



Innovation needs patents reform

William Kingston*

School of Business Studies, Trinity College, Dublin 2, Ireland

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Abstract

The international patent system demonstrates many failures to adapt to new ways of producing information. The coming of antibiotics finally forced it to take account of the shift from “individual” to “corporate” invention by establishing new criteria for patentability. However, these favour industries which can operate a “portfolio” approach in their R&D, to the disadvantage of other industries and smaller firms in all industries. In complex technologies, whose economic importance has been growing rapidly, patents are now used as much as a bargaining currency to prevent “lock-out” from use of state-of-the-art components developed by competitors, as they are as a stimulus to R&D.

Changes which have been proposed to deal with these problems, including empirical supporting evidence, are discussed. These include compulsory expert arbitration of disputes with legal aid for the respondent party in the event of an appeal to the Courts, an “Innovation Warrant” as a supplementary type of protection, and “shared-risk” compulsory licensing as a practical way of changing from time to money as the measure of a grant. This would give multiple innovators access to inventions as early as possible, while maintaining or even improving incentives to invest in invention and innovation. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

Recent decades have seen a remarkable growth in the importance of intellectual property. Among the contributory factors have been the explosion of software and the use of copyright and patents to protect it; the growth of biotechnology and the patentability of its inventions; the development of electronic databases and arrangements for protecting investment in them; the multiplication of patents arising

from University research, encouraged by the Bayh–Dole Act in the U.S. and by its imitations elsewhere; and the setting up of TRIPS (the Trade-Related Intellectual Property Section) of the World Trade Organization in 1994, with the objective of bringing about world-wide enforcement of intellectual property.

At the same time, there is an increasingly influential body of writing, particularly associated with Reichman and Samuelson (1997), which argues that the system is progressively less capable of meeting the demands which are being made on it. A typical statement of this position is the following:

[T]he nineteenth century vision that subdivided world intellectual property law into discrete and

* Corresponding author. Tel.: +353-1-608-1479; fax: +353-1-679-9503.

E-mail address: wkingston@tcd.ie (W. Kingston).

mutually exclusive compartments for industrial and artistic property has irretrievably broken down. The theory that the classical patent and copyright models coherently address the way intellectual creations behave has been discredited by its inability to deal adequately with the behavior of many commercially valuable, cutting-edge intellectual creations (Kronz, 1983, pp. 178, 180). These recent technological creations account for an ever-growing share of the gross domestic products of both developed and developing countries (Reichman, 1994, p. 2500).

The present article examines the patent system from this standpoint, finds that it is indeed failing to deliver the protection which could be expected from it, analyses the reasons for this, and discusses some proposed reforms.

2. Some aspects of patent evolution

The tap-root of modern patent arrangements is the individualistic philosophy of the 18th century Enlightenment. Another less important root goes back through the Venetian system to medieval alpine mining grants. These gave temporary monopolies to encourage investment of time and effort, as did the various arrangements for granting patents for finding new technology abroad and bringing it home — “establishing new manufacture within the realm,” as the English Statute of Monopolies of 1623/4 put it. Most of these older systems were effectively dead by the time of the French Revolution, but the doctrine of the Rights of Man on which this was based also provided a new principle on which patents could be revived. This was that since the State had a duty to protect individual personality in its physical aspect, it also had a duty to protect its extensions in the form of ideas or creative work.

This was the basis of the copyright and patent acts, which were passed by several of the American States, as well as of the French patent Act of 1791 (Bugbee, 1967, pp. 67–68; Plasseraud and Savignon, 1986, p. 46). When it came to having a Constitution for the U.S., however, the earlier kind of patent arrangements also had an influence, because the

justification of the Article (8.1) which gives Congress power “to secure for limited times to authors and inventors the exclusive right to their writings and discoveries” is “To promote the progress of science and the useful arts” (Federico, 1990). In Continental Europe, the patent Acts, which were passed in most countries during the 19th century, followed the French model in using only natural rights as their justification, but England took a very long time to graft elements from these rights on to its older — “establishing new manufacture” — system. One reason for this is likely to have been the valuable part patent protection played in the crucial invention of the industrial revolution, Watt’s separate condenser for the Newcomen steam engine.

The evolution of patent law has followed a pattern of changes which tend to begin in the U.S., and are then imitated in other countries. This is partly due to industrialization causing similar problems everywhere, but it also owes something, especially in later years, to U.S. influence on and through the Secretariat of the Paris Convention in Geneva. This Convention, which dates from 1883, was the sole regulator of the international aspects of patents and copyright until the World Trade Organization came into being in 1994.

2.1. Growth of invention by investment

The “natural rights” arrangements worked well enough as long as the “creations of the minds” of individuals could be turned into reality by themselves or by their small enterprises. With the coming of large-scale industry, however, and especially when applied science became important, they were progressively less able to cope (cf. Noble, 1980). The earliest problem that arose was how to reconcile patents with the need to employ individuals to invent in research and development laboratories. In the U.S., the power given to Congress by the Constitution provides for the grant of patents only to individuals. How then could a firm invest in employing individuals to work on research and development if any resulting patents were to be granted to them rather than to the firm? Because the U.S. has a Common Law system, this could be solved by a decision of the Supreme Court. In *U.S. vs. Burns* in

1871, it ruled that employment contracts could validly include a clause providing for any patents granted to an individual as a result of employment to be assigned to the employer for a nominal fee. Countries with a Civil Law system had to change their patent statute to achieve the same end, and indeed in Germany, the great engineer, Wernher Siemens, went into politics to bring about the Patent Act of 1877 there (Heggen, 1975, pp. 115–118).

As more and more inventions emerged from investment in purposive R&D rather than from spontaneous creativity, it became correspondingly more difficult to obtain protection for them from a patent system which had been established to enable individuals obtain rewards from their discoveries. In a landmark U.S. case in 1851, *Hotchkiss vs. Greenwood*, the Supreme Court ruled that “something more than the work of a skilled mechanic” was required if what was accepted as being both useful and new was also to be patentable. It took nearly a century to reach a judicial description of what this “something more” actually was, but in 1941, the same Court used the expression “flash of creative genius” for it in the case of *Cuno Engineering Corp. vs. Automatic Devices Corp.* Moreover, it claimed that this was the level of ingenuity which had all along been required for patentability.

Between the two cases, the way in which inventions emerged had changed almost completely from being the result of individual ingenuity to being produced by purposive, large-scale investment in research and development. The change can even be noted in differences between the legal actors: In *Hotchkiss*, they are individuals; in the *Cuno Engineering* and two 1944 cases which taught similarly (*Mercoïd Corp. vs. Mid-Continent Investment Co.* and *Mercoïd Corp. vs. Minneapolis Regulator Co.*) they are corporations.

Inevitably, the incompatibility between the old criterion of patentability and the new method of invention showed up in Court decisions. In 1925–1929, one-third of the patents coming before Circuit Courts of Appeal were ruled invalid, but 20 years later, this had almost doubled (Mintz and O'Rourke, 1978, p. 2:218, quoting Congress Hearings). Those concerned with patents, either as users or as practitioners, blamed this on progressively greater judicial stringency, but it is much more plausible that it was

simply the change in numbers of inventions resulting from investment. If a “flash of genius” is to be a requirement for patentability, it is much easier to discern it in the output of individuals than of firms. R&D laboratories are staffed by “skilled mechanics,” and those who direct them cannot allow their employees to sit around waiting for “flashes of genius.” It is hardly surprising that the Courts found many patents invalid for lack of these.

