delays of imitation is a poor bargain for society to make. Imitation always and necessarily lags behind innovation. It will be the best deal from the point of view of society if innovators optimistically overestimate this lag. If they expect the lag to be longer than it actually is, innovation will be enhanced and imitation will not be delayed. That it may create this socially wholesome illusion on the part of innovators is the strongest justification for a well-designed patent system.[203]

A. C. Pigou included "the perfecting of inventions and improvements in industrial processes" in the—

class of divergencies between marginal private net product and the marginal social net product * * * [because] the whole of the extra reward, which they at first bring to their inventor, is very quickly transferred from him to the general public in the form of reduced prices. The patent laws aim, in effect, at bringing marginal private net product and marginal social net product more closely together.[204]

This formulation of the aim of the patent system commands widest agreement among economic theorists, though not all economists would agree that government interventions should be resorted to whenever divergencies between social and private "marginal net products" are found; nor would all agree that the patent system was the best kind of government intervention for the particular purpose. Frank H. Knight has serious doubts in this respect and proposes that—

it would seem to be a matter of political development to provide a better way of rewarding these [inventive] services than even a temporary monopoly of their use * * *.[205]

F. A. Hayek expresses the same misgivings:

In the field of industrial patents in particular we shall have seriously to examine whether the award of a monopoly privilege is really the most appropriate and effective form of reward for the kind of risk bearing which investment in scientific research involves.[206]

An interesting statement is offered by Joan Robinson of what she calls "the paradox of patents":

A patent is a device to prevent the diffusion of new methods before the original investor has recovered profit adequate to induce the requisite investment. The justification of the patent system is that by slowing down the diffusion of technical progress it insures that there will be more progress to diffuse. The patent system introduces some of the greatest of the complexities in the capitalist rules of the game and leads to many anomalies. Since it is rooted in a contradiction, there can be no such thing as an ideally beneficial patent system, and it is bound to produce negative results in particular instances, impeding progress unnecessarily, even if its general effect is favorable on balance.[207]

Since many writers on the patent system have shut their eyes to the "negative results", several economists have made it their task to expose them. One of the frequently made charges concerns the partiality with which the patent system operates in favor of economic concentration and bigness, and to the disadvantage of small business. Thus, Alfred Marshall states that the patent law "tells on the side of the strong capitalist in competition with men of smaller means".[208]

[203] Fritz Machlup, The Economics of Sellers' Competition (1952), pp. 555-556.
[204] A. C. Pigou, op. cit., supra, note 182, p. 185. For an explanation of the technical terms used in this statement see below, pp. 56-58.
[205] Frank H. Knight, Risk, Uncertainty, and Profit (1921), p. 188.
[206] Friedrich A. Hayek, Individualism and Economic Order (1948), p. 114.
[207] Joan Robinson, The Accumulation of Capital (1956), p. 87.
[208] Alfred Marshall, op. cit., supra, note 169, p. 244.

it be assumed that inventors would cease to be employed if entrepreneurs lost the monopoly over the use of their inventions. Businesses employ them today for the production of nonpatentable inventions, and they do not do so merely for the profit which priority secures. In active competition, the condition in which new devices are most promptly imitated, no business can afford to lag behind its competitors. The reputation of a firm depends upon its ability to keep ahead, to be first in the market with new improvements in its products and new reductions in their prices.[194]

Corwin Edwards seems prepared to agree with the proposition that small enterprises may be unwilling to sink large amounts into development work while their rivals stand by and can—

adopt the perfected technique without incurring equivalent expense and can then force prices so low in competition as to prevent the pioneering concern from recovering the costs of development. On this theory technological progress would be retarded by the absence of patent monopolies even if there were no diminution in the amount of invention and disclosure.

Whatever merit these theories may have when they are applied to the work of individual inventors in a society of small enterprises in which inventions are relatively infrequent, they do not adequately describe the impact of the patent system in a society in which large corporations maintain research departments, purchase large numbers of inventions by outsiders, and use, simultaneously and consecutively, the monopoly power given by many patents. Change of scale in the use of patents has substantially affected both the nature of the patent grant and the effect of the patent monopoly upon the market.[195]

The thesis that patent monopolies are needed to encourage the development and practical application of inventions, even if they are not needed to stimulate the inventive activity itself, has been most strongly enunciated in the controversy about compulsory licensing. The point there has been that revenues from licensing would be insufficient and nothing less than the monopoly profits from exclusive use of the invention could allow enterprises to recover development costs. Corwin Edwards finds that this danger has been vastly exaggerated:

It has been exaggerated to such an extent as to imply the question why any outlays to develop products and markets are ever made where there is no patent protection.[196]

Products and markets are developed all the time in fields where there is no patent protection, and the required outlays are made partly because producers must keep up with their innovating competitors if they want to stay in business, partly because they believe that the natural headstart which their own innovation gives them over their competitors will allow them to recover the expenses of developing the products and markets. This is Sir Arnold Plant's contention.[197] That the natural headstart would provide adequate profit incentives for the introduction of cost-reducing inventions has been also the contention of Ravenshear.[198] E. A. G. Robinson mentions that many manufacturers do not rely on the exclusivity promised by the patent grant, partly because of doubts in the validity or insuperability of the patent:

In practice the enforcement of patent monopolies is often so difficult, and so expensive in legal fees, that competing manufacturers have in some industries preferred to pool patents; and to look for a sufficient reward for technical invention in the year or so more's advantage of priority that earlier experimentation usually gives and in the subsequent goodwill that may arise from it.[199]

[194] Arnold Plant, op. cit., supra, note 163, p. 43-44.
[195] Corwin D. Edwards, op. cit., supra, note 166, p. 217-18.
[196] Id., p. 247.
[197] See his statement quoted above, p.35 .
[198] See his statement quoted on p. 36.
[199] E. A. G. Robinson, Monopoly (Cambridge: 1941), p. 120.

readily be isolated as the just patentee, so that all patents are held by the collectivity—the corporation. Because the process of invention is more than ever a complex process of minute accretion, the individual patent is seldom large enough to exploit by itself; therefore patents are pooled as a basis of exploitation by the firm which acquires them.

For the inventors in the laboratories, the modern incentive is probably preferable to the old. These men are specialists, professionals who like their work. Where society accords scientists and inventors steady income, respect, a career, and a laboratory, it is safe to assume that most prefer these emoluments, facilities, and associations to the uncertainties of isolated research and business adventure.[189]

The question is no longer whether the patent system stimulates inventive talents to use more of their time and energy than they otherwise would for the development of new technology, but rather whether it stimulates business corporations to hire more of these talents than they otherwise would for this task. If this is affirmatively answered, the second question arises whether this use of the talents is superior to the alternative uses from which they are diverted. To answer both questions, Ravenshear makes a distinction between "intensive inventions"—those which cheapen the production of known products—and "originative inventions," which "produce a result not previously attained." No special inducement, he believes, is needed with regard to "intensive inventions"; but "originative inventions" call for investments which firms would not undertake without the patent incentive:

> A manufacturer with an established business is under the strongest inducement to adopt any means available for cheapening the production of [existing] articles * * * His market being assured, the adoption of such means is not only calculated to bring him additional profit, but the risk of not finding a market which attaches to new products is absent. The cheapening of production is, in fact, the most powerful instrument of competition he can employ. If he can profitably undersell his rivals in an established trade he occupies the most advantageous position to which he can attain. No patents appear to be necessary to induce him to take this step whenever the opportunity offers, and to secure by suitable remuneration the aid of employees who by the exercise of their ingenuity can assist him in this direction. On the other hand, most of these advantages are lacking in the case of originative invention. For a new product there is no assured market; both the sale and the profits are problematical. It may be long before the utility and advantages of the new article can be made generally known. And the calculations and estimates as to the possible demand may not be realized. Not only so, but in addition to the outlay of capital in putting a new product on the market after the producer is satisfied of its value, this stage is often preceded by a long and costly period of experiment and trial, and, even after this period has been passed, unexpected difficulties are often met with when the manufacture is begun on a commercial scale. The manufacturer, then, other things being equal, will naturally turn rather to intensive invention than to originative invention as a means of extending his trade. It is here that the patent system steps in to turn the scale in favor of originative invention * * * the final conclusion is that patents exercise a net influence in stimulating the growth of industry where stimulation is most needed, and thereby tend to counteract the effects of those causes which tend to diminish total activity and to generate employment.[190]

The thesis that patent protection is needed as a stimulus to invention has been first supplemented and then replaced by the thesis that it is needed as a stimulus to the practical use of new inventions in industry. Financing the work that leads to the making of an invention may be a relatively small venture compared with that of financing its introduction, because costly development work, experimentation in production and experimentation in marketing may be needed before the commercial exploitation of the invention can begin. The risks

[189] Alfred E. Kahn, op. cit., supra, note 159, p. 481.
[190] A. F. Ravenshear, op. cit., supra, note 176, pp. 52–55.

