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Computer Programs As Applied Scientific Know-How: Implications of Copyright Protection for Commercialized University Research

*J. H. Reichman**

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I. OVERVIEW

The extent to which universities should seek to profit from commercial exploitation of their research output became a controversial issue in the 1980s even with regard to technologies that intellectual property law had traditionally been willing to protect.¹ During this same period, university scientists and engineers have made extraordinary progress in non-traditional technologies that deviate from established patterns of academic research and that fall outside the basic subdivisions of the world's intellectual property system.²

The bulk of today's most valuable innovations flow from incremental improvements in applied scientific know-how. Products of new technologies that embody this know-how seldom behave in a manner consistent with the standard assumptions underlying the international patent and copyright systems.³ Legislative and judicial efforts to adapt domestic intellectual property laws to accommodate these new technologies have led to a proliferation of ad hoc protective solutions in all industrialized countries.⁴ However, these attempts to stimulate investment in innovative industries by tinkering with traditional intellectual property laws are shortsighted and they tend to substitute problems of chronic overprotection for those of chronic underprotection. In the long run, the cumulative disadvantages of these responses threaten to inhibit the very forms of innovation they are meant to promote.⁵

1. See, e.g., D. NELKIN, SCIENCE AS INTELLECTUAL PROPERTY: WHO CONTROLS RESEARCH? 1-8 (1984); B. REAMS, UNIVERSITY-INDUSTRY RESEARCH PARTNERSHIPS—THE MAJOR LEGAL ISSUES IN RESEARCH AND DEVELOPMENT AGREEMENTS 3-19 (1986); TECHNOLOGICAL INNOVATION IN THE '80s, at 6-7 (J. Coles ed. 1983). Patents and copyrights are the traditional modes of protecting intellectual property of primary interest to universities. See *infra* text accompanying notes 41-51.

2. Because of rapid scientific breakthroughs in biotechnology research sponsored by universities, the field of biotechnology has triggered the most intense pressure for cooperation between universities and private industries. See, e.g., D. NELKIN, *supra* note 1, at 7 (noting that "much of the discussion about intellectual property has come to focus on the commercialization of biomedical research"); B. REAMS, *supra* note 1, at ix-x. But biotechnology is just one entry in a growing list of both old and new technologies that are served inadequately by patent and copyright laws as historically conceived and applied. Prominent on this list are computer technologies, data bases, industrial designs, pharmaceuticals, and methods of medical treatment. See, e.g., K. HODKINSON, PROTECTING AND EXPLOITING NEW TECHNOLOGY AND DESIGNS 72-100, 121-47 (1987); see *infra* text accompanying notes 84-114.

3. See *infra* text accompanying notes 61-116.

4. See *infra* text accompanying notes 116-49, 236-311.

5. See *infra* text accompanying notes 59-116, 390-411; see also Reichman, *Design Protection and the New Technologies: Meaning of The United States Experience*, Paper presented at the International Conference on the Legal Protection of Industrial Design (Disegno Industriale e la Comunità Europea), Treviso, Italy (Oct. 11-13, 1988) (forthcoming in INDUS. PROF.).

Meanwhile, a proliferation of protective legal devices has created unprecedented opportunities for universities to commercialize their collective research agenda. Current methods of combining copyright, patent, and trade secret laws to protect computer programs, for example, illustrate legal strategies that university administrators can apply to a broadening range of innovative techniques.⁶ Reliance on these same strategies to protect faculty-generated software, however, can embroil administrators in thorny disputes concerning ownership of the research product⁷ and the scope of protection that their proprietary rights should command.⁸ Administrators may also require strict internal and external arrangements to prevent theft of trade secrets, and they may need to participate in spin-off corporations in order to maximize returns from derivative works.⁹ Universities that systematically seek to commercialize applications of scientific know-how will thus need to develop a rather different set of practices and procedures from those customarily employed to protect either patented research or copyrighted works of a more traditional character.

A university that uses copyright law to protect its contributions to technological innovation will find that the tension between this mode of protection and traditional academic values is far more subtle and complex than in the past. The growing propensity of universities to exploit proprietary rights in new technologies, moreover, is leading to closer cooperation with industry than was thought suitable in the past.¹⁰ Many faculties and administrators have consequently jettisoned the set of basic restraints and guidelines that a group of leading university presidents had tried to affirm as late as 1982.¹¹

This Article surveys the problems that university administrators face when seeking to exploit proprietary rights in new technologies, with particular regard to computer software. In so doing, it explores larger questions about the proper role of intellectual property laws in protecting applied scientific know-how and the proper role of universities in exploiting the opportunities that such laws increasingly make

6. See *infra* text accompanying notes 170-368.

7. See *infra* text accompanying notes 181-223.

8. See *infra* text accompanying notes 224-313.

9. See *infra* text accompanying notes 314-68.

10. See, e.g., Brooks, *The Research University: Doing Good, and Doing it Better*, ISSUES SCI. & TECH., Winter 1988, at 49, 50-51. See generally PARTNERS IN THE RESEARCH ENTERPRISE—UNIVERSITY-CORPORATE RELATIONS IN SCIENCE AND TECHNOLOGY (T. Langfitt, S. Hackney, A. Fishman & A. Glowasky eds. 1983) [hereinafter PARTNERS IN RESEARCH].

11. See, e.g., Eisenberg, *Proprietary Rights and the Norms of Science in Biotechnology Research*, 97 YALE L.J. 177, 177-80 (1987); Korn, *Patent and Trade Secret Protection In University-Industry Research Relationships in Biotechnology*, 24 HARV. J. ON LEGIS. 191, 201-08 (1987); see *infra* text accompanying notes 30-40 (discussing the Pajaro Dunes Conference).

available.

II. COMMERCIALIZED UNIVERSITY RESEARCH IN A PROMISCUOUS LEGAL ENVIRONMENT

A. *The Minimalist Putsch at Pajaro Dunes*

Since the mid-1970s, public opinion in the United States and most other industrialized countries has regarded the temporary monopolies of patent and copyright law more favorably than during the previous two decades.¹² This improved climate soon began to affect the way uni-

12. See, e.g., Adelman, *The New World Of Patents Created by the Court of Appeals for the Federal Circuit*, 20 U. MICH. J.L. REF. 979, 979-82 (1987) (stating that "[t]he patent system, . . . relegated to an obscure corner by many opinion makers, [has] made a startling comeback"). Compare, e.g., Beier, *The Significance of the Patent System for Technical, Economic and Social Progress*, 11 INT'L REV. INDUS. PROP. & COPYRIGHT L. (IIC) 563 (1980) [hereinafter Beier, *Patent System*] and Kitch, *Nature and Function of the Patent System*, 20 J.L. & ECON. 265 (1977) with STAFF OF SENATE SUBCOMM. ON PATENTS, TRADEMARKS AND COPYRIGHTS, SENATE COMM. OF THE JUDICIARY, 85TH CONG., 2D SESS., AN ECONOMIC REVIEW OF THE PATENT SYSTEM 80 (Comm. Print 1958) (authored by F. Machlup) [hereinafter F. Machlup] (noting that "[i]f 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").

According to Professor Kitch, whose reorientation in 1977 spearheaded this shift, the patent law with its prospecting function actually provided a structural and organizational foundation for the efficient allocation of resources in the research and development environment. Kitch, *supra*, at 276-81. What Professor Beier calls the "close and quite startling correlation between economic freedom, industrialization and patent protection" was thus rediscovered, perhaps because of competition from Japan, which had operated within the confines of a patent system. Beier, *Government Promotion of Innovation and the Patent System*, 13 INT'L REV. INDUS. PROP. & COPYRIGHT L. (IIC) 545, 547 (1982) [hereinafter Beier, *Government Promotion*]; see also Brooks, *supra* note 10, at 54. This rediscovery produced a growing conviction that the patent system inherently promotes the public interest, as the United States Constitution implies, and does not merely interfere with free competition through the creation of monopolies. See, e.g., R. BENKO, PROTECTING INTELLECTUAL PROPERTY RIGHTS—ISSUES AND CONTROVERSIES 17-19 (1987); H. ULLRICH, STANDARDS OF PATENTABILITY FOR EUROPEAN INVENTIONS: SHOULD AN INVENTIVE STEP ADVANCE THE ART? 101-05, 111-13 (1977); Adelman, *supra*, at 980-81; Beier, *Government Promotion, supra*, at 546-51.

Recent attempts to justify the intellectual property system under conservative economic theory have elicited a surprisingly protectionist literature from circles that were historically opposed to any such derogations from the norms of free competition. See, e.g., Landes & Posner, *An Economic Analysis of Copyright Law*, 18 J. LEGAL STUD. (1989) [hereinafter Landes & Posner, *Economic Analysis*] (forthcoming); Lehman, *The Theory of Property Rights and the Protection of Intellectual and Industrial Property*, 16 INT'L REV. INDUS. PROP. & COPYRIGHT L. (IIC) 525 (1985); Lunn, *The Roles of Property Rights and Market Power in Appropriating Innovative Output*, 14 J. LEGAL STUD. 423 (1985); see also Landes & Posner, *Trademark Law: An Economic Perspective*, 30 J.L. & ECON. 265 (1987). Nevertheless, attacks on the intellectual property system as a whole or its constituent parts recur at frequent intervals. See, e.g., Breyer, *The Uneasy Case for Copyright: A Study of Copyright in Books, Photocopies, and Computer Programs*, 84 HARV. L. REV. 281 (1970); Mandeville & Macdonald, *Innovation Protection Viewed from an Information Perspective*, in DIRECT PROTECTION OF INNOVATION 157 (W. Kingston ed. 1987) [hereinafter DIRECT PROTECTION] (arguing that innovation as such should not be protected and that "the patent system works only because it does not work: . . . its very weakness is its real strength"); Oddi, *The International Patent System and Third World Development: Reality or Myth?*, 1987 DUKE L.J. 831; see also R. BENKO, *supra*, at 19-25 (noting the views of those hostile to intellectual property protection); Adel-

versities viewed intellectual property.¹³ Historically, academic investigators had disdained the patenting of research results on the ground that they were paid to disseminate knowledge to the public.¹⁴ By the 1980s, however, as the magnitude of government support diminished in response to changed economic conditions and the value of endowments in real dollars continued to shrink, university administrators found it increasingly difficult to fund research by traditional means.¹⁵ The patenting of research results afforded universities a self-help opportunity to share in the profits that industry reaped from the work of their faculties and staffs¹⁶—sometimes with spectacular results¹⁷—while contributing to a nationwide drive for greater competitiveness on international markets.¹⁸

Once the universities began to re-evaluate the impact of patents on their educational mission, they discovered that tensions between the dissemination of basic research and the protection of applied technical ideas were not unmanageable. This was especially true under United States patent law, which provides a one-year novelty grace period that enables investigators both to publish and to patent their research results¹⁹ with careful timing.²⁰

man, *supra*, at 979-80 n.1 (citing recent articles critical of patent system).

13. See Pajaro Dunes Conference, *Draft Statement*, 9 J.C. & U.L. 533, 536 (1983) [hereinafter *Pajaro Dunes Statement*].

14. See D. DICKSON, *THE NEW POLITICS OF SCIENCE* 89-90 (1984); B. REAMS, *supra* note 1, at 23-24; Merton, *The Normative Structure of Science*, in *THE SOCIOLOGY OF SCIENCE* 267 (1973). For recent criticism of the trend toward more aggressive university patenting policies, see Weiner, *Patenting and Academic Research*, 12 *SCI. TECH. & HUM. VALUES* 50-62 (1987).

15. See, e.g., Lesser, *Financing University Research Through Patenting and Licensing: Recent Policies and Practices at Cornell University as an Example*, 18 *INT'L REV. INDUS. PROP. & COPYRIGHT L. (IIC)* 360 (1987) (observing that economic shocks, recession, budget deficits, and the trade imbalance reduced government support of university research in the 1980s).

16. See, e.g., *id.* (noting that universities in search of replacement funds turned inward and examined the commercial potential of inventions by faculty and staff). Participation in the fruits of that research may be the surest way, in the long run, to offset the loss of big donations from large sources of capital that become harder to find under the new income tax laws.

17. Consider, for example, the University of Wisconsin's patent on the process for activating Vitamin D; Indiana University and stannous flouride (Crest toothpaste); and the University of Florida and Gatorade. D. DICKSON, *supra* note 14, at 90-91. Dickson observes, however, that 12 of 35 universities polled by the Association of American Universities reported actual losses on patent-licensing operations. *Id.* at 91.