2.2. *The antibiotics crisis*

The mechanical and electrical industries could live with a patent system which was unsuited to the protection of inventions which resulted from investment in R&D, because they have other ways of obtaining the protection they need, especially through the power to exclude competitors that goes with massive investment in productive assets and in resources for marketing. There is one industry, however, which simply cannot do without patents, and that is chemicals, especially pharmaceuticals. The formula discovered in the laboratory is identical with the formula that is patented and with the formula of what the physician prescribes and his patient takes. Once that formula is known, investment in resources to make the product delivers only a trivial barrier to copying, and if the drug is effective, little persuasion is needed for its sale. Because chemical inventions can be communicated so easily to others, therefore, if patents did not protect them, free-riding would ensure that investment in research would not be justified. This is why it was from a revolution in the pharmaceutical industry that the stimulus for revolution in patents eventually came, and the cause of both was antibiotics.

The first of these was penicillin, but this was never patented, partly because the authorities in Britain, where it was discovered, considered that it was wrong that something which was so much to the benefit of mankind should be a monopoly. The next one of great importance was streptomycin, and this was patented in 1947. Penicillin had undoubtedly been discovered through a “flash of creative genius,” but the origin of streptomycin could not have been more different. It emerged from Merck's funding of the painstaking examination and testing of more than 10,000 kinds of soil microbes for antibiotic activity

by a team led by Selman Waksman of Rutgers University, New Jersey; and it started a deluge of inventions from pharmaceutical firms which were (and are) typically the output of large-scale, routine activity which is anything but inspired (see Kingston, 2000 for a full account).

Nothing could have been clearer at the time than that investment in antibiotics R&D could not be made on the large scale which was desirable unless patent protection would be available for its results. It was equally clear that the Courts would insist on looking for the “flash of genius,” which research for antibiotic inventions on the Waksman model would be unable to supply (Waksman, 1975). Consequently, there was no option but to change the patent law fundamentally. This would require careful drafting, because a law which frankly recognized that investment had replaced individuals as the source of what is to be protected, would not have been within the power given to Congress by the Constitution. Change could therefore only come about in a way that *forced the reality of invention by investment into the pretence of invention by individuals*.

The year after the streptomycin patent issued, the New York Patent Bar Association drafted a Bill and was able to get it introduced in Congress, and this, supplemented by other Bills and pressures, led to the first major revision of the U.S. patent law since 1870. This was the Patent Act of 1952, and it was explicitly intended to make the patent system suitable for protecting inventions which were the result of investment in research and development, by killing off the “flash of genius” requirement.

2.3. Defining the “inventive step”

Its first crucial provision from this point of view was that “Patentability shall not be negated by the manner in which the invention was made,” so that the result of mindless labour became just as patentable as that of instantaneous vision. The second was to replace the “flash of genius” criterion by making it a condition of patentability that the subject matter should not be “obvious to a person having ordinary skill in the art to which it pertains.” The gap between the patent system and inventions produced by purposive investment, which had been widening for more than a century, was now closed.

In the words of a judge who as a patent attorney had played an important part in the shaping of the Act, the result of both these changes is that “long toil stands on an equal footing with flashes [of genius]” (Rich, quoted in Federico, 1978, p. 1:109).

From the point of view of how change comes about in intellectual property matters (or indeed fails to do so), it is worth noting that this Act of Congress was given its form solely by special interests which would benefit by it, firstly the patent attorneys and their clients, and secondly, the Patent Office itself, whose bureaucracy would be expanded by growth in patenting: “The [1952] Patent Act was written basically by patent lawyers ... A good 95% of the members [of Congress] never knew that the legislation was under consideration, or that it had passed, let alone what it contained” (Rich, 1978, pp.1:10, 1:11). There was no mechanism for giving a voice to those who might be affected adversely by this legislation, and none of these did in the event find such a voice.

Of course, all other industrial countries were also experiencing the same progressive incongruity between patent arrangements designed to protect the results of individual creativity, and inventions which came from purposive research and development. They all solved the problem by following the example of the U.S. and including the inventive step or non-obviousness criterion in their patent examination procedure. Significantly, Japan was the first to do this in 1959, followed by Sweden in 1967, France in 1968, Germany in 1976, and Britain in 1977. Most importantly, under the Convention of 1973 which established the European patent, this criterion was built into examination of applications from the start. As interpreted by Courts in several countries, it means that in applying a known technique to a definable problem, an invention will fail the test of non-obviousness if it was “obvious to try” what led to it, or if the trying was done “with a reasonable expectation of success,” or if the “chances of success were considered worth a try” (cf. Bochnovic, 1982).

2.4. Use of R&D portfolios

Since it was the pharmaceutical industry’s requirements which had brought the issue of protecting

the results of investment in R&D to a head, it is hardly surprising that the U.S. 1952 Act and its imitations in other countries do in fact give pharmaceutical inventions very effective protection. So much is this the case that investments of the order of US\$100 million can now be rationally made to find, develop, test and market a new drug; that this industry is the biggest user of patents in every country; that several countries have given its patents extended terms to compensate for delays caused by the need for certification; and that very few disputes in it reach the Courts. What may be considered surprising, since all of this has been built on the non-obviousness criterion, is that this has happened in spite of the reality that “[t]he invention of chemical structures which are per se unobvious is an exceedingly rare occurrence” (Rowland, 1978 p. 7:201).

This can be understood by analogy with portfolio theory in finance. Rational investment in a portfolio of risky projects is possible because the risk which attaches to the portfolio as a whole is statistically lower than that of any individual project. What saves the pharmaceutical industry, then, is that the “screening” activity which is so characteristic of its research and development is in fact the operation of a portfolio of research possibilities. The research programme of a large pharmaceutical firm will have several such “portfolios,” each comprising a large number of individual research assignments. It is precisely — and indeed only — because there is a reasonable expectation of success *for each portfolio as a whole* that the firm is able to invest rationally in research on the large scale necessary. This research will of course follow up a whole series of suggestions from prior art of advantage to be gained from new combinations of it, and there will be a strong expectation of success from *somewhere* within the portfolio. Such expectation makes rational investment possible. Reverting to the case which was the catalyst for the change in the patent law, in light of what they already knew about penicillin, at the level of their portfolio of more than 10,000 possibilities Merck was betting on a near-certainty that Waksman’s team would find a valuable antibiotic.

Indeed, the kind of money that it takes to discover a new drug and put it on the market today can only be invested on a basis that *is* pretty close to certainty — in other words, the chances of success have to be

a great deal better than anything which could meet the inventive step criterion of “not considered worth a try.” Large-firm R&D is, in fact, rather well described by the words of a British Lord Justice of Appeal when he excluded from patent protection “a mere business assessment or choice to pursue an identified goal by known means” (Hobhouse, 1995).

At the level of the *individual* assignments in a research portfolio, however, a new combination can meet the criteria of non-obviousness because there was no “reasonable expectation of success” in trying the *particular* known means which had been used in it. In the painstaking examination and testing of soil microbes for antibiotic activity from which streptomycin emerged, for example, it was a research student called Schatz who actually first isolated it, and his name is on the patent for it with Waksman’s. But since there was no more “reason to try” one soil microbe rather than another, success could have come just as easily to any of the other 20 research assistants in Waksman’s team, and what Schatz found was not “obvious to one skilled in the Art.”

3. Investment and technological complexity

An important aspect of the shift to inventions resulting from purposive investment in R&D is the increasing complexity of technologies. Roycroft and Kash (1999, p. 262) define a complex technology as:

a process or product that cannot be understood in full detail by an individual expert sufficiently to communicate all details of the process or product across time and distance to other experts. (A simple product or process is one that can be understood or communicated by one individual).

They have also identified the growing economic importance of complex technologies. Between 1970 and 1995, the percentage of the world’s 30 most valuable goods exports represented by complex products and processes grew from 53% to 78% (Roycroft and Kash, 1999, p. 8).