Frank W. Taussig is skeptical concerning the need of incentives to induce men to "invent and contrive." He questions the proposition that—

men contrived simply because this was conducive to gain, and would not contrive unless prompted by the experience and prospect of gain.[178]

He holds—

that there is an instinct of contrivance, and that there is a keen satisfaction in following it. * * * To say that the forward march of the industrial arts is dependent on a patent system is like saying that poetry, music, the plastic arts are merely forms of moneymaking.[179]

On this ground—

we may be led to conclude that the patent system * * * is a huge mistake.[180]

Taussig does not come to this conclusion. For, even if the patent system is not needed to stimulate men to invent, and even if the total amount of invention would be the same with or without a patent system, the system may still be important in redirecting inventive activity into the most useful channels:

The defenders of patent legislation often descant on the public's benefit from inventions as if there were a special moral desert on the part of the projectors and patentees. They put their case badly. What deserves emphasis is the influence of calculated profit in directing the inventor's activity, spontaneous though it be, into channels of general usefulness.[181]

A. C. Pigou accepts this position without further argument:

By offering the prospect of reward for certain types of invention, they do not, indeed, appreciably stimulate inventive activity, which is, for the most part, spontaneous, but they do direct it into channels of general usefulness.[182]

Sir Arnold Plant concurs with the opinion that the patent system diverts or redirects economic activity, but he questions the greater "general usefulness" of the favored channels. He distinguishes two kinds of diversion, namely—

from other kinds of activity into invention, and from one kind of inventive activity to attempts to make such patentable inventions as will, in the expectation of the inventor or of those directing his efforts, produce the greatest possible remuneration under a regime of monopoly.[183]

What grounds are there for concluding that the output induced by this type of monopoly has any greater claim to be regarded as "generally useful" than that which would have been induced in its absence by the price conditions of the open market? I suggest that such a conclusion runs counter to all general presumptions concerning the disposition of scarce productive resources in a regime of monopolistic control as contrasted with open competition.[184]

Concerning the diversion "from other kinds of activity into invention," the question which the defenders of the patent system have—

failed to ask themselves * * * is what these people would otherwise be doing if the patent system were not diverting their attention by the offer of monopolistic profits to the task of inventing. By what system of economic calculus were they enabled to conclude so definitely that the gain of any inventions that they might make would not be offset by the loss of other output? By no stretch of the imagination can the inventing class be assumed to be otherwise unemployable. Other product which is foregone when scarce factors are diverted in this way completely escaped their attention.[185]

[178] Frank W. Taussig, Inventors and Money-Makers (New York: 1915), p. 17.
[179] Id., p. 19.
[180] Ibid.
[181] Id., p. 51.
[182] Arthur C. Pigou, The Economics of Welfare (London: 4th ed. 1932), p. 185.
[183] Arnold Plant, op. cit., supra, note 163, p. 42.
[184] Ibid.
[185] Id., p. 40.

The "exchange-for-secrets" thesis of patent protection does not find the strong support among economists that it has among other writers on patents. Several economists have shown considerable skepticism concerning the effectiveness of the patent system in eliciting the disclosure of technological secrets that would have much chance of remaining secret for long. The skepticism seems to rest on different considerations, stressed by different writers, who refer to the unwillingness of firms to patent what they think they may be able to keep secret; the unwillingness of researchers to publish what they think they may later develop into patentable inventions; the ability of inventors to obtain patents despite incomplete disclosure; and the inability of manufacturers to keep secret most of the technology they use and, consequently, society's munificence in granting monopolies for the disclosure of what would become known in any case.

Alfred Marshall was among those who called attention to the first of these points. Though he was convinced that—

it is generally in the public interest that an improvement [in technology] should be published, even though it is at the same time patented—

he also stated that—

in many businesses only a small percentage of improvements are patented—

and that—

the large manufacturer prefers to keep his improvement to himself and get what benefit he can by using it [without patenting it]—

partly because the "chief point" of some inventions—

lies in noticing that a certain thing ought to be done; and to patent one way of doing it, is only to set other people to work to find out other ways of doing it * * *.[169]

Floyd Vaughan maintained that the patent system worked to the disadvantage of the individual inventor and actually "encourages him to keep his invention secret." [170] Michael Polanyi finds this true for large industrial laboratories, chiefly because of the "purely formal tests" for the novelty of an invention. The resulting—

anomaly * * * is clearly demonstrated by the common practice pursued by industrial laboratories with respect to the publication of the results of their chemical investigations. Since they never feel sure that a chemical process may not one day be discovered to possess technical importance, they try to avoid impairing the novelty of possible future patent claims, by keeping chemical discoveries unpublished—or at least considerably delaying their publication—whenever the discoveries have any bearing on technical materials or industrial processes.[171]

The point that patent monopolies are often granted in exchange for incomplete disclosure is made by several writers. Corwin Edwards, for example, writes:

The slipshod method of identifying inventions * * * makes it possible to obtain a process patent without revealing all that must be known in order to make effective use of the patented invention. Where this is done, the public does not receive the information that supposedly justifies the grant of monopoly rights to the inventor.

Instead, the patentee obtains the bargaining power attached to a legal monopoly and also continues to enjoy whatever bargaining strength he can derive from possession of a trade secret. So commonplace has inadequate disclosure become

[169] Alfred Marshall, Principles of Economics (London: 8th edition, 1920), p. 360.
[170] Floyd L. Vaughan, op. cit., supra, note 155, p. 220.
[171] Michael Polanyi, op. cit., supra, note 27, p. 71.

in the inventive work. This is stated, for example, by Edith T. Penrose:

> * * * One man may spend his life developing a great idea for which society is not ready; another may perfect a bright idea in an evening for a clever gadget which society is willing to buy in large quantities and to pay millions of dollars for. It seems unnecessary to labor the point that there is even less relation between monopoly profits and moral deserts than there is between such profits and the social usefulness of inventions.[161]

That there is no functional relation between the earnings under a patent (or its money value) and the "social usefulness" of the invention which it covers—and that, therefore, these earnings (or money value) cannot serve as an "index of usefulness" for inventions—was clear to all who realized that some great inventions require years or decades before they, and the markets for the products, are adequately developed, while other inventions can be commercially exploited with almost no delay. Thus, as Penrose wrote,

> The arbitrary limitation of the patent to the same period for all inventions irrespective of the time and expense it takes to perfect them and to develop a market for them may well result in the more difficult and elaborate inventions receiving a smaller "index" of usefulness than the easily developed, easily marketed inventions that catch the popular fancy quickly. In the former case only a small part of the total return may arise in the period for which the monopoly is granted while in the latter all of the return may accrue to the patentee.[162]

The fact that some creators of truly great inventions obtained hardly any returns during the terms of their original patents has been deplored for hundreds of years and has often induced proposals or actual legislation for flexible periods of protection, especially for extensions of the patent in deserving cases. On this question of a flexible, fixed, or extensible duration of patent protection, Sir Arnold Plant made an interesting observation, adding a suggestion for an abridgeable term:

> The term of the patent grant must inevitably be arbitrarily determined, even if each invention were separately considered. A fixed period of years for all and sundry expediently avoids countless difficulties, the range of which may be gaged from the efforts of the courts to determine, in the case of applications for extensions, the "nature and merits" of an invention; in order to decide whether the patentee has been "inadequately remunerated" and the period, if any, for which an extension shall be granted. Economists will well appreciate why the Royal Commission of 1862, which included Lord Overstone, was strongly opposed to any extensions whatever. Yet if there were a parallel provision, that any person interested might apply at any time during the life of a patent for its revocation on the grounds that the patentee was already more than adequately remunerated, some interesting legislation would certainly ensue, and the decisions of the courts, however lacking in principle, might well be preferable to the existing fixed minimum term.[163]

Strangely enough, there is an almost complete lack of analysis of the question of the "optimum" period of patent protection if the same period is to apply to all inventions.[164] From among the various remarks about the principles that might reasonably be employed if a system of flexible durations were used, we should perhaps record

[161] Edith Tilton Penrose, op. cit., supra, note 91, pp. 30–31.
[162] Id., p. 30.
[163] Arnold Plant, "The Economic Theory Concerning Patents for Inventions," Economica, new series, vol. I (1934), pp. 46–47.
[164] One finds occasional comments on the desirability of a shorter duration for petty patents—as is provided in the German law—or on the practicability of a flexible duration to be set by the courts to allow reasonable profits from the invention—as provided in the Australian law but no attempts to apply economic analysis to the problem.