18. See, e.g., D. NELKIN, *supra* note 1, at 2; Brooks, *supra* note 10, at 52-53.

19. 35 U.S.C. § 102(b) (1982); see, e.g., Kitch, *supra* note 12, at 287 (suggesting that disclosure is actually encouraged, as a way to attract licensees); Lesser, *supra* note 15, at 360-61 (noting that the patent system permits academics to reveal invention without fear of copying). Contrast this regime with the one in the European Community, in which no novelty grace period exists. See 2 D. CHISUM, *PATENTS* § 6.02 (1988); Beier, *Government Promotion*, *supra* note 12, at 564-65; see also Winner, *Practical Effects of the Patent Co-operation Treaty and the European Patent Convention on Domestic Technology Management and Patent Practice*, 62 *J. PAT. OFF. SOC'Y* 419 (1980).

Some commentators also argued persuasively that the patenting of university inventions advanced the public interest regardless of the academic scientists' access to public and private funds donated to finance basic research.²¹ As Professor Beier explained in 1982, technical and economic progress requires that the research and development phase should lead to "industrial application and dissemination of new technical knowledge."²² Investors, however, will not readily arrange the transfer of new technology from the laboratory to industry without obtaining exclusive rights²³ that prevent competitors who do not share in the costs of research and development from duplicating patentable inventions.²⁴ Not taking patents seriously, in other words, may mean that

20. Patenting seemed not to require secrecy so much as a carefully timed disclosure that exploited this novelty grace period in American law. *See, e.g., In re O'Farrell*, 853 F.2d 804 (Fed. Cir. 1988) (noting that pioneering studies published more than one year prior to filing provided virtually all of a biogenetic method to the public and rendered the inventors' later claims obvious); *National Semiconductor Corp. v. Linear Technology Corp.*, 8 U.S.P.Q.2d (BNA) 1359 (N.D. Cal. 1988) (holding that the submission of papers preceding a conference was not a general publication for purposes of 35 U.S.C. § 102(b) (1982), even though some engineers in competing firms had received it). Even a carefully timed publication, however, can limit the patentee's ability to obtain future or additional patents on modifications of the initial invention, because the publication will itself constitute prior art against the patentee, and the patentee may be denied a continuation in part to this extent. *See, e.g., Massachusetts Inst. of Technology v. AB Fortia*, 774 F.2d 1104, 1106-07 (Fed. Cir. 1985); *In re Ruscetta*, 255 F.2d 687 (C.C.P.A. 1958) (discussing the "timing of disclosures").

Patenting also required universities to avoid public use of the claimed invention more than one year before the filing of a patent application under § 102(b). A researcher's experimental use in the laboratory, however, may be privileged. *See, e.g., TP Laboratories, Inc. v. Professional Positioners, Inc.*, 724 F.2d 965 (Fed. Cir. 1984) (holding that experimental use did not invalidate the patent); *Moxness Prod., Inc. v. Xomed, Inc.*, 8 U.S.P.Q.2d (BNA) 1281 (M.D. Fla. 1988) (holding that "public use" of an invention at University of Minnesota Health Center violated § 102(b) as a matter of law and negated patentability); Korn, *supra* note 11, at 213-16.

The advantage of a patent application is that once filed, exploitation and academic dissemination can proceed together, arguably with an overall gain in efficiency. Even with this accommodation, however, some find academic duty irreconcilable with intellectual property protection of any sort. *See* N. WADE, *THE SCIENCE BUSINESS* 27-40, 55-64 (Report of The Twentieth Century Fund: Task Force on the Commercialization of Scientific Research, background paper 1984); Weiner, *supra* note 14.

21. *See* Beier, *Government Promotion*, *supra* note 12, at 562; *see also* B. REAMS, *supra* note 1, at 4; *id.* at 149 (arguing that "[j]oint research efforts in innovation can, if properly articulated, accomplish goals of mutual interest to both industry and the university—the improvement of society"). *See generally* D. BOK, *BEYOND THE IVORY TOWER: SOCIAL RESPONSIBILITIES OF THE MODERN UNIVERSITY* 155 (1982) (patenting is consistent with the university mission); H. ULLRICH, *supra* note 12, at 105-06.

22. Beier, *Government Promotion*, *supra* note 12, at 562.

23. *See, e.g., R. BENKO*, *supra* note 12, at 17-19 (noting that the patent monopoly compensates for market failure and addresses the problem of appropriability).

24. *See, e.g.,* Beier, *Government Promotion*, *supra* note 12, at 562; Cawood, *Venture Capital and the University*, Paper Delivered at the Conference on the University Spin-Off Corporation, Donaldson Brown Center for Continuing Education, Virginia Polytechnic Institute and State University, Blacksburg, Virginia (April 24-27, 1988) [hereinafter Blacksburg Conference] (to be published as *The University Spin-Off Corporation: Entrepreneurship and Economic Development* (A.

research results will not benefit the public at all, because dissemination through publication alone fails to complete the transfer to industry and will not necessarily elicit the investment needed to perfect it.²⁵

Prodded by self-interest and this philosophy of convenience,²⁶ universities began to move toward more systematic commercialization of their research output.²⁷ By 1980, even Harvard University had announced plans to establish a company to exploit the genetic engineering advances that one of its own biochemists had pioneered.²⁸ The Harvard faculty, however, rejected this proposal and its President, in cancelling the deal, warned about tainting the relationship between universities and their professors.²⁹ As the public grew more concerned about the ethical consequences of commercialized university research, the presidents of several leading universities³⁰ decided to exert a restraining influence on the evolving partnership between industry and the university.³¹

Gathered at Pajaro Dunes, California, in 1982, to contemplate the problems that commercialized discoveries in biotechnology were already posing for the academic enterprise as a whole, this group of university

Brett, D. Gibson & K. Smilor eds. 1989)) (copy on file at Vanderbilt Law School); see also Morrison & Wetzel, *Support Network for Faculty Spin-off Companies*, in Blacksburg Conference, *supra* (advancing the venture capitalist's view that without intellectual property protection investments in development cannot be justified); *Pajaro Dunes Statement*, *supra* note 13, at 536.

25. Beier, *Government Promotion*, *supra* note 12, at 562. Beier stated: "Even though it would appear to be appropriate to make available R & D results financed by the government to everyone, by means of scientific publications, special information systems, technology clearing houses, etc., this approach has not been successful in practice." *Id.* (emphasis added).

26. See, e.g., Hackney, *Prologue*, in PARTNERS IN RESEARCH, *supra* note 10, at xi-xii (noting that the realities motivating commercialization of research—that universities cannot do research without funding and that corporations stay in business by making a profit—"are less likely to be brought out" than are the advantages of interaction); Lesser, *supra* note 15, at 370.

27. See, e.g., B. REAMS, *supra* note 1, at 18-19; Weiner, *supra* note 14, at 59 (deploring that "[m]ore and more universities are adopting aggressive patenting policies"). Thus, the premise that patents promote the public interest in general has been widely interpreted to include university patents. Major universities expressly justify their increasing use of the patent system by appealing to their concern about "the public interest in potential new products and processes resulting from discoveries or inventions made by members of the (u)niversity in connection with . . . their (u)niversity activities." Harvard University, A Statement of Policy in Regard to Patents and Copyrights (adopted by the President and Fellows November 3, 1976, amended March 17, 1986) [hereinafter Harvard Statement].

28. Gosselin, *In '80, Harvard Dropped Plan for Genetic Engineering Firm*, Boston Globe, Sept. 11, 1988, at 43, col. 1.

29. *Id.*

30. See, e.g., Giamatti, *Free Market and Free Inquiry: The University, Industry, and Cooperative Research*, in PARTNERS IN RESEARCH, *supra* note 10, at 3 (remarks of A. Bartlett Giamatti, then President of Yale University); Gosselin, *supra* note 28, at 43 (discussing statements by Derek Bok, President of Harvard University).

31. See, e.g., Rosenzweig, *The Pajaro Dunes Conference*, in PARTNERS IN RESEARCH, *supra* note 10, at 33-37 (discussing the purpose of the Conference).

presidents issued a now celebrated statement acknowledging that "applications of present knowledge can be foreseen that are likely to be of far-reaching benefit to people everywhere."³² They nonetheless felt compelled to stress "the preservation of the independence and integrity of the university and its faculty," both of which were "faced with unprecedented financial pressures and complex commercial relationships."³³ Moreover, the presidents found it necessary to reaffirm their obligation to ensure that universities "remain devoted to their primary goals of education and research, and that . . . resources be properly used in the pursuit of these goals."³⁴ The *Pajaro Dunes Statement* then proceeded to sketch a set of guidelines to govern research agreements, patent licensing, and faculty relations with universities, in each case emphasizing the primacy of teaching and research responsibilities and the need to avoid conflicts of interest.³⁵

What emerged from Pajaro Dunes was the portrait of a university that feared the contamination of its academic goals through contact with industry and the introduction of the commercial ethos into the university environment.³⁶ For present purposes, one may characterize such a university as "minimalist" in its approach to commercialized research. Minimalist universities do want to share in the proceeds of such endeavors, but they continue to believe that they are not in the business of selling technology for profit. Nor do they wish to become decentralized think tanks within larger corporate chains of production that reach into the laboratories for new products to be delivered to the consuming public. The minimalist approach aims to preserve the freedom of university professors to publish and dispose of the fruits of their intellectual pursuits as they see fit.³⁷ Whenever a potential conflict arises between corporate and university values in the commercialization of research results, the spirit of Pajaro Dunes calls for the latter to prevail.³⁸

32. *Pajaro Dunes Statement*, *supra* note 13, at 533.

33. *Id.*

34. *Id.*

35. *Id.* at 538.

36. B. REAMS, *supra* note 1, at 149; Gosselin, *In '80, Harvard Dropped Plan for Genetic Engineering Firm*, *Boston Globe*, Sept. 11, 1988, at 43, col. 1. (discussing statements made by Derek Bok, President of Harvard University).

37. See, e.g., Giamatti, *supra* note 30, in *PARTNERS IN RESEARCH*, *supra* note 10, at 4-7. *But see* Rosenzweig, *supra* note 31, in *PARTNERS IN RESEARCH*, *supra* note 10, at 37-39 (belittling the potential corruption of university goals by contact with industry in light of the potential for greater corruption that has existed since government began to dominate research funding).

38. Giamatti, *supra* note 30, in *PARTNERS IN RESEARCH*, *supra* note 10, at 3-9.

B. *New Directions in Legal Protection of Industrial Know-How*

The wisdom of hindsight suggests that the *Pajaro Dunes Statement* was inadequate under the best of circumstances. To some, it appeared naive on its face, "a merely pious and platitudinous" declaration of ideals.³⁹ The *Statement* was also grounded on the false assumption that universities would continue to be well served by the legal institutions of copyright and patent laws as they had operated in the past.⁴⁰

1. Inventions or Artistic Works—The Historical Models

Universities customarily retained a proprietary interest in patentable discoveries developed on their campuses and with their resources while relinquishing rights in the copyrightable literary output of their faculty members.⁴¹ Both legal institutions promote dissemination of research in different ways. Because copyright law lacks any novelty requirement, for example, the validity of a copyrighted work is not compromised by the mere fact of disclosure.⁴² Moreover, copyright protection does not obstruct the use of ideas, facts, discoveries, or research results as such. It pertains only to the form in which these are given expression,⁴³ it protects expression only against copying, and it cannot protect against independent creation by another author who happens to reach the same conclusions.⁴⁴ A "fair use" doctrine, codified in the Copyright Act of 1976, explicitly recognizes the right of later authors to

39. See Rosenzweig, *supra* note 31, in *PARTNERS IN RESEARCH*, *supra* note 10, at 37 (attempting to parry the charge).

40. See, e.g., B. REAMS, *supra* note 1, at 73-74; *Pajaro Dunes Statement*, *supra* note 13, at 536-37.

41. See, e.g., Dreyfuss, *The Creative Employee and the Copyright Act of 1976*, 54 U. CHI. L. REV. 590, 597-98 (1987); Muller, *Academic Responsibility and Dependencies*, 24 IDEA 141, 144 (1983); INDIANA UNIVERSITY FOUNDATION, *PATENTS, COPYRIGHTS, AND PROTECTION OF INTELLECTUAL PROPERTY* (1977); VANDERBILT UNIVERSITY FACULTY MANUAL 56-60 (1987); see also *Hays v. Sony Corp.*, 847 F.2d 412, 416-17 (7th Cir. 1988) (treating the teacher exception to works-made-for-hire doctrine under 1909 Act as an established presumption).