3.1. The role of patents in complex technologies

In contrast to simple technologies such as chemicals, for which they are indispensable, patents are

inherently *disadvantageous* for complex technologies. The primary reason is that if competing firms hold patents on different components of a complex technology, and they fail to cross-license them (which can happen from many causes, not all of them rational) development in an entire industry can be slowed down or even rendered impossible (cf. Merges, 1994).

As complex technologies emerged, therefore, firms devised arrangements to limit such harmful effects of patent monopolies, and the most important patent-using industries such as automobiles, aircraft and radio, grew on the basis of “pooled” patents. Member firms transferred all their patents to the pool, which in turn allowed all members to use the information freely, sometimes subject to a royalty that was assessed by a committee. However, it is clear that the real pay-off for pool members was their freedom to use the technology of all other members without the need for negotiation or even costly litigation, rather than any payment received for their own contributions to the pool. Pools also facilitated transfer of non-patentable technical information between members, as well as the setting of standards for components.

3.2. *Patents as a trading currency*

Perhaps inevitably, formal patent pools became suspect as aspects of anti-competitive behaviour in their industries, and in the U.S., Federal Anti-Trust policy brought all but the least important of them to an end. However, firms in complex technologies still faced the same problem, which is their need to maintain access to and freedom to use state-of-the-art knowledge. Delay in obtaining access to a component of a complex technology is of course especially damaging to firms in technologies with a short life-cycle, where the first firm to the market has every chance of setting the standards and even of locking the others out. Since they cannot be members of a formal pool, firms now patent as many components or sub-components of a technology as they can, so as to build up the strongest possible position for cross-licensing. The motivation for their extensive use of patents is therefore quite different from that of firms in simple technologies. In the latter, the emphasis

may be said to be primarily offensive (to prevent others from *using* the invention); in complex technologies it is primarily defensive (to avoid being *denied* the use of an invention).

This approach by firms in complex technologies means filing for patents on large numbers of incremental innovations. On the face of it, most of these should not qualify for patent protection, since it is in the nature of incremental changes that they emerge in an organic way, out of what is there already. Each change points toward the next, and is correspondingly “obvious to one skilled in the Art.” Indeed, this is one of the identifying marks of the normal innovation trajectory in a complex technology, characterized by incremental improvements. It is possible to speculate, therefore, that it is only because they are part of a complex technology, which itself is not understood as a whole, that such small changes are able to meet the non-obviousness criterion for patentability.

The widespread use of patents as bargaining chips in complex technologies has logically developed into arrangements between competitors to pursue some innovation projects together, at least in the early stages. In the U.S., there is even a National Cooperative Research Act to control these, and 450 collaborations were registered under it for the period 1985–1994. Nearly half of the more than 500 U.S. industry/university research institutes have up to five firms as members (Mowery, 1999, pp. 44–45). Some companies sign broad trading agreements with competitors that cover periods of several years. This often leads to common industry standards, defined by patents, even to the point where the inventors of a technology may even offer low- or no-cost licenses on their patents when they want to have their design used broadly or universally.

3.3. *Are patent pools more “pro-competitive”?*

The use of patents as trading currency should have overall economic benefit because it reduces transaction costs, and indeed, at the limit, no firm could take the risk of innovating a new complex technology unless it was sure it could trade in this way. It should be noted, however, that widespread use of patents as a mechanism to deal with Anti-Trust

disapproval of patent pools has probably *increased* both barriers to entry and transaction costs, contrary to the Authorities' intentions. If a pool is in existence, firms in it will only patent enough inventions to maintain membership of the pool, or the inventions, which they think are significant, and therefore likely to earn them some automatic royalties from other members. Since they do not have to fear being locked out from using improvements made by other pool members, they are under no pressure to patent their own minor "inventions," to build up bargaining power.

If using a pool is outlawed, however, firms are forced to patent everything which could possibly help them in the slightest way against being locked out by a competitor's patent from an incremental improvement which they might want to use in the future. Consequently, patent filing, prosecution and maintenance costs are much higher than if a pool existed, and to these must be added the costs of negotiating cross-licenses with competitors (also absent in a pool). Moreover, by definition, complex technologies are large-firm technologies. Such firms have little need for patents to protect the incremental results of their R&D, because they can do this by having the productive resources to be first into a market with an improvement, and then using marketing on a large scale to fend off rivals. Consequently, it is doubtful if the level of R&D investment in complex technologies would be significantly reduced if the patent system were to be abolished altogether.

It is even questionable whether granting of patents for the ways in which they are used in these technologies is in line with the patent system's objective of "promoting the progress of science and the useful arts." This is because of the barriers to entry they underwrite, which are analogous to the "covert cartels" which exist in markets where a comparably strong barrier to entry is provided by very large advertising expenditures (cf. Kingston, 1984, p. 66). *De facto* patent pools of the anti-competitive type have returned through the back door. Strategies of "saturation patenting" designed to slow down or altogether prevent competitors from exploiting alternative technological trajectories must surely be against the public interest. So is the threat of heavy litigation costs, which are often used against financially weaker competitors.

4. The high cost of resolving patent disputes

Such threats, which do not have to be explicit to be effective, reflect further major distortion in the operation of the patent system. Patents should be a source of market power for firms which otherwise lack it, but this objective is defeated if enforcement costs are too high. Before the introduction of the inventive step test, much litigation was either avoided altogether or aborted at an early stage by patentees, because of their perception that their chance of obtaining a ruling that a patent was both valid and infringed was so low. The much better prospects for patentees from the replacement of the "flash of genius" criterion by the inventive step, both increased patent numbers and encouraged patentees to take infringers to Court.

In the U.S., this movement was undoubtedly accelerated by the designation of the Court of Appeals for the Federal Circuit in Washington, DC in 1982, as the forum for all patent cases. Before this, infringers could practise "forum-shopping" (as they can still do in Europe under the Brussels and Lugano Conventions) whereby they could arrange for a case to be taken in a jurisdiction likely to favour them. This was a considerable deterrent to the owners of patents to appeal a case from a District Court decision. There is little doubt that patentees have fared much better from the CAFC, which has even led to a perception in some quarters that this Court has been responsible for lowering the standard of patentability. It is far more plausible that it has done no more than accept the logic of the need to protect invention resulting from investment, and not just from the individual creativity towards which earlier patent arrangements were directed.

These changes caused a marked growth in patent applications and an estimated 50% increase in litigation during the 1980s (Merz and Pace, 1994) with inevitable rapid inflation in litigation costs. Lerner has assembled data from several sources to estimate that in the U.S. these costs are now more than a quarter of what is spent on industrial basic research (1995, p. 470). Just how serious this problem is, has been officially recognized in a recent Report of the U.S. Advisory Committee on Patent Law Reform. No fewer than 36 out of 197 pages of this are devoted to the cost of enforcing patent rights, not

only financially, but in terms of delay, which it considered to be particularly urgent:

the delays and complexity of modern patent litigation have provided overly aggressive lawyers with an ample assortment of opportunities to stall, delay and harass. The net of these factors is that *patent litigation has become an increasingly inefficient, ineffective and undesirable means of resolving patent related disputes* (1992, p. 78, emphasis added).

The Committee's main conclusion could not have been more damning of the present situation in the U.S. It feared that

unless the problems of cost and delay in patent litigation are addressed now, the central purpose of the patent system to provide an effective incentive for development and commercialization of new technology will be seriously eroded. Such an erosion could well prove a threat to the very existence of the patent system... (1992, p. 76).