In a similar vein, John Bates Clark attributed to patent monopolies a role in reducing existing monopoly power:

> While a patent may sometimes sustain a powerful monopoly it may also afford the best means of breaking one up. Often have small producers, by the use of patented machinery, trenched steadily on the business of great combinations, till they themselves became great producers, secure in the possession of a large field and abundant profit.[151]

Others, however, were less sanguine about the supposedly short-lived monopoly positions created by patents. Alfred Marshall recognized that "Many giant businesses have owed their first successes to the possession of important patents * * *."[152] J. B. Clark himself admitted the possibility that the sheltered position of the patentee is extended "beyond the period covered by his patent" when "some further and less legitimate monopoly arises," and that—

> the use of an important machine builds up a great corporation which afterward, by virtue of its size, is able to club off competitors that would like to enter its field * * *.[153]

Lionel Robbins describes the influence of patent protection as follows:

> Not merely does it directly protect the manufacturer of patented articles; it also permits the creation of a whole network of tying contracts, forced joint supply, resale price maintenance and other trade practices, not particularly conspicuous in themselves but cumulatively highly conducive to the consolidation of monopolistic conditions. Indeed it is so important an influence that it is no exaggeration to say that special lines of expertise exist, not to forward the progress of invention but merely to devise variations in productive processes permitting the continuation of this form of monopoly power.[154]

A long list of sins of patent monopolies against fair and free competition has been presented by Floyd L. Vaughan:

> Patent monopolies have employed nearly every means of competing unfairly. They have tended to destroy competitors and discourage would-be rivals regardless of their efficiency. The various kinds of unfair competition committed in the name of patents are * * * : Monopolistic agreement concerning purchases and sales, dictation of supplementary supplies, control of complementary goods, maintenance of resale prices, [harassing] litigation, [insidious] interference proceedings, forced validity of patents, forced royalties, false marking, and piracy.[155]

Arthur R. Burns charges that the patent law has restricted competition to a much greater extent than would be inherent in the principle of patent protection:

> The law with regard to patents rests upon a departure from competition. The prospect of monopoly profits protected by law for a prescribed period is held out as a bait to encourage the improvement of methods of production. The contribution of the patent law to the decline of price competition has passed far beyond the limits suggested by this principle.[156]

The same charge is made by F. A. Hayek, who writes:

> The systematic study of the forms of legal institutions which will make the competitive system work efficiently has been sadly neglected; and strong arguments can be advanced that serious shortcomings here, particularly with regard to the law of corporations and of patents, have not only made competition work much more badly than it might have done, but have even led to the destruction of competition in many spheres.[157]

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[151] John Bates Clark, Essentials of Economic Theory (1927), pp. 367–368.
[152] Alfred Marshall, Industry and Trade: A Study of Industrial Technique and Business Organization (London: 1919), p. 534.
[153] John Bates Clark, op. cit., supra, note 151, p. 362.
[154] Lionel Robbins, op. cit., supra, note 145, p. 73.
[155] Floyd L. Vaughan, Economics of Our Patent System (1925), p. 106.
[156] Arthur Robert Burns, The Decline of Competition (1936), p. 11.
[157] F. A. Hayek, The Road to Serfdom (London: 1944), p. 28.

from the state, is it not his right to exploit his monopoly? * * * One can maintain that in this case the manufacturer has a right of property in his invention, that in selling the product, he is selling the invention, of which the product is the fruit, and that he has the right to make this product in such quantities as he pleases and to sell it at the price he pleases. Thus the interest of the consumer should yield here to the rights of property.[137]

Ludwig von Mises, speaking of "technological knowledge required for production" as "recipes," stated:

Such recipes are as a rule free goods as their ability to produce definite effects is unlimited. They can become economic goods only if they are monopolized and their use is restricted.[138]

The essential fact concerning these recipes is the—

inexhaustibility of the services they render. These services are consequently not scarce, and there is no need to economize their employment. Those considerations that resulted in the establishment of the institution of private ownership of economic goods did not refer to them. They remained outside the sphere of private property not because they are immaterial, intangible, and impalpable, but because their serviceableness cannot be exhausted.[139]

While the idea of property in an invention is not taken seriously by modern economists, a "property right" in a patent and in the limited monopoly which it grants is of course an accepted legal institution. A sophisticated answer to the question of just what is "owned" by the patentee was given by John R. Commons, according to whom the—

object claimed and owned is merely the expected behavior of other people to be obtained through expected restraint of competition and control of supply. * * *[140]

Perhaps it is necessary to mention, though it ought to be commonplace, that the rejection of the notion of private property in ideas implies neither antagonism to the institution of private enterprise nor hostility to the patent system.[141]

While some economists before 1873 were anxious to deny that patents conferred "monopolies"—and, indeed, had talked of "property in inventions" chiefly in order to avoid using the unpopular word "monopoly"—most of this squeamishness has disappeared. But most writers want to make it understood that these are not "odious" monopolies but rather "social monopolies", "general welfare monopolies",[142] or "socially earned" monopolies.[143] Most writers also point out with great emphasis that the monopoly grant is limited and conditional. Thus, Friedrich von Wieser wrote that the inventor's—

[137] Leon Walras, Etudes d'économie politique appliquée (Lausanne: 2d edition, 1936), pp. 201–202. (First published in 1898.) Walras proceeds to argue that the consumer's interest may also be furthered by the disclosure of technological secrets effected by the patent system. On this issue see pp. 31–32 below.

[138] Ludwig von Mises, Human Action: A Treatise on Economics (1949), p. 360.

[139] Id., p. 657.

[140] John R. Commons, Legal Foundations of Capitalism (1924), p. 279.

[141] "But the principle that private property must be protected for the sake of the common welfare is fundamental to our western civilization and is, I believe, the only ground on which political freedom can thrive. Whether there should be any private property in 'ideas' is a different question—which most of those who have thought about it have answered with 'No.' It is easy to understand why.

"The institution of private property serves important social, economic, and political purposes. The economic philosophy of private property in material things, is, however, not directly applicable to the problem of private property in ideas. While only a very limited number of people can at one and the same time write on the same desk, drive the same truck, work on the same lathe, stay in the same house, till the same piece of land—an unlimited number of people can simultaneously use the same idea. The right to exclude others from the use of particular material things is necessary for their efficient use, nay, for the prevention of chaos. There *must* be somebody who decides about the disposition of these things and can exclude 'unauthorized' users. This is no 'must' with respect to ideas. The right to exclude others from using an idea demands a justification on altogether different grounds." Fritz Machlup, The Political Economy of Monopoly (1952), pp. 280–281.

[142] Richard T. Ely, Outlines of Economics (5th edition, 1930), pp. 561–562; also Ely, Property and Contract in Their Relations to the Distribution of Wealth (1914), p. 346.

[143] Frank A. Fetter, Modern Economic Problems (2d edition, 1922), vol. II, p. 507.

money, in research, experimentation, development, and pioneer plants; in order to be effective, the hoped-for gains from the hoped-for monopoly may have to be a multiple of the expenses incurred since few would want to risk the loss of their entire stakes unless they had a good chance of getting back much more than they put up; the possible gains must be in the nature of a first prize in a lottery, of a jackpot in a game of chance.[126] A series of counter-arguments have been advanced against this thesis; that no pecuniary incentive, indeed, no incentive at all, is needed to spur on those who love to contrive and to innovate; that "the seeds of invention exist, as it were, in the air, ready to germinate whenever suitable conditions arise, and no legislative interference is needed to insure their growth in proper season";[127] that, if some spur should be desirable, honors and prizes would be preferable; that, if profit incentives should be required, the profits to be made thanks to the headstart of the innovator and the natural lagging behind of imitators would suffice;[128] that incentives, if effective, work only through diverting productive activity into different channels,[129] for example, from ordinary productive pursuits into research and development, and from research in unprotected fields to research in fields in which the results enjoy patent protection; and, finally, that the obstacles and hindrances which patent protection puts in the way of competitive enterprise involve a social cost in excess of any benefits derived from the system.[130]

The "exchange-for-secrets" thesis is independent of the question whether or not there would be enough new inventions without the monopoly-profit incentive; the point is that they would be kept secret and that society can obtain the substantial social benefit of disclosure only by offering patent protection in exchange for publication.