42. 17 U.S.C. § 102(a) (1982) (stating that copyright "subsists in original works of authorship"); 1 M. NIMMER & D. NIMMER, *NIMMER ON COPYRIGHT* §§ 2.01, 2.01[A] (1988).

43. 17 U.S.C. § 102(b) (1982); see, e.g., *Miller v. Universal City Studios*, 650 F.2d 1365 (5th Cir. 1981) (holding research not copyrightable); *Hoehling v. Universal City Studios*, 618 F.2d 972 (2d Cir. 1980). But see Denicola, *Copyright in Collections of Facts: A Theory for the Protection of Nonfiction Literary Works*, 81 COLUM. L. REV. 516 (1981) (identifying and approving sweat-of-the-brow rationale for the protection of so-called factual works). See generally Ginsburg, *Sabotaging and Reconstructing History: A Comment on the Scope of Copyright Protection in Works of History After Hoehling v. Universal City Studios*, 29 J. COPYRIGHT Soc'y 647 (1982); Gorman, *Fact or Fancy: The Implications for Copyright*, 29 J. COPYRIGHT Soc'y 560 (1982).

44. 1 M. NIMMER & D. NIMMER, *supra* note 42, § 2.01[A]; see also Jones, *Is There a Proprietary Interest in Scientific Research Data?*, 1 HIGH TECH. L.J. 447, 453-58 (1986) (arguing that copyright law does not and should not protect scientific research).

reproduce even protected portions of a work for scholarly purposes.⁴⁵

The patent approach is also reconcilable with traditional goals of dissemination, even if it does require enough patent consciousness to time the filing of claims so as not to exceed the one-year grace period after initial publication.⁴⁶ Indeed, the patent law expressly obliges an inventor to disclose both the invention and the best known mode of practicing it, in order to "enable any person skilled in the art . . . to make and use" the claimed discoveries.⁴⁷ If the patent then issues with its key claims more or less intact, the university inventor's reward for initial deference to legal formality is the right, after filing, to speak freely about the discovery, without fear that any posterior disclosures will destroy novelty as to accepted claims.⁴⁸ Even a third party who independently arrives at the same result cannot thereafter use the patented invention without authorization.⁴⁹

To be sure, the patent law does require academic inventors to demonstrate the utility of their inventions, and it excludes protection for scientific principles or ideas.⁵⁰ The judicial trend both in this country and abroad, however, is to take a more relaxed view of the utility requirement and to move the critical point of patentability forward so as to include more basic research than was thought possible ten or

45. 17 U.S.C. § 107 (1982) (fair use). See generally Raskind, *A Functional Interpretation of Fair Use*, 31 J. COPYRIGHT Soc'y 601 (1984). For a recent examination, see Fisher, *Reconstructing the Fair Use Doctrine*, 101 HARV. L. REV. 1659, 1692-95 (1988) (noting uncertainties that academics face when invoking this doctrine).

46. See sources cited *supra* notes 19-20.

47. 35 U.S.C. § 112 (1982); see, e.g., *Dana Corp. v. IPC Ltd. Partnership*, 860 F.2d 415, 418-19 (Fed. Cir. 1988) ("enablement" requirement gives the public the patented subject matter in general; "best mode" doctrine requires disclosure of specific instrumentalities or techniques recognized as the best way of carrying out the invention at the time of filing, and it ensures full disclosure in exchange for monopoly rights).

Failure to disclose the inventor's preferred embodiment of the invention can thus invalidate the patent. *Id.* Disclosures that require undue experimentation in order to practice the invention are similarly liable to invalidation. See, e.g., *In re Wands*, 858 F.2d 731, 734-36 (Fed. Cir. 1988) (finding that a deposit may satisfy the enablement requirement for inventions pertaining to microorganisms or other living cells and that failure to deposit is not fatal if the written description necessitates some experimentation, such as routine screening, but not undue experimentation).

48. Because, unfortunately, the European Community countries provide no novelty grace period, American academics bear a higher burden of secrecy in timing their disclosures when patenting abroad. Proposals to adopt a grace period in foreign law are under consideration. See, e.g., Beier, *Government Promotion*, *supra* note 12, at 564-65. Both in this country and abroad, disclosure prior to final issuance of the patent can cause unprotected release of valuable information if the patent fails to cover all the original claims. The counterweight is, of course, the absolute need for academics to publish. See Merton, *supra* note 14, in *THE SOCIOLOGY OF SCIENCE*, *supra* note 14, at 286, 325-27; Eisenberg, *supra* note 11, at 183.

49. 35 U.S.C. § 271(a), (b) (1982) (defining infringer as one who "without authority makes, uses or sells any patented invention").

50. See, e.g., D. CHISUM, *supra* note 19, §§ 1.01, 4.01; Eisenberg, *supra* note 11, at 185-87.

twenty years ago.⁵¹

If the *Pajaro Dunes Statement* reaffirmed the minimalist university's commitment to the traditional uses of these legal institutions,⁵² it nonetheless begged a number of important questions. For example, the *Statement* glossed over the legal and organizational difficulties of nurturing basic research to the point at which it qualified for patenting.⁵³ The *Statement* also chose to ignore the post-patenting efforts increasingly required of universities in order to perfect and market successfully their research results.⁵⁴ Moreover, it downplayed hard questions about when to make patentability a research goal, when to seek practical applications of basic research, and when to impose stricter than normal secrecy standards in the laboratory.⁵⁵

At a minimalist university, most of these questions will be resolved in a rather decentralized fashion, but they will not disappear altogether. Because successful patents are not self-developing, much patentable research will go unrecognized in such an environment or will perish from a lack of timely nurture.⁵⁶ The patents that are developed will not often lead to the desired licensing and profits because risk capital and developers are kept at a considerable distance.⁵⁷ But the minimalist univer-

51. See, e.g., Beier, *Government Promotion*, *supra* note 12, at 562-64 (stating that the "trend toward inclusion of scientific disclosures in patent protection, . . . especially evident in the prospective fields of biochemical, biological, and chemical-pharmaceutical research, should be favored"). But see Eisenberg, *supra* note 11, at 186-87 (implying that the requirement of utility constrains the patenting of biotechnological discoveries). See generally 1 D. CHISUM, *supra* note 19, § 4.04; H. ULLRICH, *supra* note 12, at 7-12, 50-59, 98-100.

Practitioners seem to believe that the issue of utility is seldom pressed by either the patent examiners or the courts, unless the inventor's originality has been challenged in an interference proceeding. Efforts to disentangle "basic" from "applied" research in actions for patent infringement are thus rare. In contrast, copyright law's exclusion of unprotectable "ideas" from protectable expression at the infringement stage greatly narrows the effective scope of protection. See sources cited *supra* note 43.

52. *Pajaro Dunes Statement*, *supra* note 13, at 536. The *Statement* also recognized that amendments to federal law allowed universities to own and license patents on discoveries made in the course of research financed by government grants and contracts. *Id.* See Software Protection Act of 1980, Pub. L. No. 96-517, § 6(a), 94 Stat. 3019 (1980) (codified as amended at 35 U.S.C. §§ 200-211 (1982)) (§ 202 allows universities and small businesses to retain title to patentable inventions developed in the course of government-sponsored research).

53. *Pajaro Dunes Statement*, *supra* note 13, at 536.

54. See, e.g., Fusfeld, *Overview of University-Industry Research Interactions*, in PARTNERS IN RESEARCH, *supra* note 10, at 10, 14 (stating that universities should focus on pragmatic questions of "what organizational structures are most effective and what impact these have on university procedures and objectives"); Low, *The Organization of Industrial Relationships in Universities*, in PARTNERS IN RESEARCH, *supra* note 10, at 68, 73 (discussing exchanges of people, incubators, and research parks).

55. See, e.g., Eisenberg, *supra* note 11, at 178-80, 190-95 (in the context of biotechnology).

56. See, e.g., Evenson, *Intellectual Property Rights and the Third World*, 5 EUR. INTELL. PROP. REV. (EIPR) 330, 332 (1983) (discussing gaps in the laboratory).

57. See Cawood, *supra* note 24, in Blacksburg Conference, *supra* note 24; see also D. BOK,

sity is, by definition, not overly concerned about these lost opportunities because, rightly or wrongly, it regards such opportunities as foreign to its primary mission.⁵⁸

What more profoundly undermined the minimalist university's faith in the traditional institutions of intellectual property law was the inability of this body of law to deal adequately with the new technologies that seemed to provide academicians with their most exciting commercial opportunities. To some extent this inadequacy stemmed from the reluctance of courts and legislatures to extend effective patent protection to fields such as computer software,⁵⁹ biotechnology and new methods of medical treatment,⁶⁰ or even industrial designs.⁶¹ A more pervasive problem, however, stemmed from the patent law's total preoccupation with the "inventive step," that is, with the "nonobviousness" requirement under which every patentable innovation must demonstrate a major advance over the existing state of the art.⁶²

supra note 21, at 156 n.9 (stating that "[t]he normal rule of thumb is that it takes one thousand reported discoveries to produce one hundred patents; it takes one hundred patents to produce ten licenses; and only one license in ten will yield more than \$25,000 per year").

58. See, e.g., N. WADE, *supra* note 20, at 15 (citing task force recommendation that all projects involving proprietary information be left solely to industry).

59. See, e.g., Maier, *Software Protection Integrating Patent, Copyright and Trade Secret Law*, 69 J. PAT. & TRADEMARK OFF. SOC'Y 151, 152-59 (1987) (discussing denial and subsequent recognition of computer software as patentable subject matter); Samuelson, *CONTU Revisited: The Case Against Copyright Protection for Computer Programs in Machine-Readable Form*, 1984 DUKE L.J. 663, 756-60.

60. See, e.g., K. HODKINSON, *supra* note 2, at 136-39 (noting that biotechnology seems to require patent protection, which exists, but is hedged about with qualifications, including special deposit requirements); Eisenberg, *supra* note 11, at 187-90. Prior to the Supreme Court's 1980 decision in *Diamond v. Chakrabarty*, 447 U.S. 303 (1980), biological materials were thought unpatentable under the doctrine that living organisms and cells were ineligible products of nature. Since *Chakrabarty*, the Patent and Trademark Office has extended subject matter eligibility to plants and indicated its willingness to patent "nonnaturally-occurring non-human multicellular living organisms, including animals." Eisenberg, *supra* note 11, at 189 (quoting *Nonnaturally Occurring Non-Human Animals Are Patentable Under § 101*, 33 Pat. Trademark & Copyright J. (BNA) No. 827, at 664 (Apr. 23, 1987)). "Biotechnology, microbiology, genetic engineering, [and] biological engineering are all aspects of basically the same scientific field. Biotechnology is the generalized term for the application in industry of some biological phenomena to a practical end." K. HODKINSON, *supra* note 2, at 134-35. For discussion of "new plant varieties and seeds," "novel chemical substances and discoveries," and "pharmaceuticals and methods of treatment," all of which strain the patent paradigm, see *id.* at 139-45.

61. For evidence that United States intellectual property law was traditionally hostile to the protection of industrial designs, see Reichman, *Design Protection in Domestic and Foreign Copyright Law: From the Berne Revision of 1948 to the Copyright Act of 1976*, 1983 DUKE L.J. 1143, 1189-90, 1223-24 [hereinafter Reichman, *Before the Copyright Act*]; and Reichman, *Design Protection After the Copyright Act of 1976: A Comparative View of the Emerging Interim Models*, 31 J. COPYRIGHT SOC'Y 267, 306-07 (1984) [hereinafter Reichman, *After the Copyright Act*]. For a remarkable reversal in the period 1985-1989, see Reichman, *supra* note 5, part I noting that new trends show revival of design patent law in the Federal Circuit and expanding protection for designs under Lanham Act § 43(a). See also *infra* notes 129-36 and accompanying text.

62. 35 U.S.C. § 103 (1982) (stating that "[a] patent may not be obtained . . . if the differ-

2. New Technologies Without the Inventive Step

The substantive requirement of "nonobviousness" can effectively exclude the bulk of scientific achievement in new technological fields even after subject matter eligibility becomes established and despite the intrinsic commercial value such achievement may otherwise possess.⁶³ For example, the amount of time, skill, effort, and money required to develop a complex computer program bears no necessary relation to whether the final design is viewed as a major step beyond the prior art. Even though the patenting of computer programs has become legally feasible and is always an option to be evaluated,⁶⁴ the fact remains that "most programs do not contain unobvious concepts of the type which are susceptible to patent protection."⁶⁵ Observers describe a similar situation in biotechnology in which a few pioneer patents may render the bulk of later applications obvious in the legal sense despite enormous investment in research and development and despite the impact of innovative end products on the public welfare.⁶⁶

ences between the subject matter . . . and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains"); *Graham v. John Deere Co.*, 383 U.S. 1 (1966). See generally J. BOCHNOVIC, *THE INVENTIVE STEP: ITS EVOLUTION IN CANADA, THE UNITED KINGDOM, AND THE UNITED STATES* (1982); H. ULLRICH, *supra* note 12.