In addition to the measurable costs of litigation, there are many others that are very substantial and that certainly have important social implications. These are the burdens in terms of distraction, diversion of energy, and misdirection of creativity that any intellectual property dispute currently imposes on innovatory firms.

4.1. *Particular disadvantages of smaller firms*

High litigation costs are particularly destructive of the contributions to innovation that smaller firms have proved they can make. It is obvious that the measurable costs of prosecuting or defending an action for patent infringement are far beyond the resources of all but the largest firms, apart from the fact that the burden of the costs that cannot be measured (such as distraction from more immediately paying tasks) falls most heavily on smaller ones. Smaller firms are especially inhibited from investing in innovation through fear of crippling costs to defend any intellectual property they might own (for actual cost levels, see Bouju, 1988).

Neither do they have the resources to enable them to use the "portfolio" approach, which virtually guarantees that the results from large-scale invest-

ment in research and development in certain technologies will obtain patent protection. Inventive owners and managers in small firms can only afford to try combinations of prior art if they think there is some hope of success, so that their inventions consequently often fail the "non-obviousness" criteria. Even when they are granted a patent, they often face intimidation by larger firms in seeking to use the law to enforce it. Such intimidation, it must be stressed, does not have to be explicit to be effective. Awareness of the danger of crippling legal costs can be fatal on its own to the use of the classical patent system by knowledgeable management in such smaller firms.

In public interest terms, these drawbacks to use of patents by small firms are serious, because these firms have shown that they have quite disproportionate ability to invent and innovate. In the U.S., they receive less than 4% of Federal support for research, yet they produce more than half of the innovations and get close to two-fifths of all patents (State of Small Business Report, 1997). These figures doubtlessly flatter the inventive power of small businesses, because large ones must hold a higher proportion of the more valuable patents. Nevertheless, it is a reasonable assumption that substantial economic losses are being incurred in every developed country through lack of appropriate protection for the inventions and innovations of smaller businesses.

5. Summary of diagnosis

From the foregoing, it appears that the patent system:

- operates very well indeed for firms in the chemical industries;
- operates poorly in industries whose firms cannot use a portfolio approach in their R&D;
- is disadvantageous to complex technologies and is scarcely needed by them for invention protection, but they nevertheless use it heavily to prevent being "locked out" from access to components competitors' technology;
- has very expensive dispute resolution arrangements; and partly for this reason,

- it serves small firms, which have most need of effective protection for their inventions, particularly badly.

6. Responses to patent system failures

6.1. Use of copyright to fill gaps in patent protection

As might be expected, the failure of the patent system to protect inventions in certain areas has led to use of alternative arrangements to try to fill the gaps. The most striking illustration of this is computer programs. When patent protection was sought for the earliest of these, it was denied by the U.S. Patent and Trademark Office, not on strict legal grounds, but simply because the Office did not have the resources to cope with the volume of applications it envisaged would follow. The Court of first instance rejected the Office's decisions, but the Supreme Court supported them, so for many years, developers of such programs could only obtain copyright protection. Recently, this Court changed its stance, so protection of such programs by patents has become increasingly possible in the U.S., although not elsewhere to the same extent.

Copyright is also being adapted to protect functional designs, as under British legislation which will be discussed below. This can also be seen in a response to patent system failure in the U.S. relating to manufacture of fibreglass yacht hulls. Considerable originality, skill and investment is needed to optimize a modern hull configuration, which will be then be expressed in the "plug" or mould from which multiple copies can be produced. However, this design and research work is not carried on in a way which can enable it to meet the "non-obviousness" criterion and get a patent. Since the hull configuration is consequently not protected, all a free-rider needs to do is buy a single example of a successful design from its originator, shape his own "plug" from this, and proceed to make and sell perfect copies without having to make any of the investment it took to develop the design, or to share in its risk.

The State of Florida rightly considered that this discouraged investment in boatbuilding and passed a law protecting vessel designs including their "plugs."

However, this was struck down by the Supreme Court, using the words "the federal patent laws must determine what is protected, but also what is free for all to use" (*Bonito Boats vs. Thundercraft Boats*, 1989, p. 141). The response in this case has been the "Vessel Hull Design Protection Act," passed by the House of Representatives and sent on to the Senate in March, 1998. This is an amendment to the Copyright Act, and echoes some of the wording of British functional design protection, e.g., the hull design must not be "staple or commonplace."

The Vessel Hull Design Bill and its discussion in Congress reveal some of the factors which make patents reform so difficult. In the 19th century paradigm, patents protect "function" and copyright protects "expression." It was essential (especially in light of the explicit Supreme Court ruling) that the new protection should be located in Copyright, that is, in "expression." To achieve this, the bill contains a clause that Hull Design protection shall not apply to any design which is "dictated solely by a utilitarian function of the article that embodies it." It has indeed been claimed that "the perfecting of a type of object mechanically is evidenced by its beauty" (Gilfillan, 1935, p. 8) but this is hardly what is at stake here: like an aircraft's wing, it is function and not aesthetics which determines the shape of a vessel's hull.

As expressed in the House discussion, the U.S. Patent and Trademark Office did not have a formal view on the bill, "but as a general policy, they prefer not to enumerate subgroups of patents" (Scott, 1998). The clear implication of this statement is that the Office likes to think that the existing patent system is able to provide protection for *all* technologies, an attitude they share with Patent Offices in other countries. It is manifestly not correct. As explained above, the system is strongly biased in favour of technologies whose R&D can use the portfolio approach, primarily the pharmaceutical industry. It gives correspondingly poor protection to firms that cannot use this approach to meet the inventive step criterion, above all, the small firms whose inventions most need patent protection. As Thurow (1997, p. 103) has argued in the wider context,

The world's one-dimensional intellectual property system must be overhauled to create a more differ-

entiated one. Trying to squeeze to-day's developments into yesterday's system of intellectual property rights simply won't work. One size does not fit all.

6.2. "Second-tier" patent protection

Several other attempts to fill gaps in protection resulting from the way in which the patent system has evolved are categorized as "second-tier" patent protection. These often build upon existing arrangements for "utility models" or "petty patents," now in 60 countries, of which at least 12 have been established since 1980 (Janis, 1999, p. 153). Britain had legislation for utility models as early as 1843 and Germany introduced its system in 1891. Both were intended to protect the external configurations of, for example, handtools, and were not concerned with the functional aspect of these. The British system lapsed, and German *Gebrauchsmuster* protection was used only to a limited extent. However, in 1987, Britain introduced functional design protection on a copyright rather than a patent model in that it is automatic, requiring neither application nor fees, and of course there is no examination. The criterion of novelty is that the subject matter is "not commonplace" and protection applies to first marketing within the European Union as well as to first design. The term is 15 years from design or first marketing, whichever is shorter, and during the final 5 years of the term, compulsory licensing applies, with the Comptroller of Patents as arbitrator if the parties cannot agree royalty terms.

In 1979, Australia introduced "petty patent" protection, giving a short-term of protection without examination, but with the same "non-obviousness" criterion as regular patents. This feature ensured that it was scarcely used at all. In 1997, proposals to remedy this were brought forward in the form of an "Innovation Patent," which would give protection for 8 years without examination, with a much relaxed novelty criterion.

In 1990, Germany upgraded its utility model arrangements so as to make the range of what they can protect the same as regular patents, and in 1992, Ireland introduced a "short-term patent" to be granted for 10 years, with application but without examina-

tion unless requested. The criterion of novelty, that the claimed subject matter should not "clearly lack an inventive step," is substantially that of the British 1949 Act, before that Country adopted examination for non-obviousness in 1977. Ireland's examination of applications for regular patents has looked for an inventive step since 1964.