> The patent constitutes a genuine contract between society and inventor; if society grants him a temporary guaranty, he discloses the secret which he could have guarded; quid pro quo, this is the very principle of equity.[131]

The most frequent answer to this has been that society would lose little or nothing if some inventors tried to guard their secrets, because few producers could succeed in doing so for very long and, moreover, similar ideas are usually developed by several people within a short time, if not simultaneously.[132] The most cogent objection rested on a simple reflection: An inventor who, optimistically, thinks he need not fear that others would either find out his secret or come independently upon the same idea, will not go to the expense and trouble of taking a patent; he will disclose only what he fears cannot be kept secret.[133] Another kind of counter-argument tried to show that, at one stage at least, the patent system might promote rather than reduce secrecy; since patents are granted only on inventions devel-

[126] Friedrich List, The National System of Political Economy (1st German edition, 1841; London: 1885), p. 307. Certainly, no one has expressed the stimulus theory in terms more impressive than Abraham Lincoln, who said: "The patent system * * * added the fuel of interest to the fire of genius. * * *" Lecture on Discoveries, Inventions, and Improvements (1859). In complete Works of Abraham Lincoln (2d edition, 1905), vol. V, p. 113.

[127] Sir William Armstrong, opening address of the president, Report of the 33d Meeting of the British Association for the Advancement of Science, held at Newcastle in 1863 (London: 1864), p. lii.

[128] Albert E. F. Schäffle, op. cit., supra, note 111, p. 265.

[129] John Prince-Smith, op. cit., supra, note 123, p. 161.

[130] The Economist, February 1, 1851, pp. 114-115. Rogers, op. cit., supra, note 111, p. 128. Speech of Sir Roundell Palmer, M. P., House of Commons, May 28, 1868, reproduced in R. A. M. [Macfie] editor Recent Discussions, etc., op. cit., supra, note 125, p. 97.

[131] Louis Wolowski, Annales de la Société d'Economie Politique, vol. VIII, 1869-70 (Paris, 1895), p. 126.

[132] The Economist, July 26, 1851, p. 182.

[133] J. E. T. Rogers, op. cit., supra, note 111, pp. 128-134; Hermann Rentzsch, op. cit., supra, note 115, p. 629; Viktor Böhmert, op. cit., supra, note 122, p. 67 ff.

C. DISCUSSION OF THESE ARGUMENTS: ECONOMIC OPINION 1850–73

All four arguments for patent protection have been severely criticized, partly by opponents of any sort of patent protection, partly by advocates who supported one argument but rejected the others. In presenting the criticisms or counterarguments, some of the authors who participated in the patent controversy of the 19th century (1850–73) will be cited. These references serve only as samples, since in most instances many writers have made the same points. Indeed, if one always cites only the "first and true inventor" of an argument concerning the patent system, one will rarely be able to cite an author of the 20th century.

The "natural-law" thesis was solemnly adopted by the French Constitutional Assembly, when it stated in the preamble to the patent law of 1791—

> that every novel idea whose realization or development can become useful to society belongs primarily to him who conceived it, and that it would be a violation of the rights of man in their very essence if an industrial invention were not regarded as the property of its creator.

This notion of French lawyers that an "idea" could be subject to the same kind of property right that applied to material objects was criticized, rejected, and ridiculed in many quarters.[111] If property in ideas was a "natural right," it was asked,[112] how could it be limited to 14 or 17 years instead of being recognized for all time? As a matter of fact, some diehards did campaign for "permanent and inalienable" property rights in ideas.[113] Others pointed out that no man can have "exclusive possession" of an idea, be it for a limited or an unlimited time, after he has communicated it and, hence, shares it with others.[114] The logical elements of the concept of property as applied to material things—occupation, possession, control, appropriation, restitution, etc.—are largely inapplicable to ideas not embodied in material things. He who complains about the "theft" of his idea—

> complains that something has been stolen which he still possesses, and he wants back something which, if given to him a thousand times, would add nothing to his possession.[115]

In contrast to property in material things, so-called intellectual property is neither control of a thing nor of an idea but rather "control of a market" for things embodying an idea.[116] A material thing must "belong" to somebody who can determine how it has to be used; it would be necessary to take it away from its possessor before it could

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[111] "To talk of the 'natural rights' of an inventor is to talk nonsense * * *", "The Patent Laws," Westminster Review, new series, vol. XXVI, p. 329. "Nor do vague and angry declarations that invention is property, and the lavish use of the expressions 'pirate' and 'pilfer,' and 'stealing the fruit of other men's minds and labour,' prove more than that certain persons gain an advantage rightly or wrongly, which they wish to keep." Rev. J. E. T. Rogers, "On the Rationale and Working of the Patent Laws," Journal of the Statistical Society of London, vol. XXVI (1863), p. 128. See also the interesting review of earlier controversies on this issue by Le Hardy de Beaulieu, "Discussion sur la propriété des inventions," Journal des Economistes second series, vol. XXXIV (1862), and the continued exchanges in L'Economiste Belge, 9 année, Nos. 7, 12, 22 (1863). A German economist denounced the "Faseleien (twaddle, babble, drivel) about property in ideas," Albert E. F. Schäffle, Die nationalökonomische Theorie der ausschliessenden Absatzverhältnisse Tübingen: 1867), p. 110. Another German, proud of the victory of the patent advocates, lauds them for "correctly understanding" that this "sophistic debate" about property in ideas "was absolutely sterile." Hermann Grothe, op. cit., supra, note 14, p. 4. All these writers had long been anticipated by a series of pronouncements of English law, reflected in Thomas Jefferson's statement that "Inventions * * * cannot, in nature, be a subject of property."

[112] Charles Coquelin, "Brevets d'Invention," Dictionnaire de l'Economie Politique (Paris: 1873), p. 213.

[113] J. B. A. M. Jobard, Nouvelle économie sociale ou monautopole industriel, artistique, commercial et littéraire (Paris: 1844), pp. 5, 130, 239 et passim. Between 1829 and 1852, Jobard published no less than 48 books on the same subject: for tariff and patent protection, against free trade and competition.

[114] Anton Edler von Krauss, op. cit., supra, note 11, pp. 7–9.

[115] Hermann Rentzsch, "Geistiges Eigenthum," Handwörterbuch der Volkswirtschaft (Leipzig: 1866), p. 334.

[116] Albert E. F. Schäffle, op. cit., supra, note 111, pp. 113–114.

that had been particularly expensive and "could not just as easily have been made by others"; patents for "accidental inventions" and "insignificant artifices" could easily paralyze the industry of others and, therefore, would be iniquitous.[104] Johann Friedrich Lotz (1822) conceded that it might be "fair and economically advantageous for a nation to compensate the inventor" for efforts and expenses, but that it was "very questionable whether monopolization of his invention is the right kind of compensation."[105] Karl Heinrich Rau (1844), on the other hand, found that, though "some important inventions are made by accident," many require great effort and one "would not make such sacrifices if he could not hope for a period of protection from encroachment by competitors in the use of his invention."[106]

In France, Jean Baptiste Say (1803) agreed fully with the English classical writers' views favoring patent protection. "Who could reasonably complain about a merely apparent privilege?" he asked.

> It neither harms nor hinders any branch of industry that was previously known. The costs are paid only by those who do not mind paying them; their wants * * * are not less fully satisfied than before.[107]

Simonde de Sismondi (1819), the "dissenter," dissented on this issue, as on most others. In his view—

> The result of the privilege granted to an inventor is to give him a monopoly position in the market against the other producers in the country. As a consequence the consumers benefit very little from the invention, the inventor gains much, the other producers lose, and their workers fall into misery.

He wanted "all inventions immediately made known and immediately subjected to imitation by all the competitors of the inventor." If the zeal of inventors should thereby be cooled, this would be a most welcome result, in Sismondi's opinion.[108] Pierre-Joseph Proudhon (1846), although he wrote a satirical pamphlet against the demands for "majorats," or perpetual, hereditary rights in intellectual products,[109] accepted the possibility of monopoly as a condition of progress and regarded the grant of temporary monopolies to inventors as a "necessity" in our society.[110]

B. THE CHIEF ARGUMENTS FOR PATENT PROTECTION

While the early opinions on the patent system were expressed merely in occasional comments and remarks contained in general treatises on political economy, economists during the great patent controversy of the second half of the 19th century wrote articles, pamphlets, and books on the economics of exclusive rights. The arguments for and against the patent system have not changed much since that time.