63. The Court of Appeals for the Federal Circuit has, in recent years, allowed so-called secondary factors, including commercial success, to play a larger role in cases in which the validity of a patent is challenged on the grounds of obviousness. See, e.g., *Adelman*, *supra* note 12, at 989-90; Note, *A Critique of the Use of Secondary Considerations in Applying the Section 103 Nonobviousness Test for Patentability*, 28 B.C.L. REV. 357 (1987). While the preferred view is that commercial success cannot of itself elevate an obvious claim to the level of patentability, see, e.g., 2 D. CHISUM, *supra* note 19, § 5.05[2], this principle is not uniformly respected. See, e.g., *Alco Standard Corp. v. Tennessee Valley Auth.*, 808 F.2d 1490, 1499-1501 (Fed. Cir. 1986) (holding that, while prior art standing alone indicated obviousness, strong secondary considerations indicating nonobviousness should prevail); *id.* at 1504-11 (Rich, Cir. J., dissenting).

64. See, e.g., Sumner, *Patent Protection—Structure of Program Code*, Paper presented to the LaST Frontier Conference on Software Protection, Center for the Study of Law, Science and Technology, Arizona State Univ. College of Law (February 13-14, 1989); Sumner & Plunkett, *Copyright, Patent, and Trade Secret Protection for Computer Software in Western Europe*, 8 COMPUTER L.J. 327 (1988). See generally Maier, *supra* note 59.

65. Galbi, *Proposal for New Legislation to Protect Computer Programming*, 17 BULL. COPYRIGHT Soc'y 280, 281 (1969). Galbi added: "The creation of a new program which does not contain an unobvious concept still involves a substantial amount of investment. The patent system can adequately protect inventive concepts; however, the patent law does not have any means of protecting the investment which goes into developing noninventive innovations." *Id.* The fact that the PTO currently issues many patents that indirectly protect nonobvious computer programs, see *supra* note 64, does not vitiate Galbi's shrewd observation that most computer programs will fail the nonobviousness test of patentability despite their commercial value.

66. See, e.g., Purvis, *Patents and Genetic Engineering—Does a New Problem Need a New Solution?*, 9 EUR. INTEL. PROP. REV. (EIPR) 347, 347-48 (1987) [hereinafter Purvis, *Patents and Genetic Engineering*]; Thurston & Burnett-Hall, *Genentech Inc. v. The Wellcome Foundation Limited: How Important is the Decision for the Biotechnology Industry?*, 10 EUR. INTEL. PROP. REV. (EIPR) 59-62 (1988); see also Korn, *supra* note 11, at 216-17, 231 (noting problems of the

Part of the difficulty undoubtedly stems from judicial inexperience in applying the test of nonobviousness to nascent technologies.⁶⁷ This inexperience cuts both ways, however, because it induces some courts to validate unduly broad claims while others tend to narrow claims arbitrarily in unfamiliar technical environments.⁶⁸ The fundamental problem remains that of rewarding or simply recompensing large expenditure for incremental innovations that fall chronically short of the current legal threshold for patentable inventions.⁶⁹

novelty, utility, and disclosure requirements in the field of biotechnology); Purvis, *Letter*, 10 EUR. INTELL. PROP. REV. (EIPR) 95, 95 (1988) (noting that "the possibility must be faced that . . . science has outrun the law and that the kinds of claims . . . necessary to provide the incentives that the genetic engineering industry requires are not permissible under the present law of patents") [hereinafter Purvis, *Letter*]. *But see* K. HODKINSON, *supra* note 2, at 135-36 (suggesting that the test of nonobviousness may be less of a problem for the biotechnology industry, which is capital intensive and relies more on pure research, than for the microelectronics industry, in which low levels of research investment produce high levels of return); Mellor, *Patents and Genetic Engineering—Is It a New Problem?*, 10 EUR. INTELL. PROP. REV. (EIPR) 159-62 (1988) (questioning whether a new form of protection is required in the field of genetic engineering).

The situation in the United States remains unclear. Support for the fears expressed in the text may be found in *In re O'Farrell*, 853 F.2d 894 (Fed. Cir. 1988) (applicants' own publication of pioneering studies rendered their later genetic engineering method obvious despite uncertainty of success). In an unrelated field, however, the Court of Appeals for the Federal Circuit has just upheld a broad claim supported by a disclosure that some experts deem trivial. *United States Steel Corp. v. Phillips Petroleum Co.*, 865 F.2d 1247 (Fed. Cir. 1989).

67. *See generally* Adelman, *supra* note 12, at 991 (predicting that the Federal Circuit will eventually acquire enough experience to differentiate between new technological areas when applying the common nonobviousness standard).

68. *See, e.g.*, *Genentech, Inc. v. Wellcome Found. Ltd.* (U.K. 1988), *noted in* 37 Pat. Trade-mark & Copyright J. (BNA) 206 (1988) (holding the bulk of claims to recombinant DNA technology both excessively broad and obvious); Purvis, *Patents and Genetic Engineering*, *supra* note 66, at 347 (criticizing this decision); Thurston & Burnett-Hall, *supra* note 66, at 62 (discussing the lower court's decision that a biotechnology invention disclosed "a particular route to a known end"; the court explained that a patent monopoly could hinder discoveries of other possibly better routes to the same end and thus could stifle research); *see also* Thurston, *The Commercial and Legal Impact of the Court of Appeals Decision in Genentech v. Wellcome*, 11 EUR. INTELL. PROP. REV. (EIPR) 66, 73 (1989) (noting appellate court's confirmation that diligence and skill are not to be rewarded by a patent).

69. *See, e.g.*, Purvis, *Patents and Genetic Engineering*, *supra* note 66, at 348 (noting that biotechnological industries and the research area are "threatened by the inability of . . . patent law to grant any meaningful protection to valuable research"); Thurston & Burnett-Hall, *supra* note 66, at 62 (arguing that investment in information establishing molecular structure of matter deserves "some form of protection" if compared to functional designs, to "look and feel" of computer software, and to semiconductor chip topographies). *But see* Mellor, *supra* note 66, at 161-62 (equating genetic engineering, protein engineering, hybridoma technology, and transgenic animals to semiconductor chip designs because all require the expenditure of time, effort, and money; but rejecting the view that patent law is inadequate or that special protection should be extended to these or other nonpatentable technologies on the basis of a lower standard of eligibility).

The exclusionary power of the nonobviousness requirement is naturally weaker when applied to pioneer achievements. *See, e.g.*, *Texas Instruments, Inc. v. United States Int'l Trade Comm'n*, 6 U.S.P.Q.2d (BNA) 1886, 1888 (Fed. Cir. 1988) (noting that a judicially liberal view of both claim interpretation and equivalency is accorded a "pioneer" invention, which is characterized as "a dis-

The current importance of this phenomenon was foreshadowed by the difficulties that beset the quest for adequate legal protection of industrial designs during the last century and a half. In the United States, for example, where industrial designs have long been eligible for full protection in patent law,⁷⁰ relatively few designs ever satisfied the statutory requirement of nonobviousness.⁷¹ Innovation in ornamental designs of useful articles normally reflects only small variations on established themes rather than major advances in a designer's chosen field of endeavor. Most of these variations are "obvious" in the patent sense even when novel and attractive to consumers.⁷² Yet, these innovations are as vulnerable to instant appropriation by competitors as any successful painting or novel would be if copyright law did not intervene on behalf of "authors and artists."⁷³

tinct step in the progress of the art" rather than a mere improvement; this view "flows directly from the relative sparseness of prior art in nascent fields of technology"). Even in new fields, however, this exclusionary power inevitably grows more pronounced over time as the accumulated disclosures produce a denser field and elevate the level of routine skill in the pertinent arts. *See, e.g., Korn, supra* note 11, at 217 (stating that "[a]s the number of advances, publications, and skilled researchers in biotechnology increases, the amount of scientific knowledge considered prior art will increase as well, and more of the potential inventions will be deemed obvious"); *see also Texas Instruments*, 6 U.S.P.Q.2d (BNA) at 1888 (holding that notwithstanding the judicially liberal view of pioneer inventions, the standard of infringement remains unchanged); *Texas Instruments, Inc. v. United States Int'l Trade Comm'n*, 231 U.S.P.Q. (BNA) 833 (Fed. Cir. 1986) (apparently narrowing the doctrine of equivalents for broad-based pioneer claims of means-plus-function variety in order to expand the range of posterior noninfringing improvements in rapidly moving technology); *Becker, Texas Instruments v. ITC: Insight or Aberration?*, 8 *COMPUTER L.J.* 43 (1987) (criticizing this decision).

70. 35 U.S.C. § 171 (1982). The Design Patent Statute was enacted in 1842. *See, e.g., Hudson, A Brief History of the Development of Design Patent Protection in the United States*, 30 *J. PAT. OFF. SOC'Y* 380 (1948).

71. The nonobviousness requirement of 35 U.S.C. § 103 (1982) is incorporated by reference into § 171, which governs ornamental designs. For a discussion of the federal appellate courts' tendency to invalidate virtually all design patents challenged for nonobviousness prior to the establishment of the Court of Appeals for the Federal Circuit in 1982, see Reichman, *Before the Copyright Act, supra* note 61, at 1190-1245; and Denicola, *Applied Art and Industrial Design: A Suggested Approach to Copyright in Useful Articles*, 67 *MINN. L. REV.* 707, 710 (1983). For evidence that the new court will allow more designs to satisfy the nonobviousness requirement than the federal appellate courts allowed in the past, see generally Reichman, *supra* note 5, part I. *See infra* notes 129-34 and accompanying text.

72. *Compare, e.g., Avia Group Int'l, Inc. v. L.A. Gear Cal., Inc.*, 853 F.2d 1557, 1564 (Fed. Cir. 1988) (holding that design of athletic shoe was not obvious) *with Unette Corp. v. Unit Park Co.*, 785 F.2d 1026 (Fed. Cir. 1986) (holding design patent invalid for obviousness) *and Lytton System, Inc. v. Whirlpool Corp.*, 728 F.2d 1423, 1443 (Fed. Cir. 1984) (holding design patent invalid for obviousness).

73. *See Berne Convention for the Protection of Literary and Artistic Property* (1886 as amended through 1971) [hereinafter *Berne Convention*], *reprinted in UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION (UNESCO) & WORLD INTELLECTUAL PROPERTY ORGANIZATION (WIPO), COPYRIGHT LAWS AND TREATIES OF THE WORLD* (1982) [hereinafter *COPYRIGHT LAWS*]. Industrial designs, however, did not appreciably benefit from the protection accorded other artists under the Convention. *See, e.g., S. RICKETSON, THE BERNE CONVENTION FOR THE PROTECTION*

For a while, this experience induced some European governments to admit industrial designs into their domestic copyright laws even though such designs only rarely compete on the market for artistic works as such. Over time, however, full copyright protection of commercial designs appeared to interfere with free competition on markets for the underlying products, and this experiment was abandoned everywhere except in France.⁷⁴ Foreign experts began instead to view industrial design as a legal hybrid falling in between the patent and copyright systems, and the search for an appropriate *sui generis* legal solution gathered considerable momentum beginning in the 1950s.⁷⁵

Most commentators on industrial property law are still inclined to dismiss commercial design as a marginal case that does not challenge the general soundness of the overall intellectual property framework.⁷⁶ In retrospect, however, it appears more accurate to view industrial design as a precursor of the many legal hybrids that intellectual property law would strain to accommodate in the latter half of the twentieth century.⁷⁷ Recent technologies such as computer software and chip designs or even genetic engineering share two things in common with industrial design: One is a proclivity to yield extravagant financial rewards from incremental improvements in know-how that require considerable capital and effort to develop; and the other is a vulnerability to rapid duplication by competitors who bear no part of the development expenditure.⁷⁸

OF LITERARY AND ARTISTIC WORKS: 1886-1986, at 267-82 (1987).

74. See Reichman, *Before the Copyright Act*, *supra* note 61, at 1153-64 (discussing the "Unity of Art" thesis in France and elsewhere); *infra* notes 291-94 and accompanying text.