The authorities of the European Union have been distracted from concern with the broader inadequacies of the present patent system by their difficulties in bringing the Community Patent Convention into life. This is intended to give a unitary patent for all member-countries, with a single Court to deal with disputes. Nevertheless, in 1995, they started to produce proposals for harmonizing utility model protection throughout the EU. In their latest form, these are for a 6-year term with two possible renewals each of 2 years, with no examination of applications. Biological inventions and chemical processes would be excluded from the scope of protection, as would computer programs. The alternative to the non-obviousness criterion of regular patents is that the subject-matter should disclose either (a) particular effectiveness in terms of, for example, ease of application or use, or (b) a practical or industrial advantage.

7. Further reforms needed

The evident motivation for much of the development of second-tier protection is to try to repair some of the faults in the regular patent system, but what has so far been proposed for second-tier patent arrangements falls well short of what is needed. However, three broad changes, two of which already have support from empirical research, could go a long way towards making regular patents and second-tier protection into an effective combination, capable between them of operating equitably and applicable to all technologies. These changes (in order of likely difficulty of introduction) are:

- Compulsory arbitration of disputes, with legal aid for the respondent party in the event of an appeal to the Courts from an arbitration decision;
- Direct protection of innovation, in the form of "Innovation Warrants," as the best possible second-tier system, to provide protection in tech-

nologies where the portfolio approach cannot be used well enough in R&D to obtain valid patents; and

- Changing from time to money as the measure of the patent grant.

8. Reducing the cost of resolving patent disputes

8.1. *Penalty of using ordinary courts*

An important reason for the high levels of patent litigation cost is use of the same Court arrangements for settlement of what are at heart technical issues, as for non-technical disputes. Even in a specialist court with some judges who have a scientific or engineering background, such as the Court of Appeal for the Federal Circuit in Washington, DC, the judges still have to be educated in the specific technology of each case by teams of attorneys (the most highly paid teachers in the world). This education also has to be provided in duplicate to the judges by these expensive mentors on behalf of *both* parties to a dispute.

This “education” of judges rarely reaches the level where even the most self-confident of them feel able to pit their own technical assessment against really expert witnesses. Consequently, the advantage is with the party that can afford to have the most authoritative witnesses (who also tend to be the most expensive) on its side. As soon as the possibility of a dispute between pharmaceutical firms appears on the horizon, for example, a race begins between them to retain the services of the most prestigious academics in the particular field. It is surely significant that the U.S. Commission on Patent Law Reform (1992, p. 95) explicitly urged measures to reduce the use of experts and to diminish their role as advocates in patent cases, recommending that judges require “a strong showing” of need before authorizing testimony from expert witnesses.

8.2. *Alternative dispute-resolution methods*

Because of the scale of litigation costs, a series of alternative dispute resolution means has developed, in attempts “to resolve disputes more quickly, in a less costly manner, and in a way that will reduce the burden on the judiciary — without sacrificing jus-

tice” (Creel, 1987). The most important of these is expert arbitration, and within the last few years, for example, the World Intellectual Property Organization has set up arrangements for arbitration of disputes, but this has been very little used. The obvious reason is that arbitration is *voluntary*, so that it can be used only when both parties agree on it as a way of settling their dispute. In turn, such agreement invariably reflects comparable levels of economic strength. Arbitration is *not* used in intellectual property cases where the cost of litigation intimidates — and is indeed intended to intimidate — attempts by a weaker party to obtain justice. Deliberate policy decisions to infringe patents and to use the court system to postpone the day of reckoning until a dominating market position has been built up are frequent. Large firms have enormous opportunities at present for imposing burdens on their opponents in litigation in terms of delays and discovery actions. As an example, when E.M.I. invented and innovated the brain scanner — “the most important advance in diagnostic technique since X-rays” — their patents were deliberately and quickly infringed by General Electric and Ohio Nuclear.

Although E.M.I. did win its actions long afterwards, the royalties which it obtained did not remotely compensate it for having been driven out of the business that it had pioneered, an event that occurred within 7 years. There can hardly be any area in which the dictum that “justice delayed is justice denied” applies with more force than in intellectual property, because lead time is such an effective alternative way of protecting investment in innovation (cf. Levin et al., 1987).

Since at present a patent is no more than a license to litigate, a great need exists for some means of resolving disputes that will be swift (especially because the law’s delays hurt smaller firms more than large ones) and will also eliminate differences in financial resources between the parties as far as possible. If “war is too important to be left to the generals,” then equally, patents are too important to be left to lawyers and judges.

8.3. *Compulsory arbitration*

These problems could be solved by compulsory arbitration with a special feature added (Kingston,

1995). This would be carried out by an expert or experts selected on an ad hoc basis for each case out of the technological and academic community. Such people would need no education in the state-of-the-art, could deal with the parties without intermediaries, and could deliver a quick decision. Persuasive empirical support for this approach has emerged as a by-product of research in the “Interference” records of the U.S. Patent and Trademark Office. Interferences exist because of the explicit provision in the Constitution, referred to earlier, that patents and copyright can only be granted to *individual* inventors and authors.

This provision makes it necessary for the Office to have procedures to ensure that a patent is granted only to whoever can be identified as “the true and first inventor.” Consequently, when it is noted that two (or more) applications that might possibly be for the same inventive entity have been filed, an “interference” is declared, and all parties must provide evidence as to their respective dates of “conception of the invention” and of their efforts to reduce it to practice. The Board of Patent Appeals and Interferences, which decides on the evidence submitted, is recruited from the most experienced members of the Patent Office’s Examiner Corps.

Interference procedure, therefore, is precisely a system of compulsory arbitration of patent disputes by experts. It is an actual large-scale working precedent or model for the means of resolving such disputes now proposed. The Board delivers between 40 and 50 final decisions each year. Just over one-third of these are appealed to the courts, but only 5% of them are either wholly or even partially reversed (Calvert and Sofocleous, 1989, 1992, 1995).

Another valuable feature of the interference model is the high proportion of cases that are settled voluntarily. Out of a typical 61 cases studied, for example, no less than 14 ended in agreement between the parties. It is not possible to be certain of the conditions that generally apply in such agreements, but a few cases where agreement texts have been found in the files suggest that — as one might expect — the parties cross-license their inventions. The result is that any new technology arising from these cases will reflect competitive development effort by at least two firms. Such a technology can be expected to advance more quickly than others, because each of

the parties would explore its own particular “trajectory” of improvement possibilities.

All in all, therefore, in terms of how few of its decisions are successfully appealed to the courts and of how many of its cases reach voluntary settlement, the performance of compulsory expert arbitration in the interference procedure is a very good augury of how well a similar system could work for the settlement of disputes *after* grant of exclusive privilege. Any arrangement that works 95% of the time, after all, is giving at least as good a result as we are entitled to hope for in human affairs.

Extending compulsory arbitration to post-grant disputes would depend on being able to find individuals who need no education in the state-of-the-art and who are also completely independent of the parties to a dispute. The record of the Administrative Judges in the U.S. Patent and Trademark Office shows that they would be eminently capable of performing this task. There is no reason to think that their opposite numbers in, e.g., the European Patent Office, would not be equally able to deal with post-grant issues. In order to stress arbitrators’ independence, the special Board might be administratively and even physically separated from the Patent and Trademark Office. To ensure that the arbitrators were always up-to-date in the state of their particular Arts, they might be seconded from their Office to the Board only for limited periods, or even for particular cases in relation to which their expertise is particularly relevant.