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[104] Ludwig Heinrich Jakob, Grundsätze der Polizeigesetzgebung und der Polizeianstalten (Halle: 2d edition, 1837), p. 375; first published in 1809.

[105] Johann Friedrich Eusebius Lotz, Handbuch der Staatswirthschaftslehre (Erlangen: 1822), vol. II, p. 118.

[106] Karl Heinrich Rau, Grundsätze der Volkswirthschaftspolitik, Lehrbuch der politischen Oekonomie (Heidelberg: 3d edition, 1844), vol. II, p. 362.

[107] Jean Baptiste Say, Traité d'Economie Politique (Paris: 1st edition, 1803), p. 263. This passage does not appear in some later editions.

[108] J. C. L. Simonde de Sismondi, Nouveaux Principes d'Economie Politique ou de la Richesse dans ses rapports avec la population (Paris: 2d edition, 1827), vol. II, pp. 334-335.

[109] Pierre-Joseph Proudhon, Les Majorats Littéraires; reprinted in Complete Works (Paris: 1868), vol. XVI.

[110] Pierre-Joseph Proudhon, Système des Contradictions Economiques ou la Philosophie de la Misère (Paris: 2d edition, 1850), vol. I, pp. 235-242.

when their inventions were patented to others who beat them to the patent office in countries which granted patents to the first applicant rather than the first inventor.

Probably the oldest international agreements involving patent matters were among German states in the second quarter of the 19th century, and the first multilateral agreement was among the member states of the German Zollverein in 1842. The first International Patent Congress was held in 1873 in Vienna, the next two in 1878 and in 1880 in Paris; in 1884 the International Union for the Protection of Industrial Property was created, with a permanent secretariat, the International Bureau for the Protection of Industrial Property, in Bern, Switzerland. Only a few of the irksome problems of foreign patenting were solved and no progress was made toward the establishment of an "international patent." After several revisions, of which the last one [93] was in 1934 (though the two previous ones, of 1925 and 1911, are still partly in effect), the convention provides that (1) foreigners (nationals of Union countries) shall receive in each country the same treatment as the nationals of that country; (2) an applicant for a patent on an invention in one country shall be given the advantage of that date of application in other Union countries provided application is made in the latter within 12 months of the original application (the so-called priority clause); (3) patents in each country shall be independent of patents on the same invention in other countries—particularly they shall not be affected by refusal, revocation, or expiration in any other country; (4) importation by the patentee of goods produced in other Union countries shall not entail forfeiture of patent protection for these goods; and (5) each country may take measures to prevent abuses resulting from the exclusive rights conferred by patents, such as "failure to use," but it may revoke these patents only if compulsory licensing should be an insufficient remedy—and compulsory licenses cannot be required until 3 years after issuance of a patent and only if the patentee does not produce acceptable excuses.[94]

The "national treatment" clause forecloses the use of the reciprocity principle, under which a country might discriminate against nationals of countries with less generous patent laws. Thus, under reciprocity, a country might deny a patent to a national of a country that has no patent law; under "national treatment," Swiss inventors were able to get patents abroad even when Switzerland gave no patents. The "priority" clause, the most important provision of the convention, has been regarded as a substitute, however poor, for "universal patents," inasmuch as it established the right of the inventor to obtain patents in all Union countries in which his kind of invention is patentable. (In the absence of such a clause, in some countries the patent would go to the first applicant even if he were not the inventor.)

Countries with strong patent positions have often prodded and put pressure on weaker countries to adopt patent systems. Yet "any country must lose if it grants monopoly privileges in the domestic

[93] Another conference is supposed to convene in Lisbon in November 1958.

[94] Detailed discussion of the international conferences, of the provisions of the International Union, and of the economic issues involved are contained in the work by E. T. Penrose, op. cit., supra, note 91. See also Vernon, The International Patent System and Foreign Policy, Study No. 5 of the Subcommittee on Patents Trademarks, and Copyrights, Senate Committee on the Judiciary, 85th Cong., 1st sess. (1957). Note: This series of studies, of which the present study is one, will hereinafter be cited as "Senate Patent Study No.—."

and later of the objections to giving discretionary powers to public administrators. The plans varied with regard to the ways of determining the bonuses and of financing them: the bonuses were to be awarded by the government, by professional associations financed through voluntary contributions from private industry, by an international agency set up by national governments, or by an international association maintained through contributions from industries of all countries.[84] All these proposals were confined to important inventions, and denied the desirability of either rewards or patent protection for petty inventions.

The Soviet Union has actually experimented with a premium system: "Certificates of Authorship" can be issued to inventors entitling them to rewards from the government if and when their inventions are exploited. An Act Governing Inventions and Technical Improvements has been on the books since 1931, a new Inventions Act since 1941. An Awards Decree in 1942 increased the scale of awards; the most recent scale came into effect in August 1956. Most awards are made on the basis of the annual economies achieved as a result of the inventions or improvements. For inventions resulting in relatively small economies the rate is 30 percent; for inventions yielding large economies the rate is lower and limited by an absolute ceiling. The scale for mere improvements is lower than that for original inventions.[85]

In a country where all industry is owned and operated by the government it is obvious that private monopolies in the utilization of new inventions would be meaningless and that payments by the government are the only conceivable form of reward, apart from "honors." Whether these payments are called bonuses or royalties or profit-shares would not make any material difference. The fact, however, that the bonus system seems to be the "logical" form of award in a socialist economy, should not mislead us into assuming that proponents of such systems have necessarily been of socialistic persuasion. On the contrary, most proponents of alternatives to the patent system, of reforms to reduce its monopoly features, or of the abolition of any form of inventors' protection have not been socialists but rather economists of the free-enterprise, free-trade tradition.[86]

One of the alternatives is government-financed research and development work. There are projects for inventive work involving expenses beyond the means of private concerns. If society wants these projects carried out, government must finance them.[87] On the other hand, one may expect private enterprise to finance and undertake a fair amount of inventive and innovative activity even without patent incentives. The profit expectations due to the headstart of the innovator and the natural lag of the imitators should be sufficient to stimulate inventions and innovations within normal reach;[88]

[84] E. g., Robert Andrew Macfie, The Patent Question Under Free Trade (London, 2d edition, W. J. Johnson, 1864), pp. 24, 29. In 1867 a society for the establishment of an international fund to give money awards in lieu of patents for inventions was founded. See Viktor Böhmert, "Gründung eines Vereins zum Ersatz der Erfindungspatente und zur Belohnung unpatentierter Erfindungen in Zurich," Jahrbücher für Nationalökonomie und Statistik, vol. IX (1867), p. 93.

[85] Francis Hughes, "Soviet Invention Awards," Economic Journal, vol. LV (1945), pp. 291–297; see also, Hughes, "Incentive for Soviet Initiative," Economic Journal, vol. LVI (1946), pp. 415–425.

[86] For example, in 1869 an American patent expert—Mr. George A. Matile, examiner in the U. S. Patent Office—observing the free-enterprise antipatent movement in Europe and expecting that England would soon abolish the patent system, wrote that the United States would never permit itself to fall behind other nations "in a matter of liberty" and would surely follow suit if other countries repealed their patent laws. Revue de droit international et de législation comparée, vol. I (1869), p. 311.

[87] Cf. "Government, Industry, the University, and Basic Research," three papers by Paul E. Klopsteg, Monroe E. Spaght, and Kenneth S. Pitzer. Science, vol. 121 (June 1955), pp. 781–792.

[88] On the theory of the headstart see pp. 23–24, 38–39, and 59–60, infra.

tial monopoly profits in cases of relatively less strategic inventions, but they would probably be much smaller in cases of basic inventions and in all other instances where a strong patent position could permit a firm to control some of its markets. Thus, the hopes for the highest prizes to be won in the "patent lottery" would be dashed, and the anticipated returns from investment in innovations based on patented inventions would be reduced.