75. The first work to identify the hybrid character of industrial designs through comparative analysis was M. PEROT-MOREL, *LES PRINCIPES DE PROTECTION DES DESSINS ET MODELES DANS LES PAYS DU MARCHE COMMUN* 16 (1968). For a lucid clarification of the theoretical problems posed by this identification, see F. PERRET, *L'AUTONOMIE DU REGIME DE PROTECTION DES DESSINS ET MODELES* (1974). See also Reichman, *supra* note 5, part II.

76. See, e.g., 3 S. LADAS, *PATENTS, TRADEMARKS AND RELATED RIGHTS: NATIONAL AND INTERNATIONAL PROTECTION* 1617 (1975) (expressing traditional view of industrial design as the poor relation of an industrial property law that is otherwise soundly conceived).

77. See generally Reichman, *supra* note 5, part II (entitled: "Premises for International Action to Harness a Disruptive Legal Hybrid").

78. Compare, e.g., *id.* part II (problems of industrial design viewed as one of several "Intermediate Technologies Between Art and Invention") with Purvis, *Patents and Genetic Engineering*, *supra* note 66, at 342. The latter article observes:

[K]nowing the sequence, it is simple to deduce myriad other routes by which to make it. Once this is done, perhaps in a matter of weeks or even days, competitors are in a position to produce the substance on a large scale, and, with no research and development costs to recoup, can undercut the discoverer of the sequence easily . . . and deprive . . . [the innovator] of any reward at all.

Id.; see also Galbi, *supra* note 65, at 281-82 (same phenomenon in regard to computer programs); *infra* text accompanying notes 96-114.

3. Incremental Innovation Bearing Know-How on Its Face

Broadly conceived, know-how encompasses the "totality of unpatented knowledge utilized in industry."⁷⁹ It is not concerned with major principles or inventive ideas, but rather with "detailed innovation in industrial techniques" of a practical nature that is often the "fruit of . . . experience and trial and error."⁸⁰ The value of know-how is thus measured in terms of commercial superiority and marketing advantages.⁸¹ It typically accrues from incremental improvements on some aspect of the existing state of an art and not from creative activity that raises the level of an art as a whole.⁸² Because know-how includes "techniques that are still at an experimental stage," as Professor Magnin astutely observed in 1974, it links the kinds of basic and applied research normally carried out in academic and other nonindustrial institutions with industrial research and development.⁸³ For this reason, "know-how plays a considerable role in modern industry, whose activities are essentially based upon innovation."⁸⁴

79. F. DESSEMONTET, *THE LEGAL PROTECTION OF KNOW-HOW IN THE UNITED STATES OF AMERICA* 11 (2d rev. ed. 1976); see also J. JEHL, *LE COMMERCE INTERNATIONAL DE LA TECHNOLOGIE: APPROCHE JURIDIQUE* 109 (1985) (treating know-how as nonpatentable techniques). But see F. MAGNIN, *KNOW-HOW ET PROPRIETE INDUSTRIELLE* 14-22, 93-94, 381-88 (1974) (emphasizing the distinctive phenomenology of know-how as a basis for its positive recognition in international industrial property law).

80. 3 S. LADAS, *supra* note 76, at 1617.

81. See, e.g., Troller, *The Legal Protection of Know-How: General Report*, in *THE PROTECTION OF KNOW-HOW IN 13 COUNTRIES* 149, 150, 152 (H. Cohen Jehoram ed. 1971) [hereinafter Troller]. (reports to the Eighth International Congress of Comparative Law Research, Italy, 1970). According to Ladas, know-how is the "knowledge of how to organize a certain production in the most efficient and competitively advantageous manner." 3 S. LADAS, *supra* note 76, at 1617 (emphasis in original). He adds that know-how is "essentially a fund of technical knowledge and experience acquired by an enterprise in the use and application of an industrial technique." *Id.*

Professor Magnin, instead, stresses that know-how is not an isolated technique or formula, but rather "tout l'ensemble d'une fabrication," that is, "the entire industrial process from the choice of raw materials right up to the modalities of distributing the end products." F. MAGNIN, *supra* note 79, at 114 (J. Reichman trans.). Hence, for him, know-how is a "manufacturing art" (un *art de fabrication*). *Id.*

Professor Dessemontet, after reviewing and rejecting all the definitions of know-how, concluded that the "[c]onfusion is . . . hopeless." F. DESSEMONTET, *supra* note 79, at 16. He believed that the "heterogeneous nature of all knowledge and techniques . . . labelled as know-how . . . prevents us from recognizing in the term . . . a precise . . . pragmatic or legal notion similar . . . to [that of] the patentable invention." *Id.* at 16-17. Hence, "[c]autious commentators . . . abstain from defining know-how precisely. So the eminent Ladas needs no less than some twenty lines to enunciate all that is known under this term." *Id.* at 16.

82. See, e.g., Kingston, *The "Thesis" Chapters* [hereinafter Kingston], in *DIRECT PROTECTION*, *supra* note 12, at 1, 2-3, 31-34; Kingston, *Innovation Patents and Warrants* [hereinafter *Innovation Patents and Warrants*], in *PATENTS IN PERSPECTIVE* 68, 75, 78, 79-80 (J. Phillips ed. 1985); Kronz, *Patent Protection for Innovations: A Model (pt. 1)*, 7 *EUR. INTELL. PROP. REV. (E.I.P.R.)* 173, 180 (1983).

83. F. MAGNIN, *supra* note 79, at 114 (trans. J.H.R.).

84. *Id.*

Unlike patents for invention, which tend to convey descriptive information,⁸⁵ industrial know-how is manifested in tangible, working embodiments of information that function in the external environment.⁸⁶ In theory, control over the tangible vehicle of communication provides effective control over know-how,⁸⁷ despite its intellectual and potentially ubiquitous character.⁸⁸ As a practical matter, however, industrial know-how is usually secret and often the subject of restrictive licensing agreements that prohibit its disclosure to the public at large.⁸⁹ While know-how derives its economic value from the competitive advantages that exclusivity confers, this exclusivity depends on actual secrecy rather than on the grant of any proprietary rights under positive intellectual property law.⁹⁰

The protection of traditional forms of industrial know-how is thus entrusted to contracts and trade secret laws, which make acquisition of the pertinent knowledge unlawful only when obtained by means that are excluded by private agreements or that are generally forbidden by law or are against public policy.⁹¹ Given what Professor Troller called its "meta-legal nature,"⁹² innovative know-how remains exempt from free competition only so long as it is neither voluntarily revealed nor reverse engineered.⁹³ The very notion that intellectual property law

85. See, e.g., Eisenschitz, *The Value of Patent Information*, in *PATENTS IN PERSPECTIVES*, *supra* note 82, at 42, 42-53; Kronz, *supra* note 82, at 179 (noting that the information function of patent specification is the chief benefit of the patent system).

86. See, e.g., Kingston, *supra* note 82, in *DIRECT PROTECTION*, *supra* note 12, at 2-3; Troller, *supra* note 81, at 151. Professor Troller wrote: "Know-how, as an intangible thing, . . . is fixed on a tangible thing . . . by physical means . . . In this way know-how is detached from the awareness of the individual . . . and made an item of independent information comprehensible to third persons." *Id.*; see also 3 S. LADAS, *supra* note 76, at 1617. Ladas states that "the tangible elements, strictly speaking, are not the know-how. This is none other than the knowledge and experience contained in these tangible things." *Id.*

87. Troller, *supra* note 81, at 151.

88. Owing to its intellectual nature, know-how remains potentially ubiquitous, like artistic works, despite its embodiment in a tangible medium. *Id.* Magnin believes that this capacity to be conveyed or transmitted is a key feature of know-how. F. MAGNIN, *supra* note 79, at 115-16.

89. See, e.g., Troller, *supra* note 81, at 151, 160-64.

90. *Id.* at 151-52, 156-57. Troller states that "[i]n the case of know-how, . . . the technical or managerial principle as such is not a direct subject of protection." *Id.* at 156.

91. *Id.* at 156 (based on comparative surveys of 13 countries, including the United States). Troller observes that "[t]he acquisition and utilization of the knowledge are not in themselves unlawful," but they become unlawful when procured by breaching a confidence, inducing an employee to betray company secrets, stealing designs, "or otherwise by means . . . against proper usage, public policy or loyalty and good faith," or when used "in such a way that the confidence of the owner is abused." *Id.*; see also Kitch, *The Law and Economics of Rights in Valuable Information*, 9 J. LEGAL STUD. 683, 688-93, 699-701, 711-23 (1980).

92. Troller, *supra* note 81, at 152.

93. See, e.g., 3 S. LADAS, *supra* note 76, at 1617. Ladas states:

The essential difference between a patent and know-how is that the one is a legal monopoly and the other a factual one which may come to a sudden end without the consent of the

might one day attempt to organize a positive legal regime that would sever know-how from these moorings has aroused intense controversy.⁹⁴

From this perspective, the trouble with the kinds of innovative know-how underlying most of the important new technologies is that they do not lend themselves to secrecy even when they represent the fruit of enormous investment in research and development. Because a true trade secret tends to defy reverse engineering, intellectual property law encourages inventors to obtain patents and disclose their art whenever possible.⁹⁵ But modern forms of innovative know-how associated with the new technologies, despite a certain formal elegance and complexity, are easier to duplicate, as a rule, than yesterday's typical engineering products.⁹⁶ Indeed, this vulnerability to rapid appropriation makes such innovation behaviorally similar to works of art and literature.⁹⁷

The senior patent attorney for IBM, writing in 1969, was the first to grasp the significance of this phenomenon for computer programs. In Galbi's view, the "special nature of computer programming" arose from

owner. . . . [A]ny one who discovers the secret of another or develops [the] same by his own efforts may use it. . . . Once published to the world, the economic value of the know-how as a competitive advantage is lost to its owner.

Id. at 1621. In this sense, know-how bears affinities to trade secrets, F. DESSEMONTET, *supra* note 79, at 11, 18-20, 33-48; indeed, in the traditional American legal terminology, according to Dessemontet, "the term know-how is but the synonym of *trade secrets*," *id.* at 49 (emphasis in original). *But see* F. MAGNIN, *supra* note 79, at 113-16 (stressing the importance of differentiating know-how from trade secrets).

The line of demarcation between inventions and know-how is correspondingly obscure. Troller suggests that an invention "is a rule for the use of natural forces" and that, so long as it remains secret, it is also "a form of know-how that . . . exhibits the particular characteristics demanded of an invention by patent law (technical advance, inventive level)." Troller, *supra* note 81, at 152-53.

94. *See, e.g.*, F. MAGNIN, *supra* note 79, at 15-16. Another author recently observed:

[T]he protection of know-how tends to approach that conferred on patents. The latter serves as a kind of reference point. Firms are trying to win recognition of an exclusive right to their know-how that is of the same nature as a patent. Their efforts aim in effect to obtain a right to be exercised against third parties, in general. One can therefore declare that the protection of know-how completes and imitates that of patents.

J. JEHL, *supra* note 79, at 110. (J. Reichman trans.); *see also id.* at 27-40, 63-112 (discussing the principle of property rights in intangible goods and the appropriation of technology through know-how). *See generally* DIRECT PROTECTION, *supra* note 12 (thesis favoring direct protection of know-how and critical responses).

95. *See, e.g.*, Kitch, *supra* note 91, at 699-701 (noting the "contorted incentives" of trade secret law).

96. *See* Kingston, *supra* note 82, in DIRECT PROTECTION, *supra* note 12, at 61 (stressing the ease with which free riders may appropriate information once it is embodied in a product and put on the market); *supra* note 78 and accompanying text.