8.4. *Appealing arbitration decisions*

Since any form of arbitration must allow for appeal to the courts, it might be considered that this proposal only pushes the problems of cost and intimidation back a stage. This objection could be dealt with by providing legal aid *for the party which had accepted the arbitrator’s decision, i.e., the respondent in an appeal case.* It is most unlikely that this would cost very much. No small- or medium-size firm would ever appeal, both because it would lack the resources to litigate and because to do so would give a gratuitous advantage to its opponent by shifting the ground of the battle to where the latter is likely to be stronger. Large firms would also see many convincing reasons for not appealing, once

they were no longer able to bring their financial advantage to bear, including the following:

- Courts invariably give a lot of weight to the outcome of expert arbitration, as the Interference figures show. The odds for an appellant must therefore be against winning the legal battle, having lost the arbitration.

- In present circumstances, even the threat of litigation will almost certainly force a small firm to capitulate. It is quite a different matter if such a firm will be provided with the resources to defend itself in court because it has accepted the arbitration award. Large firms will be reluctant to fight an opponent who has now effectively been made “their own size.”

- At present, intimidation is not evident to the public. With the arrangement proposed, there would be more transparency. A large firm would likely be reluctant to have it known that it is using its financial strength against a smaller one after an independent arbitrator has ruled in favour of the latter.

- Most litigation is entered into in the expectation that it will end in compromise. Since the firm that has accepted the expert arbitration would not have to pay any subsequent legal costs itself, it would be under less pressure to settle the case out of court. This would greatly add to the “downside” of the possible outcomes that a prospective appellant would have to take into account when deciding whether or not to appeal.

- Quick decisions, such as could be obtained by compulsory expert arbitration, may be found to be even more valuable to large firms than to smaller ones because their range of innovative activities is likely to be correspondingly wider. Consequently, they may see it as being in their interest to support the proposed system, specifically by adopting a formal policy of *not* appealing decisions to the courts.

8.5. *Paying for arbitrations and legal aid*

Any costs of the proposal should be regarded exactly as a counterpart to the necessary expense of conventional policing of other kinds of property. Every property right system involves policing by the State. If patents are to be real rights of property, therefore, the State cannot escape having to spend money on their protection.

The near-certainty that no small firm would appeal from an arbitration, and the likelihood that large firms would be cautious about doing so, supported by the extremely low proportion of successful appeals to the Courts from Interference arbitrations, also have another implication. This is that commercial insurance cover against costs, in the first instance of appeals, and subsequently of arbitrations also, might be obtainable. Patent litigation insurance up to now has been merely cosmetic, and largely useless to small firms, because it is so hedged about with limitations, but if the figures were seen to justify it, it would not be long before some insurer would make it available. In that event, the legal aid aspect of this proposal might become redundant.

8.6. *A voluntary patent pool?*

An interesting recent response to the excessive cost of litigation in patent disputes is the National Patent Board, which was established in the U.S. on the initiative of Procter and Gamble. At the time of writing, this has 40 members, all large firms, which agree that any dispute between them will be dealt with by alternative resolution means, such as mediation or arbitration. If a member firm decides to litigate the issue subsequently, it must then assume all the costs of the earlier procedures.

Research for the European Commission is currently investigating a variant of this for small firms. This would in effect be a voluntary patent pool. A firm which joined would accept compulsory arbitration of any dispute with another member. Members' fees would provide the pool's Direction with resources to undertake litigation in cases where a non-member is in dispute with a member and refuses arbitration. It is believed that as a track record of such litigation was built up, intimidation would be reduced correspondingly. A potential infringing firm would not know whether or the dispute in which it is involved would be taken up for litigation by the pool's Direction, but it might well consider that the risk of this was enough to make it prudent to negotiate a license.

A particular advantage of a voluntary pool, of course, is that it could be established without legislation. Also, because of the size of its member firms and the diversity of their markets, there could be no

question of such a pool being judged as anti-competitive.

9. An “innovation warrant”

A proposal for this was explored in detail for the European Commission (1996) (Kingston, 1987) and research since then has refined its approach to protecting innovation *directly*, instead of indirectly, through whatever protection a patent is able to give to its related invention. It is a type of “second-tier” patent protection, but it will be shown below that it shares none of the disadvantages which Janis (1999) has found in other types of this, either actual or proposed. Its objective is to provide protection for any kind of information that results from investment, in the following ways:

- The criterion of novelty would be the strictly commercial one of “non-availability in the ordinary course of trade.” *Anything*, not just technology, which is not so available, but could be made available by investment, would be entitled to protection. Although the principle of granting protection for investment in innovation per se without any “inventive step” or creativity requirement was considered radical in 1987, it now underpins the European Union’s 1996 Database Directive.

- Applications would be published immediately on the Internet, and their examination would rely heavily on information resulting from pre-grant opposition.

- The grant of exclusive privilege would be *irrevocable* for a period, to make it a sound basis for investment. Who would take the risk of drilling for oil if any license granted could be made worthless as a result of new knowledge of the seismic structure of the allotted block becoming available? Yet, this is in effect all the security a patent gives to an investor at present, since no Patent Office can guarantee that its search is absolutely comprehensive, and judicial decisions cannot be forecast with any certainty.

- The term of the privilege would vary according to the risk of the investment, i.e., whether it related to a radical innovation or to an incremental innovation or to something in between. It would also vary according to the meaning of the level of risk for the applicant. A proposal requiring investment that could

bankrupt a small firm in the event of failure, for example, might scarcely be noticed in the accounts of a multinational. Terms in general would be significantly shorter than for patents at present, but from an investor’s point of view a short term of really effective exclusivity is worth a lot more than a nominally longer one that is uncertain. Replacement of the measure of the grant of exclusive privilege in terms of time by a money measure, to be discussed in a later section, would be especially appropriate.

9.1. Warrants tested against Janis’ arguments

9.1.1. Presumption of validity

Janis stresses that it is characteristic of second-tier arrangements that applications are not examined. The resulting lack of any presumption of validity eliminates speedy interlocutory injunctions against an infringer. Some regimes provide for examination when called for, but this still involves delay. Inability to obtain injunctory relief can be disastrous for a small firm, especially if the infringer has strong marketing resources.

Innovation Warrants, in contrast, would have such a presumption of validity, both because applications would be examined, and because of the nature of their novelty criterion, which is based on fact rather than judgement. This would be helped by pre-grant opposition, in spite of the bad reputation which attaches to this procedure. The U.S. has never had it; in Japan, it is notorious as a non-tariff barrier to imports; and industry’s view of the European Patent Office version is that it “must be judged a failure. An unacceptable number of years often elapses before a final decision, which is then often the beginning of national Court proceedings” (Yorke, 1999). An aspect of these delays is the unwillingness of that Office to admit that “one size does not fit all,” reflected in the domination of its procedures by the requirements of its biggest user, the pharmaceutical industry. Since this industry has to carry out lengthy tests for opposition purposes, periods for response which are appropriate for it, are far longer than is needed for other technologies.

With a novelty criterion of “non-availability in the ordinary course of trade,” the factual information needed for a decision is easily collected. Moreover, for this purpose, the best imaginable search engine is

the vigilance of firms likely to be affected competitively by grant of a Warrant. Publishing new applications on the Internet would facilitate their ease of monitoring. The combination makes it possible for both opposition and examination periods for a Warrant to be very short indeed, and for its grant to be irrevocable, at least long enough for a larger firm which takes a license on the invention, to gain “first mover” advantage on the market for it. Since it is in the interest of society that there should be many innovating firms, the irrevocable part of the Warrant term might be longer if a small firm is exploiting the invention itself, since seed and venture capitalists would require this.