D. PLANS FOR REFORMS AND ALTERNATIVES TO THE PATENT SYSTEM

One cannot simply and safely deduce that a reduction of expected returns from investment in innovations will diminish the flow of invention. According to one opinion on the system of general compulsory licensing—

> * * * no convincing argument has yet been put forward to show that * * * a "license of right" system whereby, after a very short period, anyone might use a patent on paying a license fee to the inventor, would * * * diminish the flow of invention.[69]

The chief objections to general compulsory licensing, however, are not based on the contention that such a system would reduce the stimulus to invent, but that it would reduce the stimulus to innovate, that is, to develop and introduce inventions already made and patented. It is widely assumed that, in this respect, general compulsory licensing—

> would practically amount to the abolition of patents, which * * * would, on balance, do definitely more harm than good.[70]

Even some of those who hold that general compulsory licensing would be the simplest and most expedient reform of the patent system and would not unduly impair its effectiveness in generating inventive and innovative activities are prepared to consider less radical reforms. A carefully argued "minimum" program—"necessary if [the patent] system is to be kept consistent with a competitive policy"—has recently been set forth.[71] It contains the following recommendations: Maintain the highest standard of invention; avoid broad claims; insist on more adequate disclosure; publicize patent applications and establish opposition procedures; improve examination procedures; apply "economic as well as technological tests * * * in determining whether to grant the patent";[72] abandon the flash-of-genius notion in favor of explicit consideration of the size of research expenditures required for inventive and developmental activity; institute compulsory licensing under patents that are not worked at all or are worked less than may be regarded as a "reasonable use of the invention"; authorize "any patentee to obtain a license under a patent held by another if he can show that his own patent cannot be worked without this license and if he is willing to grant a reciprocal license";[73] "remove the exclusive features from patent pools whenever the patents thus pooled are numerous enough and important enough to be a source of substantial power";[74] reduce monopolistic power over a whole indus-

[69] Lionel Robbins, The Economic Basis of Class Conflict (London: 1939), p. 73.
[70] Michael Polanyi, op. cit., supra, note 27, p. 67.
[71] Corwin D. Edwards, Maintaining Competition: Requisites of a Governmental Policy (1949), p. 236.
[72] That is, "the Patent Office should consider whether or not the proposed grant would impede the progress of the useful arts, in the industries to which the invention is applicable, by unduly concentrating the control of technology." Id., p. 237.
[73] Id., p. 242.
[74] Thus, pooled patents should "be made available for license to all applicants on nondiscriminatory and nonrestrictive terms." Id., p. 243.

tion or to "fence in" the competition by blocking possible developments of inventions patented to them.[58]

Nonworking of patented inventions has been high on the list of grievances against patent protection. One must distinguish, however, between the nonuse of inventions whose use would be uneconomic, and the suppression, or "wrongful nonuse," of patented inventions which could be used economically.[59] In the first category are inventions of unmarketable articles, inventions of inoperable or too expensive processes, and inventions of alternative processes, instruments, or products, not superior or perhaps inferior to those in actual use; neither the patentees nor anyone else may want to use the inventions in question. It has been estimated that between 80 and 90 percent of all patents may be in this category.[60] "Suppression" of patented inventions can be proved, at least prima facie, if others want licenses which the patentee refuses to grant although he himself does not use the invention. In the absence of any applications for licenses, "suppression" of inventions is difficult to prove: one would have to prove that their use would be economically practical and desirable although the patent owners, perhaps in view of the "premature" obsolescence of their capital equipment, have decided to keep these inventions "on ice." The proof might be feasible for cost-saving inventions, but hardly for product-improving ones: after all, cost calculations can be checked, but demand estimates are mere conjectures.

In some countries, especially in England, "insufficient working" is regarded as an abuse of the patent monopoly, as is also the charging of excessive prices for patented articles. Since it is the very essence of patents to restrict competition and permit output to be kept below, and price above, competitive levels, it is difficult to conceive of economic criteria by which one could judge whether output is less than "reasonably practicable" and price is "unreasonably high."[61] In any case these so-called "abuses" are merely some of the social costs "inherent in the patent system and are only rarely connected with any malpractices on the part of patentees."[62]

Domestic nonuse or "insufficient" domestic use of inventions which are patented to foreigners who mainly seek to protect the domestic market for goods made abroad and imported, raises issues involving foreign-trade theory. Forcing the domestic working of patented inventions which otherwise would not be so worked operates like a protective tariff: it may lead to an uneconomic location of industry, to a reduction in the international division of labor, and to higher prices to consumers. To grant patents to foreigners may be socially costly, but this cost would not be reduced and may be increased by forcing their domestic working.[63]

[58] Illustrations of all these practices can be found in the TNEC Hearings, pt. 2 (1939), especially pp. 386-387, 433, 460-461, 776.

[59] There is nothing "wrongful" in suppression under United States law; the term fits the situation of other countries, especially the United Kingdom, where the law requires working of all patented inventions "without undue delay and to the fullest extent that is reasonably practicable."

[60] Peter Meinhardt, op. cit., supra, note 35, p. 256. This estimate may be too high, but the view that the percentage of patents on which taxes or renewal fees are paid for several years roughly measures the proportion of patented inventions in use probably errs in the other direction; it overlooks the optimism of patentees, who long keep up the hope that the inventions may be of use eventually.

[61] The few decisions in which English courts considered the reasonableness of prices demanded for patented articles do not reflect any great insight into the economics of pricing.

[62] Edith T. Penrose, op. cit., supra, note 47, p. 153.

[63] Id., pp. 137-161, especially pp. 142-145, 154, 158.

tion is probably more political than economic; one clear fact is that many patent attorneys and few economists were heard by the legislative bodies.

In several countries patents terminate prematurely upon failure to pay renewal fees; such fees may increase from very modest charges for the first years—none for the first 4 years in the United Kingdom—to progressively higher levels in later years. The fiscal result of this scheme is insignificant, but it probably fulfills the economic purpose of weeding out worthless patents.[46] "Live patents" may obstruct inventive or innovative activity long after their owners have decided not to use the inventions covered.

B. "ABUSE" OF THE PATENT MONOPOLY

In general one speaks of an abuse of the patent monopoly when the social objectives which it is supposed to serve are not promoted but rather jeopardized by the way it is used.[47] This will be most plausibly asserted when the temporal, functional, or material limits of the monopoly intended by the patent grant are overstepped and the actually achieved monopolistic control is extended in time, in scope, or in strength.

Patentees may succeed in extending the time period of control (*a*) through procedural devices, especially through delays in the pendency of the patent between application and issuance;[48] (*b*) through secret use of the invention prior to the application for a patent, or through incomplete disclosure, making it impossible for those without special "know-how" to use the invention even after expiration of the patent;[49] (*c*) through the successive patenting of strategic improvements of the invention which make the unimproved invention commercially unusable after expiration of the original patent;[50] (*d*) through crea-

[46] In England, 45.6 percent of all patents issued in 1933 had lapsed after 6 years; only 23.6 percent were kept alive after 10 years. See Floyd L. Vaughan, op. cit., supra, note 41, p. 301. In Germany before 1920, 60 percent of all patents lapsed after 3 years, 80 percent after 6 years, and only 3.5 percent reached their maximum age of 15 years. Robolski and Lutter, "Patentrecht," Handwörterbuch der Staatswissenschaften (Jena: Fischer, 4th ed. 1920), vol. VI, p. 826. For an interesting discussion of the experience with renewal fees, see P. J. Federico: "Renewal Fees and Other Patent Fees in Foreign Countries," Journal of the Patent Office Society, vol. 36 (November 1954), pp. 827–861.

[47] This would be much too wide a definition from the point of view of United States law, but it reflects the comprehensive conceptions of "abuse" frequently expressed in England and several other countries, and fervently debated in international conferences. For example, in a text approved by the United States delegation and submitted to the 1925 Conference at The Hague, the phrase "abuse of the monopoly" was understood to include the refusal of the patentee to grant licenses on equitable terms, unduly restricted working, or nonworking, of the patented invention, the charging of excessive prices, etc. See Actes de la conférence réunie à la Haye du 8 Octobre au 6 Novembre 1925 (Bern: 1926), p. 434. Quoted from Edith Tilton Penrose, The Economics of the International Patent System (Baltimore: Johns Hopkins Press, 1951), p. 85. Dr. Penrose comments: "The fact is that the term 'abuse of the monopoly' is extraordinarily misleading. For the most part, the so-called 'abuses' are merely some of the costs that are inherent in the patent system and are only rarely connected with any malpractices on the part of patentees." Id., p. 153.