97. *See infra* note 101 and accompanying text; *cf.* Landes & Posner, *Economic Analysis*, *supra* note 12, at 10 (by reducing the time required to make copies and by facilitating the production of high-quality copies at low cost, modern technology has increased the need for copyright protection even of artistic works). *See generally* Reichman, *supra* note 5, part II.

the special vulnerability of programming know-how.⁹⁸ While a conventional manufacturer could "transfer the possession of a new machine without transferring the know-how involved in manufacturing the machine," Galbi argued that anyone "who comes into possession of a computer program has all of the manufacturing know-how involved in creating additional identical computer programs."⁹⁹ Although computer programs produce "economic benefits in somewhat the same manner that machines produce economic benefits," use of the relevant technology for its intended economic purpose allowed computer programs to "be duplicated in the same way that one creates and duplicates a literary work."¹⁰⁰ Thus, third parties who are able to obtain some physical embodiment of this know-how can readily deprive its originator of any competitive advantage that the innovation initially conferred, in much the same way that one can make a cheap photocopy of a novel or a photographic reproduction of a painting.¹⁰¹

In this respect, today's technically refined forms of unpatentable know-how enjoy a less favorable competitive position than run-of-the-mill industrial products and processes that are unpatentable by definition. In principle, the manufacturer of any new product or process benefits from that minimum amount of protection that flows naturally from having been first on the market.¹⁰² Third parties who want to compete effectively will have to reverse engineer the originator's product or process, establish their own modes of production, develop their own lines of distribution, and establish their own reputations as producers of quality goods.¹⁰³ Because this task of catching up to the originator's head start takes time, it presumably endowed traditional innovators with a period of natural lead time that enabled them to gain a foothold in the market.¹⁰⁴

98. Galbi, *supra* note 65, at 281.

99. *Id.*

100. *Id.* Galbi was also among the first to stress the dual nature of computer programs as both "writings" and functioning parts of a machine. *Id.* The dual nature of computer programs is now accepted even by one of the leading protagonists of maximum protection in copyright law, who, however, sees no contradiction between this dualist premise and his maximalist conclusion. See Davidson, *Common Law, Uncommon Software*, 47 U. PITT. L. REV. 1037, 1064-65 (1986); *infra* notes 272-88, 297-301 and accompanying text.

101. Galbi, *supra* note 65, at 281; see also Brown, *Eligibility for Copyright Protection: A Search for Principled Standards*, 70 MINN. L. REV. 579, 580-89, 606-09 (1985) (discussing free riders and level playing fields); Landes & Posner, *Economic Analysis*, *supra* note 12, at 10.

102. See, e.g., H. ULLRICH, *supra* note 12, at 106. To the extent that an unpatented product or process embodies know-how that competitors cannot duplicate without a lengthy period of learning time, the originator may recover costs and gain profits even without legal protection. *Id.*

103. *Id.*

104. See, e.g., Brown, *Design Protection: An Overview*, 34 UCLA L. REV. 1341, 1388 (1987). The "originator will have had a head start. That is often the only advantage our system grants . . . and it is often enough." *Id.*

In contrast, from the moment third parties free of contractual restraints obtain any tangible embodiment of the relevant information, they can rapidly reverse engineer the know-how embodied in technologies such as a new industrial design, a software design, a chip topography, or a biotechnological product.¹⁰⁵ What Galbi observed of computer programs thus applies to most of today's new technologies in the sense that each tends to bear its know-how on its face.¹⁰⁶ Without incurring the high costs of research and development, any would-be competitor can appropriate the commercially valuable information these technologies embody and then offer virtually the same product at a lower price than that of the originator. There is no period of natural lead time in which to recoup either the originator's initial investment or his losses from unsuccessful essays, not to mention the goal of turning a profit.

In short, today's most productive and refined technical innovations are among the easiest of all forms of industrial know-how to duplicate. Because each product of the new technologies tends to bear its know-how on its face, like an artistic work, each is exposed to instant predation when successful and is likely to enjoy zero lead time after being launched on the market.¹⁰⁷ Paradoxically, such products obtain little or no protection under the dominant paradigms of classical intellectual property law¹⁰⁸ despite their contributions to the public welfare. This result follows because the patent paradigm will exclude the bulk of the new technological innovations that appear to be slight or merely incremental advances over the prior art.¹⁰⁹ At the same time, because of

105. See, e.g., Karjala, *Copyright, Computer Software, and the New Protectionism*, 28 JURIMETRICS J. 33, 33-36 (1987); Kastenmeier & Remington, *The Semiconductor Chip Protection Act of 1984: A Swamp or Firm Ground?*, 70 MINN. L. REV. 417, 437-38 (1985) (discussing the vulnerability of semiconductor chip designs to copying by rapid and cheap techniques); sources cited *supra* notes 66, 69 (discussing the same susceptibility of biotechnology and other relevant fields); see also *supra* note 96 (discussing the vulnerability of embodied information in general).

106. See *supra* text accompanying notes 98-101.

107. See sources cited *supra* notes 66, 69, 96.

108. The notion of a paradigm as a particular way of thought, perception, and action associated with a vision of reality was developed by T. KUHN, *THE STRUCTURE OF SCIENTIFIC REVOLUTIONS* (1967). Later references in this Article to industrial art and industrial literature as the oldest and newest marginal cases, respectively, to challenge the dominant intellectual property paradigms are hardly casual in this regard. See *infra* notes 401-03.

109. See, e.g., Kingston, *supra* note 82, in *DIRECT PROTECTION*, *supra* note 12, at 31 (regretting that patent officers in all advanced industrialized countries, by adopting the requirement of an "inventive step" or nonobviousness, "have turned their backs on the task of protecting incremental innovation," which by its nature "evolves out of what is already there" and therefore "lacks the element of surprise . . . supposed to be a characteristic of a true 'inventive step'"); see also Galbi, *supra* note 65, at 281 (stating that "[t]he patent system can adequately protect inventive concepts; however, the patent law does not have any means of protecting the investment which goes into developing noninventive innovations"); Kronz, *supra* note 82, at 179-80 (stressing irrelevance of patent system to real problem of transforming "technical knowledge into products and investment under . . . difficult market entry conditions").

their functional character, the new technologies are alien to the spirit of the copyright paradigm, which historically rewards works of art and literature without encroaching upon the domain of industrial property law.¹¹⁰

The most economically significant technologies are thus likely to be *intermediate technologies* that fall between the patent and copyright paradigms.¹¹¹ These technologies are, in effect, legal hybrids in the sense that their behavior deviates from the standard behavioral assumptions that underlie the classical forms of legal protection for either industrial or artistic property.¹¹² As a result, they occupy no discrete position of their own within the international intellectual property system established by the Paris and Berne Conventions over a century ago.¹¹³ The extent to which a new intellectual property right is needed

Professor Magnin, writing in 1974, may have been the first to perceive a direct connection between the need to accommodate know-how within positive industrial property law and the new technologies, especially computer programs and products of biogenetic engineering, which were situated largely in the universities. See F. MAGNIN, *supra* note 79, at 15-16 (stressing the need to modify the concept of patents to accommodate products of modern technology); *id.* at 121-26 (discussing problems arising from the nonpatentability of computer programs and biotechnological processes). However, the full implications of this connection have become clear only in recent years, once these same technologies gained recognition as patentable subject matter. See *infra* notes 118-31 and accompanying text.

110. See, e.g., *Baker v. Selden*, 101 U.S. 99 (1879); NATIONAL COMM'N ON NEW TECHNOLOGICAL USES OF COPYRIGHT WORKS, FINAL REPORT 27-37 (July 31, 1978) [hereinafter CONTU REPORT] (Hershey, Comm'r, dissenting); see also OFFICE OF TECHNOLOGY ASSESSMENT, INTELLECTUAL PROPERTY RIGHTS IN AN AGE OF ELECTRONICS AND INFORMATION 78-85 (1986) [hereinafter OTA REPORT] (discussing functional works and computer programs); Vandenberghe, *La protection du logiciel et des chips aux Etats Unis: Un exemple pour l'Europe?*, 126 REVUE INTERNATIONALE DU DROIT D'AUTEUR (RIDA) 85, 110-14 (1985) (discussing impropriety and disruptive effects of allowing copyright law to govern technology).

111. See Reichman, *supra* note 5, part II (subsections entitled "Why Know-How Attracts the Copyright Modality" and "Measured Exploitation of a Possibly Fatal Attraction"); Reichman, *Legal Hybrids Between the Patent and Copyright Paradigms* (1986) (unpublished project document) (submitted to and funded by the German Marshall Fund of the United States); see also Piatier, *Innovation Patent, Invention Patent, or Both?*, in DIRECT PROTECTION, *supra* note 12, at 125, 138-49 (discussing the marketing of intangible goods, including ideas, knowledge, and information, and calling attention to an "intermediate phase of innovation").

These technologies are not "intermediate" in the sense this term is also used to connote traditional technologies requiring moderate levels of skill that are appropriate for developing countries to absorb in an integrating world economy. The Author regrets this ambiguity but has not found an acceptable alternative for the term "intermediate technologies" as used in this Article.

112. See, e.g., OTA REPORT, *supra* note 110, at 78. The task is to bring that much of the copyright paradigm to bear on these intermediate technologies as will perform needed protective services, while discarding such technical features (and all of the mystique) as are inconsistent with the industrial nature of these same intermediate technologies. See *infra* text accompanying notes 404-07. See generally Reichman, *supra* note 5, part II.

113. Paris Convention for the Protection of Industrial Property of March 20, 1883 (as revised through July 14, 1967), reprinted in 1 WORLD INTELLECTUAL PROPERTY ORGANIZATION (WIPO) & UNITED INTERNATIONAL BUREAU FOR THE PROTECTION OF INTELLECTUAL PROPERTY (BIRPI), MANUAL OF INDUSTRIAL PROPERTY CONVENTIONS (1978); Berne Convention, *supra* note 73, in COPYRIGHT

to protect interested parties against the misappropriation of unpatentable industrial know-how has thus become a crucial issue for world economic development.¹¹⁴

4. Breakdown of the World's Intellectual Property System

The fear is that these intermediate technologies, if left to fend for themselves in this nether world between the dominant paradigms, will attract insufficient investment owing to the great risk of loss inherent in the innovative enterprise and to the likelihood that imitators rather than innovators will reap the rewards of success in the end.¹¹⁵ Consequently, world intellectual property law has come under intense pressure to alleviate this perceived risk aversion by providing modern innovators with artificial lead time through one legal device or another.¹¹⁶

The response has varied with the technology in question. The United States Supreme Court, for example, has recognized genetically engineered micro-organisms as patentable subject matter.¹¹⁷ The patent authorities currently read this precedent to cover all "nonnaturally occurring nonhuman multicellular living organisms, including animals."¹¹⁸ Patent offices around the world are struggling to devise depository regulations that will reconcile the public's need to use patented micro-organisms in further experimentation with the patentees' exclusive rights to exploit their biogenetic inventions.¹¹⁹

LAWs, *supra* note 73. It should be pointed out that Article 4(I) of the Paris Convention, added at the Revision Conference of Stockholm in 1967, gave limited recognition to "inventors' certificates" for purposes of the priority rights guaranteed to industrial property owners under the Convention. See G. BODENHAUSEN, *GUIDE TO THE APPLICATION OF THE PARIS CONVENTION FOR THE PROTECTION OF INDUSTRIAL PROPERTY* 58-60 (1968). The "inventor's certificate," used primarily in certain countries having centrally planned economies, can be construed as extending some recognition to unpatentable know-how, without pretending to address or solve the larger problems discussed in the text. See, e.g., F. MAGNIN, *supra* note 79, at 15-16. A discussion of the inventor's certificate is beyond the scope of this Article.

114. See, e.g., F. MAGNIN, *supra* note 79, at 16; Kingston, *supra* note 82, in *DIRECT PROTECTION*, *supra* note 12, at 33-34; Kingston, *Reponse*, in *DIRECT PROTECTION*, *supra* note 12, at 279-93; Kronz, *supra* note 82, at 178-80; see also J. JEHL, *supra* note 79, at 110; Dreyfuss, *New Information Products: A Challenge to Intellectual Property Theory*, 20 *J. INT'L L. & POL.* (forthcoming 1989). But see, e.g., Mandeville & Macdonald, *supra* note 12, in *DIRECT PROTECTION*, *supra* note 12 (opposing creation of such a right); Mellor, *supra* note 66.

115. See Kingston, *supra* note 82, in *DIRECT PROTECTION*, *supra* note 12 at 4-5; Kingston, *Response*, *supra* note 114, in *DIRECT PROTECTION*, *supra* note 12, at 299-302; sources cited *supra* note 66, 69; see also R. BENKO, *supra* note 12, at 22-25.

116. See, e.g., Kastenmeier & Remington, *supra* note 105, at 465-70.

117. *Diamond v. Chakrabarty*, 447 U.S. 303 (1980); see also Eisenberg, *supra* note 11, at 189-90.