9.1.2. “*Tacit*” and “*explicit*” knowledge

Janis (1999, p. 171) describes the criteria for grant of protection in second-tier patent systems generically as “soft obviousness,” and foresees much difficulty in resolving disputes over these in practice, especially in the case of the proposed EU Utility Model. The same factors as would give the Innovation Warrant its presumption of validity would also give it an advantage in this respect. The criterion for grant of a Warrant (“non-availability in the ordinary course of trade”) leads to protection of tacit information (defined by Polanyi, 1967 as “what we know but cannot tell”) as well as the explicit information which is all that the classical patent system tries to protect. Tacit information is generally discussed in terms of the practical knowledge and skills of those who make a new product, which are only transferable with difficulty, when indeed they are transferable at all. A point to note is that this includes knowledge of what does *not* work as well as what does. Both these types of tacit information embodied in a new product have been obtained as a result of the investment and risk of the originator, and consequently deserve to be protected just as much as the related explicit knowledge.

9.1.3. “*Anticommons*” property

A third point made by Janis against second-tier patents is the danger of what Heller (1998) calls “anticommons property.” This is the opposite of freedom of access to a resource, which leads to its overuse and consequent destruction, as in the case of

the Newfoundland cod fishery. In an “anticommons,” so many individuals have rights that the resource cannot be effectively used at all. If these rights are patents, then the “blocking” effect already discussed in relation to complex technologies can come into being (cf. Lemley, 1997). Resources will then be underused because of “intellectual property rights in future products or by permitting too many upstream patent owners to stack licenses” (Heller and Eisenberg, 1998, p. 699).

There are two safeguards against this in the Innovation Warrant proposal. The first of these is that since the function of the Warrant is to make it possible to invest rationally in innovation, it lapses if that investment is not made; this makes perverse “blocking” (i.e., in order to exact ransom from a firm which is committed to make such an investment) impossible. Secondly, the monopoly period would be relatively short, and would be succeeded by a further period when compulsory licensing would apply, as in the British functional design protection. In relation to a similar proposal to protect computer programs Reichman (1994, p. 2540) finds that “periods of 2 or 3 years of lead time have particular appeal.”

9.1.4. *Smaller firms*

Fourthly, Janis (1999, p. 179) calls attention to the extent to which interest in second-tier protection is caused by concern that the inventions of smaller firms do not have access to protection from the regular patent system. This is, of course, perfectly true, and Janis is also right to point out that from its cost aspect, far too much attention has been paid to *acquisition* costs. The potential costs of enforcement are greater by an order of magnitude, so that it is on these that attention should be focused. The special form of compulsory arbitration discussed in Sections 8.3 and 8.4 above is the appropriate response to this problem, and has been part of the Innovation Warrant proposal from the outset (cf. Kingston, 1987, pp. 328–331).

9.1.5. *Other comparisons*

Finally, Janis explains why second-tier patents are unable to justify the claims made for them that they would give protection to non-traditional technologies

(p. 190) and to products with short life-cycles (p. 188) and that they are more appropriate to developing countries than regular patents are (p. 194). The Innovation Warrant's novelty criterion ("non-availability in the ordinary course of trade") clearly applies as well to non-traditional technologies as to traditional ones. Internet publication of applications, combined with that novelty criterion and the short period allowed for opposition, would use up less of any product's potential life-cycle than any other arrangement. For developing countries, the Warrant shares with other second-tier systems the advantage over patents that adaptation of its general approach to local requirements is not restricted by TRIPS (the intellectual property aspect of the World Trade Organization Agreement).

10. Money instead of time as the measure of a patent grant

The third proposal is the most radical, but correspondingly promises most benefit. It is to change the way patent grants are measured from time to money. For inventions that result from investment, time is an extremely poor measure — the proper one can only be money. No doubt, in the early days of patents, any measure other than time was out of the question, since accounting techniques were undeveloped. But Kelvin's dictum that "we advance according to the precision of our measures" is not only true for natural science: to persist with such a poor measure as time for patents is simply to ignore all the achievements of accountancy.

It can only be by sheer accident that any period of time which is the same for all technologies (as the 20-year patent term is today) could provide just the incentive that is required to bring about a particular investment at high risk. As will be seen below, many of the problems of intellectual property rights, especially for new fields such as biotechnology and information processing, are actually *caused* by using time as the measure of a patent or copyright grant. The techniques are now available to change the measure of the grant of exclusive privilege from time to money, without reducing incentives to invest in R&D, and with strengthened support for innovation.

10.1. Need for rapid innovation diffusion

There is now persuasive evidence that progress in any field of technology is made most rapidly when several firms are competing to capture a share of a new market, and to widen the scope of application of an invention, through making incremental improvements along overlapping or competing trajectories (cf. Merges and Nelson, 1990, p. 908). This evidence strongly suggests that early freedom to use inventions should be an essential component of modern intellectual property. Complex technologies do in fact achieve this through their use of patents as a trading currency, as the growth in their importance reported by Roycroft and Kash (1999) confirms. On this point, it is ironic that if the existing patent system actually worked in practice as it is supposed to do in theory, there would be even less innovation than there is. Empirical research has shown that (except for chemicals) in contrast to a patent's nominal 20-year monopoly term, the average period of effective protection is no more than 3 years. Worse still, the cost to the imitator of producing a competitive product within that period, has been shown to be less than what the invention had cost the originating firm (Mansfield et al., 1981; Levin et al., 1987).

Instead of relying for innovation diffusion on the failure of the patent system to deliver the protection it promises, therefore, it would clearly be better to use a compulsory license system to get the process of diffusion started in an orderly way and as early as possible. This would open the way for competitive firms to explore several different trajectories of incremental change, to the undoubted benefit of product quality, employment and economic growth.

The idea of compulsory licensing is anathema to users of the patent system, who see it as inimical to their chances of gaining big enough rewards to justify the risks they take. Their views must be taken with the utmost seriousness, since if any compulsory licensing arrangement meant reducing the incentive to invest in inventing, there would be fewer or even no inventions to diffuse. The problem is therefore to reconcile the need for the quickest and widest possible diffusion of inventions to the market, with maintaining, indeed improving, incentives to invent and innovate. This requires a *quite new kind* of compulsory licensing.

10.2. “Shared-risk” compulsory licenses

Ideally, any exclusive privilege should last until its possessor has made profits from his innovation which amount to some socially acceptable multiple of the investment which was made in it at high risk. However, *ex post* measurement of this kind has been found to be impractical. Measuring *ex ante*, i.e., establishing what it costs to produce an invention or innovation, is much more practical and less susceptible to fraud. If obtaining protection is going to depend upon keeping precise records, firms will make sure that this is done. As Merges (1992, p. 55) has pointed out, proving such costs

will not be difficult or burdensome. Patent applicants and patentees collect this information anyway for a variety of reasons, including (1) tax benefits, (2) internal cost accounting, (3) use in project evaluation, (4) use in licensing negotiations and the like. Patentees appear to have no trouble showing research expenditures at the damages stage of a patent infringement suit, and ... such information has been introduced in some cases to show the nonobviousness of the invention involved. Simply adding one more reason to collect data on the cost of a research project does not appear to pose a major problem.

It is also the case that analysts of high-tech stocks on the Nasdaq market are increasingly paying attention to price/R&D ratios, which in itself must be forcing innovatory firms towards more precise recording of their investments in research.

Availability of such data would open the way to allowing a competing firm to share the use of any information generated by an inventor/innovator, provided that it also shares retrospectively in the investment which the originator had to make in order to bring the information into being, *as well as the risk of that investment*. This could be done by making the payment for a compulsory license (a) a *multiple* of the R&D investment the originator had made, and (b) a once-off, capital sum rather than royalties.