[48] For a brief account of the History of the Growth of the Long Pending Patent Application Evil, see the memorandum prepared and distributed by the patent section of the General Motors Corp., dated May 26, 1931, reproduced as exhibit No. 110 in hearings before the Temporary National Economic Committee (hereinafter cited as "TNEC Hearings"), pt. 2 (1939), pp. 701–714. Examples of important patents whose application had been pending for extremely long periods—with or without fault on the part of the applicants—are the Gubelmann (cash register) patent with a pendency of over 26 years, the Fritts (photographic sound recording) patent with a pendency of 36 years, and the Steimer (automatic glass machinery) patent with a pendency of 27 years. A more recent example is the Jorgensen (automatic choke) patent, issued to General Motors Corp. in 1955 after a pendency of over 23 years, chiefly due to 12 interference proceedings and litigation. See Hearings, supra, note 41, pp. 287–291. The official life of a patent begins, of course, only after its issuance. Hence the total lives, from application to expiration, of the first 3 mentioned patents varied from 43 to 53 years.

[49] Within certain limits, prior use and incomplete disclosure, if proved, make a patent invalid, but proof is not easy to come by. The Alien Property Custodian who had taken the United States patents from enemy owners during the First World War testified: "Since we took up the patents, more than a million dollars have been spent on finding out how to work them, because always something was left out and always something was covered up." Pooling of Patents, Hearings, supra, note 21, pt. 1, p. 746.

[50] For examples of how patents on "minor improvements continue the protection" of the original inventions "when the basic patents expire," see Investigation of Concentration of Economic Power, TNEC Hearings, pt. 2 (1939), p. 777. See also, Pooling of Patents, Hearings, supra, note 21, pt. 4, p. 3836.

the economic consequences of closing an industry to newcomers by granting a patent on a "basic" invention, a possibility which, to many economists, indicates the need for compulsory licensing. Finally, there is the old controversy whether patentability should not be confined to "useful and important" inventions, a requirement included in the United States patent laws of 1790 and 1836, though not seriously enforced by the Patent Office.[38]

The questions who is to judge the patentability of an invention and at what stage of the game, have received different answers, and different procedures have been adopted in different countries. Under the registration system the validity of a registered patent is examined only if an interested party attacks it in the courts and asks that the patent be invalidated. Under the examination system a patent is issued only after the Patent Office has carefully examined the patentability of the invention. This examination may include so-called "interference proceedings," when the Office finds that two or more pending applications seem to claim, partly or wholly, the same invention, so that the priority of one invention has to be established. The so-called "Aufgebotssystem," or examination-plus-opposition system, provides for an interval of time after publication of the specifications examined and accepted by the official examiner and before the issuance of the patent, in order to enable interested persons to oppose the patent grant. In such proceedings the grounds of the opposition, such as "prior use" or "prior patent grant," are heard and examined by the Patent Office.[39] The registration system is administratively the cheapest but may burden the economy with the cost of exclusive rights being exercised for many inventions which, upon examination, would have been found nonpatentable. In favor of the examination system it has been said that it avoids a mass of worthless, conflicting, and probably invalid patents, onerous to the public as well as to bona fide owners of valid patents; that it prevents the fraudulent practice of registering and selling patents similar to the claims being patented by others; and that it drastically reduces the extent of court litigation.[40] The latter advantage, however, may not be realized if Patent Office and courts apply different standards of patentability.[41]

In some countries the law denies patent protection to certain categories of invention. For example, in Germany (and until 1949 in England) no patents could be granted for inventions of new food

[38] According to a published commentary to the Patent Act of 1952, which deleted the clause, the requirement of importance "had seldom been resorted to either in the Patent Office or in the courts." The official explanation for its deletion was as follows: "The phrase 'and that the invention is sufficiently useful and important' is omitted as unnecessary, the requirements for patentability being stated in secs. 101, 102, and 103." (The requirements stated in these sections include "usefulness," but not "importance.") See H. Rept. No. 1923, 82d Cong., 2d sess. (1952).

[39] The National Patent Planning Commission recommended that the United States adopt a procedure in which the Patent Office may cancel a patent challenged by "any member of the public" within 6 months upon evidence showing that the patent should not have been issued. National Patent Planning Commission, Report, American Patent System (1943).

[40] All these points were made in the Senate committee report (Senator Ruggles) of April 28, 1836, which enumerated some of the "evils which necessarily result" from a system of issuing patents without examination. See "The Patent Act of 1836," Journal of the Patent Office Society, vol. XVIII (July 1936, Centennial Number), pp. 92-93.

[41] "There is an ever widening gulf between the decisions of the Patent Office in granting patents and decisions of the courts who pass upon their validity." Report of the National Patent Planning Commission (Washington: 1943). Some patent attorneys claim that the "decisions [of the Supreme Court] amounted to judicial legislation abolishing the patent system * * *." Statement of Karl Lutz, patent attorney, Hearings Before the Subcommittee on Patents, Trademarks, and Copyrights of the Senate Committee on the Judiciary, 84th Cong., 1st sess. (1956), p. 309. In an economist's opinion, "If and when the Patent Office administers the standard of patentability indicated by the Supreme Court, the number of patents should be reduced at least one-half. The granting of fewer patents would in turn lead to fewer applications and the need for fewer examiners; moreover, it would reduce correspondingly the need of taking out so-called defensive patents." Floyd L. Vaughan, The United States Patent System (Norman: University of Oklahoma Press, 1956), p. 299.

III. Institutional Facts and Problems

A. Conditions, Procedures, and Limits of Patent Protection

A patent confers the right to secure the enforcement power of the state in excluding unauthorized persons from making commercial use of a clearly identified, novel, and useful invention; but just what an "invention" is, and when it can be regarded as "novel" and "useful," is not self-evident. The questions of the "correct" criteria of utility, novelty, and invention have been answered in many different ways, and the courts of several countries are constantly reconsidering earlier answers.

An invention is a new contrivance, device, or technical art newly created, in contrast to a discovery of a principle or law of nature that has already "existed" though unknown to man. But not every new way of doing or making something, not every new thing never made before, is regarded as an "invention"; it must be "an unusual mental achievement," [27] a contribution involving more than the exercise of technical skill. Indeed, the courts of some countries have suggested that "invention" must involve a new idea hatched by an imaginative mind, a "flash of genius," [28] as opposed to findings resulting from the "work of a mechanic skilled in the art" [29] or from the plodding labors or routine experimentations of large-scale laboratories. Much controversy has centered around the relative roles which superior ability, ordinary skill, extraordinary expenses, exceptional genius, or plain luck may have played in making those contributions to the technical arts which are to be called "inventions." Many lawyers have attempted to deduce incontrovertible solutions of this problem from the letter of the law. Others, annoyed by the narrow attitudes of the courts, have insisted and even legislated that "patentability shall not be negatived by the manner in which the invention was made." [30] This seems fair enough because it is "according to foresight, not hindsight" that one should judge whether the difference between the old art and the new looked "sufficiently difficult" beforehand to be regarded as an invention and "to require the inducement of a hoped-for patent." [31] In brief, sensible answers can come only from an economic analysis of the objectives and consequences of patent protection—which however presupposes that one agrees on just what the objectives are.[32]

This holds true also for the criteria of novelty and utility. That "subjective novelty" is universally rejected in favor of objective tests,

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[27] Michael Polanyi, "Patent Reform," Review of Economic Studies, vol. XI (1944), p. 71.

[28] *Densmore* v. *Scofield*, 102 U. S. 358, 375 (1880); *Cuno Engineering Corp.* v. *Automatic Devices Corp.*, 314 U. S. 84, 90–91 (1941).

[29] *Hotchkiss* v. *Greenwood*, 52 U. S. 248 (1850).

[30] United States Patent Act of 1952, 35 U. S. C., sec. 103.

[31] S. C. Gilfillan, "The Root of Patents, or Squaring Patents by Their Roots," Journal of the Patent Office Society, vol. XXXI (1949), p. 614.

[32] "It is surprising * * * that in numerous cases gadgetry wins judicial approval while inventions of some consequence fail to make the grade. The bench of the United States Supreme Court found that Marconi's contributions did not rise sufficiently above the level of the art as to make him the inventor of the wireless; yet the same bench found a new combination of circuits in a pinball machine to be genuine invention. In such decisions there is less of mystery than the opinions of the Court suggest. Often there are real reasons for decisions which do not appear among the good reasons put on public display. A valid patent in the field of gadgetry does no great harm; it is easy enough to 'walk around' the patent and turn up another device or process which performs the same function. An exhibit was once presented of a collection of can openers, each of which had its distinct identity and none of which infringed the patent of any other. With more basic things, however, a recognition of the invention as genuine and issuance of the patent may serve to confer upon the patentee an overlordship of a sizable area of the economy. The best patent lawyers always slip into their briefs a few paragraphs concerned with economics and public policy." Walton Hamilton, The Politics of Industry (New York: Knopf, 1957), pp. 71–72.