118. See Eisenberg, *supra* note 11, at 189-90.

119. See, e.g., R. SALWANCHICK, *LEGAL PROTECTION FOR MICROBIOLOGICAL AND GENETIC ENGINEERING INVENTIONS* 55-77 (U.S.), 147-59 (Foreign 1982). See generally *WORLD INTELLECTUAL*

In contrast, computer programs ("software") were granted full copyright protection as literary works in most countries.¹²⁰ A more limited form of tailor-made protection was granted by France,¹²¹ and it now appears that Switzerland will follow suit.¹²² Computerized data bases also qualify for copyright protection in the United States¹²³ and

PROPERTY ORGANIZATION & CORNELL UNIVERSITY, SYMPOSIUM ON THE PROTECTION OF BIOTECHNOLOGICAL INVENTIONS (1987).

120. Software Protection Act of 1980, Pub. L. No. 96-517, § 10(b), 94 Stat. 3015, 3028 (codified as amended at 17 U.S.C. § 117 (1982)). Besides enacting the current version of § 117, Congress added a definition of a "computer program" to the list of definitions in § 101. *Id.* § 10(a), 94 Stat. at 3028 (codified as amended at 17 U.S.C. § 101 (1982)). The definition of "literary works" in § 101 of the 1976 Act also includes computer programs. *See generally* 1 D. BENDER, *COMPUTER LAW* §§ 3B.04 to 3B.06 (1988); Keplinger, *Authorship in the Information Age: Protection for Computer Programs under the Berne and Universal Copyright Conventions*, 21 *COPYRIGHT* 119 (1985). For a recent survey of foreign law, see Kindermann, *The International Copyright of Computer Software—History, Status, and Developments*, 24 *COPYRIGHT* 201, 204-14 (1988).

121. Law No. 85-660 (France July 3, 1985), *Relative aux Droits des Auteurs et aux Droits des Artistes Interprètes, des Producteurs de Phonogrammes et de Videogrammes et des Entreprises de Communication Audiovisuelle*, arts. 45-51 (Des Logiciels) (computer programs). This Act creates a presumption of employer authorship; limits moral rights; protects against unauthorized use and against unauthorized reproduction, *id.* at Art. 47; but limits duration to 25 years from the date of creation, *id.* at Art. 48. *See, e.g.*, R. PLAISANT, *PROPRIÉTÉ LITTÉRAIRE ET ARTISTIQUE* 14-15, 22-23 (Supp. MISE A JOUR No. 1 Aug. 1, 1985); Kindermann, *supra* note 120, at 206-07; Gaudrat, *La protection des logiciels par la propriété littéraire et artistique*, 128 *REVUE INTERNATIONALE DU DROIT D'AUTEUR (RIDA)* 180 (1986).

122. *See* M. Ritscher, *Untitled Paper Submitted to the Conferees at the LaST Frontier Conference on Software Protection, Center for the Study of Law, Science and Technology, Arizona State University College of Law* (Feb. 13-14, 1989) (source on file with Author). According to this source, the Swiss legislature had considered granting sui generis protection for both microchips and computer programs in a neighboring rights statute allied to the new Copyright Act. But the proposal as regards software was abandoned. *See infra* note 389 and accompanying text. Brazil has apparently agreed to adopt a modified copyright approach in response to intense pressure from the United States. *See, e.g.*, Barbosa, *Software and Copyright: A Marriage of Inconvenience*, 24 *COPYRIGHT* 194-200 (1988).

123. 17 U.S.C. § 101 (1982) (defining "compilation" as a "work formed by the collection and assembling . . . of data . . . that are selected coordinated, or arranged in such a way . . . as [to] constitute[] . . . an original work of authorship"); *id.* § 103 (specifically including compilations and derivative works within the subject matter of copyright); *see also* *West Publishing Co. v Mead Data Cent., Inc.*, 799 F.2d 1219 (8th Cir. 1986); *Telerate Sys., Inc. v. Caro*, 689 F. Supp. 221, 228-31 (S.D.N.Y. 1988) (holding that defendants' computer program enabling user to analyze data vicariously infringed plaintiff's copyrighted data base). *See generally* Denicola, *supra* note 43, at 531-35, 539-42; Tapper, *An Aspect of Copyright in Data Bases*, 14 *N. KY. L. REV.* 169 (1987); Note, *Copyright and Computer Databases: Is Traditional Competition Law Adequate?* 67 *TEX. L. REV.* 993, 994-96, 1027-28 (1987).

However, considerable judicial resistance may yet be encountered in adjudicating claims for infringement in specific cases. *Compare, e.g.*, *West Publishing Co.*, 799 F.2d at 1219 (holding that LEXIS star pagination feature was copyrightable and infringed) and *United Tel. Co. v. Johnson Publishing Co.*, 855 F.2d 604 (8th Cir. 1988) (holding that compilation copyright in telephone directory protects against direct copying of new and updated listings) and *Rand McNally & Co. v. Fleet Management Sys.*, 634 F. Supp. 604 (N.D. Ill. 1986) (holding that appropriation of data from compilation of maps was infringement) with *F.I.L. v. Moody*, 808 F.2d 204, 207-08 (2d Cir. 1986) (finding that sweat-of-the-brow arrangement was not an original work of authorship) and *Worth v. Selchow & Righter Co.*, 827 F.2d 569, 572-73 (9th Cir. 1987) (stating that "facts, like ideas are

abroad,¹²⁴ although the Nordic countries have reportedly endorsed a *sui generis* solution that will soon take effect.¹²⁵ In 1984, Congress granted modified copyright protection to semiconductor chip designs,¹²⁶ and most industrialized countries have now enacted similar measures. Computer programs also became indirectly eligible for protection in patent law as a result of a United States Supreme Court decision in 1981,¹²⁷ other industrialized countries have since moved in this direction.¹²⁸

In the period from 1985 to 1989, moreover, the United States Court of Appeals for the Federal Circuit has revitalized this country's design patent law.¹²⁹ During the same period, the federal appellate courts have collectively transformed the treatment of trade dress under Section 43(a) of the Lanham Act into an unofficial design law that affords a much broader and conceivably perpetual form of protection.¹³⁰ The United States patent authorities have just granted a number of design patents covering the screen displays used in conjunction with certain computer programs.¹³¹

Proposals to improve the special legal regimes already available to protect ornamental designs of useful articles in all industrialized coun-

never protected," and holding that sweat-of-the-brow rationale would no longer apply).

124. See, e.g., Gotzen, *Grandes orientations du droit d'auteur dans les Etats membres de la C.E.E. en matiere de banques de donnees*, in *BANQUES DE DONNEES ET DROIT D'AUTEUR* 85-98 (1987) (proceedings of a Conference held at Paris, Nov. 27, 1986); see also Kerever, *Ces Arrrets microfor [The Microfor Judgment]*, 137 *REVUE INTERNATIONALE DU DROIT D'AUTEUR (RIDA)* 16 28-31, 38-41 (discussing recent decision that clarifies but perhaps weakens the scope of protection for data bases in France).

125. According to Professor Karnell, this law would apply to databases that did not otherwise qualify as original literary works under the copyright laws in force. It would thus signify a general agreement among the Nordic countries to treat noncopyrightable databases and other compilations as a neighboring right, subject to a very short term of protection, in keeping with the solution previously adopted by Section 49 of the Danish Copyright Act (giving 10 years of protection to catalogues, tables, and similar items). See, e.g., A. DIETZ, *COPYRIGHT LAW OF THE EUROPEAN COMMUNITY* 31, 34-35, 180 (1978) (discussing Danish law on compilations).

126. Semiconductor Chip Protection Act of 1984, Pub. L. No. 98-620, 98 Stat. 3347 (1984) (codified as amended at 17 U.S.C. §§ 901-914 (1982 & Supp. IV 1986)); see, e.g., R. STERN, *SEMICONDUCTOR CHIP PROTECTION* § 1.4, § 10.1 (1986); see also Kastenmeier & Remington, *supra* note 105; Samuelson, *Creating a New Kind of Intellectual Property: Applying the Lessons of the Chip Law to Computer Programs*, 70 *MINN. L. REV.* 471 (1985).

127. *Diamond v. Diehr*, 450 U.S. 175 (1981); see also 2 D. CHISUM, *supra* note 19, § 1.03[b] [g]-[i]; Maier, *supra* note 59; Note, *The Patentability of Computer Programs: Merrill Lynch's Patent for a Financial Services System*, 59 *IND. L.J.* 633 (1984); *infra* notes 172-75 and accompanying text.

128. See, e.g., H. HANNEMAN, *THE PATENTABILITY OF COMPUTER SOFTWARE* 85-247 (1985) (discussing patentability of computer-related inventions in foreign law); Sumner & Plunkett, *supra* note 64.

129. See generally Reichman, *supra* note 5, part I.

130. See, e.g., Brown, *supra* note 104, at 1357-86; see also Reichman, *supra* note 5, part I.

131. See, e.g., Kluth & Lundberg, *Design Patents: A New Form of Intellectual Property Protection for Computer Software*, 70 *J. PAT. TRADEMARK OFF. Soc'y* 847 (1988).

tries except the United States are under active consideration by the Commission of the European Communities.¹³² Measures to confer sui generis protection on functional designs, and not merely on ornamental designs of useful articles, recently won legislative approval in the United Kingdom.¹³³ Similar measures may yet be enacted in the United States.¹³⁴ A few industrialized countries already protect novel functional designs and other minor inventions under utility model laws or so-called petty patent laws,¹³⁵ and there is a growing list of developing countries that seem eager to enact such laws.¹³⁶ Some commentators contend that computer programs should be treated as utility models under the Paris Convention rather than as literary works under the Copyright Conventions.¹³⁷

132. See generally Posner, *The Legal Protection of Industrial Design—Some Community Aspects*; Cohen Jehoram, *Cumulative Design Protection, A System for the European Community?*, Papers Presented to the International Conference on the Protection of Industrial Design (Convegno Internazionale Disegno Industriale e Protezione Europea), Treviso, Italy (October 12-13, 1988) (proceedings to be published in 1989); Lahore, *Harmonization of Design Laws in the European Communities: The Copyright Dilemma*, 20 COMMON Mkt. L. REV. 233, 233-68 (1983).

The trade-related aspects of these proposals are now openly acknowledged. See Posner, *supra*, at 4, 9 (stating that the design of a useful article has become "a prime tool in the ability of community enterprises to compete with the enterprises of third countries which have lower production costs . . . [m]any community industries have only one advantage over competing industries from third countries: namely their superior design"). This protectionist thrust cuts both ways, however, because third world countries also have great potential for competing in the world's design sweepstakes, and they may claim national treatment under the copyright conventions.

133. See, e.g., Copyright Designs and Patents Act, 1988, ch. 48, §§ 213-264 (15 Nov. 1988); see also INTELLECTUAL PROPERTY RIGHTS AND INNOVATION (Cmd. 9712) at 18-23 (1986). Noncommonplace functional designs are protected under a modified copyright model for up to ten years subject to a compulsory license after five years and to complicated "must fit" and "must match" restrictions; foreigners are subject to reciprocity, not national treatment under the Act as adopted. See e.g., Fellner, *The New U.K. Industrial Design Law*, U. BALTIMORE L.J. (Symposium Issue on Design, forthcoming 1989). Fellner, *Design Protection in the UK: Copyright, Registered Designs, Unregistered Designs . . . What Will They Think of Next?* 1, 5-11, Paper Presented to the International Conference on the Legal Protection of Industrial Design (Disegno Industriale e Protezione Europea), Treviso, Italy (October 12-13, 1988).

134. See, e.g., S. 791, 100th Cong., 1st Sess. (1987). Compare, e.g., Fryer, *Industrial Design Protection in the United States of America—Present Situation and Plans for Revision*, 27 INDUS. PROP. 115 (1988) (proposing extensive protection in sui generis law that would no longer require either nonobviousness or "ornamentality" and that could protect functional designs) with Brown, *supra* note 104, at 1399-1403 (criticizing this proposal). A sui generis bill to protect ornamental designs in the United States was deleted at the last moment from the Copyright Act of 1976. See Reichman, *Before the Copyright Act*, *supra* note 61, at 1186-1200.

135. See, e.g., 2 S. LADAS, *supra* note 76, at 949-56 (noting that utility model laws are available for functional designs or petty patents in leading industrialized countries such as Italy, the Federal Republic of Germany, and Japan).

136. See, e.g., I. POLI, *EL MODELO DE UTILIDAD* 1-9 (1982) (arguing that utility model laws are especially appropriate for developing countries). Mexico recently enacted such a law within the framework of its new industrial property law.