The reason for (a) is of course to take account of the risk which had been taken in making the investment, and the multiple must be such as at least to maintain present incentives to invest. That for (b) is

because of the principle of sharing retrospectively in both the investment and the risk that brought the information into existence. That investment is now a sunk cost for the originator. Fair sharing in it by a licensee should not depend on that licensee’s future success in using the information, as would be the case with royalty payments. By reducing the number of potential competitors who would take such a license, this condition would also enhance the originator’s return on investment.

Socially acceptable “multiples” of the investment which had been made to produce the information that is to be the subject of the license would be officially prescribed for capital payments beforehand. They could be varied according to the needs and risks of different industries and according to the stage of invention or innovation reached when the license is taken out, but of course, there would be no question of adjusting the multiple to individual firms, any more than the patent term would be adjusted today.

10.3. Empirical support

To investigate how this proposal could work in practice, the risks and amounts of investments of 23,000 cases in the U.S. Small Business Innovation Research Programs, stage-by-stage from ideas to products on the market, were calculated (Kingston, 1994). The results indicate the feasibility of working out “multiples” that would combine better incentives for investment in inventing and innovating than those offered by the patent system now, with the earliest possible and widest diffusion of the results.

10.4. Some advantages of measuring by money

Mazzolini and Nelson (1998, p. 274) have pointed out that recent growth in interest in intellectual property is associated with a general view that “is heavily weighted toward the proposition that strong and broad patent rights are conducive to economic progress.” They urge caution in respect of this proposition, and it is interesting to note how far using money instead of time as the measure of protection can provide answers to their objections. “Shared-risk” compulsory licensing would combine the possibility of large

rewards for an originator with immediate access to information by followers. Those who made improvements on an original breakthrough would not be blocked by the originator from putting it on the market, nor would the originator be blocked from using the improvement, both being recompensed appropriately by the “multiples” for their respective contributions.

Another consequence is that there is likely to be much less infringement, since competitors will calculate that it is in their interest to buy a “shared-risk” license and get into production quickly, rather than take the chance of losing early mover advantage in the market as well as an infringement action. It would also be reasonable to expect the Courts to treat infringers more severely than they do at present, because of failure to exercise an option which had been open to them.

For complex technologies, “shared-risk” compulsory licensing would provide all the advantages and none of the disadvantages of a patent pool. No firm would ever find itself locked out from use of any component which it needs. The waste and other harmful effects of policies such as “saturation patenting” by firms in complex technologies, which of course could not even have been envisaged when the original, “natural rights” patent system was formulated, would be eliminated.

10.5. *More incremental innovation*

A single patent of the present type, if it has broad scope and with its monopoly measured by time, can even enable a firm to deter others from trying to invent “in its neighborhood.” Lerner’s (1995, p. 463ff) empirical research has shown, for example, how in biotechnology small firms are inhibited from patenting in areas already colonized by larger ones. This will also mean that there will be a narrower range of *incremental* innovation than there could be, since this type of innovation depends on the competitive efforts of several firms to satisfy the full range of a market’s requirements. Neither of these disadvantages would apply to “shared-risk” compulsory licensing arrangements. Any rival firm would be free to work the invention by retrospectively sharing both the investment made by the originator and its risk

through making the prescribed capital payment for a license. Nor would this remove an advantage which has been claimed for present arrangements, which is that others may be forced to work on quite different alternatives. With the proposed change, any competitor would remain free to do this as an alternative to paying for a license.

Kitch’s (1977) “prospect theory” of patents argues that broad patents are necessary if there is to be orderly development of an invention which opens up a whole range of follow-on inventions. It is claimed that effective control of these by the holder of the original master patent reduces waste in terms of the efforts of a number of inventors who work in the prospect of a profitable invention, but find that they are beaten in the patent “race.” Just as what is now proposed would deal with the problems of “blocking” patents, it would also achieve the objectives listed by Kitch very efficiently, since licenses to use any master patent would be available to all those willing to share retrospectively in both the originator’s investment *and its risk*. The wastes associated with patent “races” would be eliminated.

10.6. *Implications for university research*

In recent years, there has been remarkable growth in patenting of the results of university research (cf. Mowery, 1999, p. 41). This is causing concern lest intellectual property rights should be granted on what used to be considered as “science” and therefore intrinsically in the public domain. The unease is all the stronger because of the extent to which such research is publicly funded. It is widely held that information which is the result of such funding, should be made available as extensively as possible. Without reversing the encouragement now being given to universities to use intellectual property, generous licensing of it is clearly desirable. Indeed, the world’s biggest royalty-earner from university research, the Cohen–Boyer biotechnology patent, has been very widely licensed. This, of course, is exactly what would happen with all inventions if the changes now proposed were in force.

A question of particular importance for scientists is, how early in the process of information generation can protection legitimately be introduced? Com-

pletely free access to the earliest stages has traditionally been the norm, and those who work in basic science are naturally on their guard against any erosion of this freedom by those who would extend the range of proprietary protection. The changes proposed would protect freedom of access, because they would eliminate monopoly rights. Without eroding incentives to produce information, they would make access to and use of that information contingent only on readiness to share in the effort that was responsible for it. Such arrangements could hardly be objected to by anyone who believes that useful information should be both as plentiful and as freely accessible as possible.

10.7. Advantages for biotechnology

The issue of appropriate intellectual property rights for useful information, which emerges close to the frontier with basic research, is raised in an acute form in patents for biotechnology. This is emphatically a field where discoveries are made, not by the individual activity of the patent system's origins, but by large-scale, expensive and purposive research activity, much of which takes place in universities. Commercialization of the results may require the use of a number of gene fragments, so that the holder of a single patent can be in a classical "blocking" position (cf. Heller and Eisenberg, 1998). Two ways in which changing from time to money as measure of the grant of protection could deal with this problem are immediately evident.

- It would provide a basis for ending the battle between those who want exclusive privileges in respect of biotechnology to be as strong or as weak as possible. This conflict can be seen in its extreme form in the contrast between one group which holds that patents for gene sequences should be issued with broad claims, and another group which wants distribution of all relevant information to be so free as even to be on the Internet. If "shared-risk" compulsory licenses were available, the first group would get the incentive for risky investment which it wants, and the second one would see all information able to be used freely, subject only to the condition of sharing retrospectively in both the investment and the risk which produced it.

- It would greatly reduce both the volume of litigation and the cost of individual actions. One of the roots of the thinking of those who are against patent protection for biotechnology inventions is the belief that this type of monopoly is anti-social, coupled with a certain fear of it. Opponents of patents over-estimate the extent to which they actually deliver the monopoly power that they nominally confer. At the same time, in an entirely new field such as biotechnology, there are indeed grounds for caution, lest whole areas of development in the life sciences might be in danger of monopolisation by individual firms. This would also carry with it the danger of slower development through lack of stimulus from competition. Changing from time to money as a measure of any exclusive privilege granted, with its corollary, "shared-risk" compulsory licensing, would result in the multiple sources of innovation which optimum development requires. In doing so, it would also remove the legitimate grounds for concern on the part of those who oppose biotechnology patents in their present form. The fact that the President of the U.S. and the Prime Minister of the U.K. have felt it necessary to issue an unprecedented joint statement on this matter, is evidence of the depth of this concern.

11. Conclusion

Legal changes had to be made to try to adjust the administration of patents to the reality that invention and innovation now primarily result from investment rather than from individual creativity. An unintended result of these changes has been to make it difficult for firms in most non-chemical technologies, and all smaller firms, to obtain the protection they need for risky investments in innovation. However, reforms are possible, including compulsory arbitration of all disputes, with legal aid for the respondent party in the event of an appeal from an arbitration to the Courts; the Innovation Warrant version of second-tier patent protection; and changing from time to money as the measure of the exclusive privilege granted, made possible through "shared-risk" compulsory licensing in exchange for capital payments.

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