1825; Sardinia, 1826; the Vatican State, 1833; Sweden, 1834; Wurttemberg, 1836; Portugal, 1837; Saxonia, 1843.

C. THE RISE OF AN ANTIPATENT MOVEMENT (1850–1873)

During the second quarter of the 19th century various groups pressed for the strengthening of the patent system and for its expansion. In Britain, they wanted patents made more easily obtainable and more effectively enforceable. In Germany a unified patent system was sought after an agreement of the Zollverein in 1842 had reduced the value of patents by permitting patented articles to be imported from member states. Petitions in Switzerland, partly inspired by German interests, asked for patent legislation. Provoked by such pressures and in line with the free-trade movement of the period, an antipatent movement started in most countries of Europe.[12]

Parliamentary committees and royal commissions in Britain investigated the operation of the patent system in 1851–52, in 1862–65, and again in 1869–72. Some of the testimony was so damaging to the repute of the patent system that leading statesmen urged its abolition.[13] A patent-reform bill, providing for stricter examination of applications, a reduction of the term of protection to 7 years, and compulsory licensing of all patents, was passed by the House of Lords.

In Germany several trade associations and chambers of commerce recommended abolition of the patent laws,[14] the Kongress deutscher Volkswirte in 1863 condemned "patents of invention as injurious to common welfare;" [15] the Government of Prussia decided to oppose the adoption of a patent law by the North German Federation; and Chancellor Bismarck in 1868 announced his objections to the principle of patent protection.[16]

In Switzerland, the only industrial country of Europe that had remained without patent legislation, the legislature rejected proposals in 1849, 1851, 1854, and twice in 1863, the last time with a reference to the fact that "economists of greatest competence" had declared the principle of patent protection to be "pernicious and indefensible." [17]

In the Netherlands the majority of the Parliament was convinced that "a good law of patents is an impossibility." [18] The abolitionists won and, in 1869, the patent law was repealed.

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[12] Fritz Machlup and Edith Penrose, "The Patent Controversy in the 19th Century," The Journal of Economic History, vol. X (1950), pp. 1–29.

[13] For contemporary reports see Parliamentary Debates, The Economist, The Spectator, and The Westminster Review. For selections from testimonies, committee reports, and parliamentary speeches by John Lewis Ricardo, Lord Granville, Lord Stanley, Sir Roundell Palmer, Robert A. Macfie, and others, see Robert Andrew Macfie, The Patent Question under Free Trade (London, second edition, W. J. Johnson, 1864), and R. A. M. (Macfie), editor, Recent Discussions on the Abolition of Patents for Inventions in the United Kingdom, France, Germany, and the Netherlands (London: Longmans, Green, 1869).

[14] "Die Gutachten der preussischen Handelsvorstände über die Patentfrage," Vierteljahrschrift für Volkswirthschaft und Kulturgeschichte, 2. Jahr (1864), No. I, pp. 193–215; see also Hermann Grothe, Das Patentgesetz für das Deutsche Reich (Berlin: Guttentag, 1877), pp. 22–32; Al. Pilenko, Das Recht des Erfinders (Berlin: Heymann, 1907), pp. 96–102.

[15] "Bericht über die Verhandlungen des sechsten Kongresses deutscher Volkswirte zu Dresden am 14., 15., 16., und 17. September," Vierteljahrschrift für Volkswirthschaft und Kulturgeschichte, 1. Jahr (1863), No. III, p. 221.

[16] Hirth's Annalen des Norddeutschen Bundes (Berlin) 1868, pp. 39–42; id., 1869, p. 33.

[17] Offizielles Bundesblatt, Jahrgang 1864, No. II, pp. 510–511.

[18] M. Godefroi, in the debate in the Dutch Parliament. Quoted in the British House of Commons Sessional Papers, LXI, doc. 41 (Feb. 16, 1870).

II. Historical Survey

A. EARLY HISTORY (BEFORE 1624)

The oldest examples of grants of exclusive rights by kings and rulers to private inventors and innovators to practice their new arts or skills go back to the 14th century.[4] Probably the first "patent law," in the sense of a general promise of exclusive rights to inventors, was enacted in 1474 by the Republic of Venice.[5] In the 16th century, patents were widely used by German princes, some of whom had a well-reasoned policy of granting privileges on the basis of a careful consideration of the utility and novelty of the inventions and, also, of the burden which would be imposed on the country by excluding others from the use of these inventions and by enabling the patentees to charge higher prices.[6]

Some of the exclusive privileges were on new inventions; others on skilled crafts imported from abroad. Some of the privileges were for limited periods; others forever. (For example, the canton Bern in Switzerland granted in 1577 to inventor Zobell a "permanent exclusive privilege.") Some of the privileges granted protection against imitation and therefore, competition, and thus created monopoly rights. Others, however, granted protection from the restrictive regulations of guilds, and thus were designed to reduce existing monopoly positions and to increase competition. In view of the latter type of privilege, patents have occasionally been credited with liberating industry from restrictive regulations by guilds and local authorities and with aiding the industrial revolution in England.[7] In France, the persecution of innovators by guilds of craftsmen continued far into the 18th century. (For example, in 1726, the weavers' guild threatened design printers with severe punishment, including death.) Royal patent privileges were sometimes conferred, not to grant exclusive rights, but to grant permission to do what was prohibited under existing rules.[8]

Many of the privileges, however, served neither to reward inventors and protect innovators, nor to exempt innovators from restrictive regulations, nor to promote the development of industry in general, but just to grant profitable monopoly rights to favorites of the court or to supporters of the royal coffers. Patents of monopoly of this sort became very numerous in England after 1560, and the abuses led to increasing public discontent.[9] In 1603, in the "Case of Monopolies," a court declared a monopoly in playing cards void under common law, and in 1623–24 Parliament passed the Statute of Monopolies (21 Jac. I., cap. 3) forbidding the granting by the Crown of exclusive rights to trade, with the exception of patent monopolies to the "first

[4] W. H. Price, English Patents of Monopoly (Boston: Houghton Mifflin, 1906); Arthur A. Gomme, Patents of Invention (London: Longmans, Green, 1936); M. Frumkin, "The Origin of Patents," Journal of the Patent Office Society, vol. 27 (1945), p. 143; Harold G. Fox, Monopolies and Patents (Toronto: University of Toronto Press, 1947).

[5] S. Romanin, Storia documentata di Venezia (Venice: 1855), vol. 4, p. 485.

[6] Cf., for example, the thoughtful considerations which August of Saxony expressed in connection with a 10-year privilege granted for a new invention in 1568. The documents are quoted by Fritz Hoffmann, "Beiträge zur Geschichte des Erfindungsschutzes in Deutschland im sechzehnten Jahrhundert," Zeitschrift für Industrierecht, vol. X (1915), p. 89. Briefly reviewed in Edith Tilton Penrose, The Economics of the International Patent System (Baltimore: Johns Hopkins Press, 1951), p. 3.

[7] Harold G. Fox, op. cit., supra, note 4, pp. 85, 125–126.

[8] Augustin-Charles Renouard, Traité des brevets d'invention (Paris: 3d edition, 1865), p. 43; F. Malapert, "Notice historique sur la législation en matière de brevets d'invention," Journal des Économistes, 4th series, vol. 3 (1878), p. 100.

[9] E. Wyndham Hulme, "The Early History of the English Patent System," Select Essays on Anglo-American Legal History (Boston: Little, Brown, 1909), vol 3; Harold G. Fox, op. cit., supra, note 4.

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Government policies with respect to enemy assets, of which patents were an important part. Currently, he is making an extensive economic study of patents and the patent system under a Ford Foundation grant.

In publishing this study, it is important to state clearly its relation to the policies and views of the subcommittee. The views expressed by the author are entirely his own. The subcommittee welcomes the report for consideration, but its publication in no way signifies acceptance by the subcommittee of the statements contained in it. Such publication does, however, testify to the subcommittee's belief that the study represents a valuable contribution to patent literature and that the public interest will be served by its publication.

JOSEPH C. O'MAHONEY,
Chairman, Subcommittee on Patents, Trademarks, and Copyrights, Committee on the Judiciary, United States Senate.

JUNE 30, 1958.

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