137. See, e.g., Higashima & Ushiku, *A New Means of International Protection of Computer Programs Through the Paris Convention—A New Concept of Utility Model*, 7 COMPUTER L.J. 1, 15-22 (1986); Note, *Petty Patents in the Federal Republic of Germany: A Solution to the Problem*

Meanwhile, Switzerland recently amended its unfair competition law with the express aim of protecting manufacturers who invest in intermediate technologies that are vulnerable to easy duplication.¹³⁸ Article 5(c) of this law protects products that embody the results of intellectual effort, labor, and investment against competitive exploitation by third parties who employ "technical methods of reproduction" to copy these products outright without repeating the steps originally needed to manufacture them.¹³⁹ While the new law permits would-be competitors to use an originator's ideas and know-how to recreate or reverse engineer an identical product, it prohibits them from merely reproducing the completed products as a whole.¹⁴⁰ No express limitation is placed on the period during which this protection may last; but it reportedly lapses when "the investment of the owner has been amortized" so that "the copying of the product by a third party no longer distorts competition."¹⁴¹

Echoes of this approach have also been heard in the United States, where some state legislatures recently enacted so-called "plug mold" statutes¹⁴² forbidding duplication of the shapes of certain products by a direct molding process.¹⁴³ The Supreme Court has just determined that

of Computer Software Protection?, 8 Sw. U.L. Rev. 888-909 (1976).

138. See *Loi federale contre la concurrence deloye du 19 decembre 1986* [Federal Law on Unfair Competition of December 1986], art. 5 (Switzerland) (effective March 1, 1988), reprinted in 27 *INDUS. PROP. 1* (Laws & Treaties Supp. Sept. 1988); see also Probst, *Protection of Integrated Circuits in Switzerland*, 4 *EUR. INTEL. PROP. REV. (EIPR)* 108 (1988). In the 1970s some experts reportedly voiced concern about new technical means of reproduction that enabled competitors to make direct copies of common merchandise, but matters have come to a head in recent years with demands for generalized protection against misappropriation of skilled efforts and of products such as technical drawings, computer software, and certain diagrams. Thus, while the provision was not drafted specifically to deal with the topographies of semiconductor chips, it could also apply to chip designs, gate arrays, and combinations of compartments selected from cell libraries. *Id.*, at 109-10.

139. See Probst, *supra* note 138, at 109. As Probst unofficially translates the relevant provisions of Article 5 ("Exploitation of products of others"), an unfair act is performed by "whoever . . . [c.] exploits the marketable products of others, obtained as such without [their] own appropriate effort by applying technical methods of reproduction." *Id.* at 108.

140. *Id.* at 109-10.

141. *Id.* at 110. Probst interprets this to mean that "[t]he period of protection . . . varies according to the investment needed for the creation of a specific product. Results of work which, like chip products, require intensive research and development will be protected longer than common merchandise." *Id.* at 110. Compare with Probst the proposals of Kingston and Kronz calling for a variable term of protection for industrial know-how linked to the grantee's "innovative capacity." Kingston, *supra* note 82, in *DIRECT PROTECTION*, *supra* note 12, at 42, 114.

142. See, e.g., ALA. CODE § 17300 (Supp. 1987); FLA. STAT. ANN. § 555.94 (West 1985); MICH. COMP. LAWS ANN. § 445.621-4 (West Supp. 1987); TENN. CODE ANN. § 47-50-111 (1984); Brown, *supra* note 104, at 1391-95.

143. Under these statutes, use of an object to make a mold is forbidden. "You have to model the object itself. Then you can make a mold and compete—or rip off, depending on one's point of view—without violating the 'plug mold' statute." Brown, *supra* note 104, at 1392.

these laws unconstitutionally interfere with the federal patent and copyright systems.¹⁴⁴ These rather crude initiatives evoke the spirit of earlier efforts to implant the misappropriation doctrine in domestic unfair competition law.¹⁴⁵ Far bolder and more refined proposals are emanating from the European Community countries, where some experts advocate *sui generis* protection for all forms of know-how as such, without regard to the availability of patent protection or the kinds of subject-matter distinctions familiar in traditional intellectual property law.¹⁴⁶

The end result is a patchwork quilt of protective devices, complemented by an increasingly supple law of trade secrets,¹⁴⁷ that has strained the classical system of intellectual property law to the breaking point. Taken together, these makeshift devices provide some protection to a broadening array of industrial innovations that manifest relatively low levels of quantitative or qualitative distance from the prior art.¹⁴⁸ In so doing, these devices reveal the extent to which applied scientific know-how, inadequately served by the traditional patent law matrix, now poses a serious threat to the stability of an international system built around a static notion of "industrial property" that no longer corresponds to empirical reality.¹⁴⁹

C. A Maximalist Response to the Challenge of New Technologies

1. Expanding Opportunities for Legal Protection of University Research

This expanding protective framework renders university research into virtually any field a potential source of proprietary rights capable

144. See *Bonito Boats, Inc. v. Thunder Craft Boats, Inc.*, 515 So. 2d 220 (Fla. 1987), 109 S. Ct. 971 (1989). Compare *Interpart Corp. v. Italia*, 777 F.2d 678 (Fed. Cir. 1985) (holding California plug mold statute constitutional because it proscribes only one unscrupulous mode of copying and allows reverse engineering) with *Bonito Boats*, 515 So. 2d 220 (construing FLA. STAT. ANN. § 559.94 (West 1985), which was held unconstitutional and preempted under *Sears-Compco*).

145. See, e.g., Brown, *supra* note 104, at 1381-86 (stressing preemptive effects of *Sears-Compco* doctrine, codified at § 301 of the 1976 Copyright Act); see also Baird, *Common Law Intellectual Property and the Legacy of International News Service v. Associated Press*, 50 U. CHI. L. REV. 411 (1983).

146. See authorities cited *supra* note 94; see also F. MAGNIN, *supra* note 79, at 16.

147. UNIF. TRADE SECRETS ACT, 14 U.L.A. 537, 543 (1979); see, e.g., Bender, *Protection of Computer Programs: The Copyright/Trade Secret Interface*, 47 U. PITT. L. REV. 907, 919-24 (1986) (discussing advantages and disadvantages of using trade secret laws to protect computer programs); Kitch, *supra* note 91, at 699-701 (discussing portable black box approach used for computer programs and criticizing the "contorted incentives" of trade secret law, which encourages secrecy and disfavors innovations that are necessarily revealed to competitors).

148. See, e.g., K. HODKINSON, *supra* note 2, at 121, 135-36.

149. See, e.g., F. MAGNIN, *supra* note 79, at 13-17, 65-69, 93-94, 114-16; see also authorities cited *supra* note 94.

of generating substantial revenue. The array of legal devices available to protect new technologies blurs such traditional lines as those dividing pure from applied research¹⁵⁰ or those separating major (hence protectable) from minor (hence unprotectable) innovation. These devices invite university administrators to monitor a seemingly infinite spectrum of technologies with a view toward maximizing commercial opportunities.¹⁵¹ Administrators are likewise encouraged to identify commercially exploitable projects at the earliest possible stage of research and development¹⁵² without the inhibitions that the strict requirements of patent law traditionally imposed. They are tempted to establish businesslike organizational structures capable of systematically nurturing every promising research project from the laboratory to the industrial drawing boards.¹⁵³

The *Pajaro Dunes Statement* of 1982, which appealed to caution and restraint, has thus been overtaken by an overload, if not a breakdown, of the classical intellectual property system as structured in the nineteenth century. The resulting proliferation of atypical restraints on trade in intellectual goods indiscriminately renders just about everything a university does both protectable and commercially exploitable provided that faculty, students, and administrators are willing to pay the price.

Arguably, the *Pajaro Dunes Statement* did provide some guidance for this new situation to the extent that it admonished faculty and administrators to think about the *price*—to reflect on the costs of conducting university business this way.¹⁵⁴ Had there been more time to digest the changes occurring in both applied science and intellectual property law, its minimalist message might have exerted a more lasting influence.

In reality, there was little time to ponder the ethical and philo-

150. See, e.g., Eisenberg, *supra* note 11, at 190 (spreading reach of patent law into basic research discoveries of biomedical sciences).

151. See D. Bok, *supra* note 21, at 149 (discussing "Bush's law"—that applied research drives out pure research).

152. See e.g., Samuelson, *Innovation and Competition: Conflicts Over Intellectual Property Rights in New Technologies*, 12 SCI, TECH. & HUM. VALUES 6, 14-16 (1987) (discussing early consultations between faculty and private firms).

153. See, e.g., Brooks, *supra* note 10, at 53.

154. See, e.g., *Pajaro Dunes Statement*, *supra* note 13, at 533. The *Statement* explained: The translation from opportunity to reality is not simple or easy. Serious problems . . . center on the preservation of the independence and integrity of the university and its faculty, both faced with unprecedented financial pressures and complex commercial relationships. Universities are a repository of public trust, and, in many cases, of public funds as well, and they have an obligation . . . to ensure that they remain devoted to their primary goals of education and research and that their resources be properly used in their pursuit of these goals.

Id.

sophical implications of broadly commercializing research in a promiscuous legal environment. Industrialists and venture capitalists were eager to invest in the new technologies,¹⁵⁵ and universities rushed to make the most of these financial opportunities without looking over their shoulders.¹⁵⁶ Evidence of this changing attitude emerged in the spring of 1988 from a set of papers presented at a Conference on the University Spin-off Corporation held at Blacksburg, Virginia.¹⁵⁷

2. Birth of the Spin-off Mentality

Barely six years after the celebrated Biotechnology Conference at Pajaro Dunes, the titles of the papers presented at Blacksburg told a different story and constituted a veritable program for future action. For example, the Blacksburg Conference opened with papers discussing "Technology Transfer by Spin-off Companies versus Licensing,"¹⁵⁸ and "Promoting University Spin-off Companies through Equity Participation."¹⁵⁹ Other contributions explored "The Process by Which University Research Results Become a Business"¹⁶⁰ and described the workings of "The University of Chicago Technology Commercialization Center."¹⁶¹

No constituency was overlooked. A paper advocating "A Program to Encourage Entrepreneurship in Undergraduate Students"¹⁶² complemented a study entitled "Exploring Perceived Threats to Faculty Commercialization of Research."¹⁶³ Perhaps the most ambitious or ominous

155. See, e.g., Aaron, *Tapping into University Technology*, High Tech. Bus., Dec. 1988, at 26 (stating that "[t]he number of companies turning to universities for research is growing"); Eisenberg, *supra* note 11, at 196. By 1984, as much as one-quarter of all biotechnological research that universities carried out reportedly was funded by nearly one-half of all companies that generally fund such research. See *id.* at 195 n.95 (citing authority).

156. See, e.g., B. REAMS, *supra* note 1, at 18. Professor Reams suggested, "Cooperation between universities and industry is now rapidly becoming a significant force contributing to the innovation process. Indeed, such joint undertakings are so new that little opportunity has existed for the collection of . . . data or the actual comparison of contracts." *Id.*; see also Weiner, *supra* note 14, at 59 (noting that "more and more universities are adopting aggressive patenting policies").

157. See generally Blacksburg Conference, *supra* note 24.

158. Gregory & Sheahan, *Technology Transfer by Spin-off Companies vs. Licensing*, in Blacksburg Conference, *supra* note 24.

159. Wilson & Szygenda, *Promoting University Spin-offs through Equity Participation*, in Blacksburg Conference, *supra* note 24.

160. Krist, *The Process by Which Research Results Become a Business*, in Blacksburg Conference, *supra* note 24.

161. Giannisis, Willis & Maher, *Technology Commercialization in Illinois*, in Blacksburg Conference, *supra* note 24.

162. Ellis & Petro, *A Program to Encourage Entrepreneurship in Undergraduate Students*, in Blacksburg Conference, *supra* note 24.

163. Allen, Norling, Jordan & Sampathkumaran, *Exploring Perceived Threats to Faculty Commercialization of Research*, in Blacksburg Conference, *supra* note 24.

presentation of all, depending on one's point of view, outlined "The Role of the Research University in Creating and Sustaining the U.S. Technopolis."¹⁶⁴ Its vision of the future appears in a diagram reproduced later in this Article.¹⁶⁵

While the minimalist university predominated at Pajaro Dunes, a portrait of the university that wanted to maximize its contributions to industry emerged from the Blacksburg Conference.¹⁶⁶ Such a "maximalist" university will reach deep into the research and development process to stimulate protectable ideas; it will invest heavily in developing, incubating, and promoting these ideas; and in order to encourage technology transfer, it may be willing to impose direct or indirect controls on the ability of its investigators to publish or disseminate research results while offering industry the most lucrative package it can provide.¹⁶⁷

What seems a new and disquieting prospect for the decades ahead, in short, is the convergence of the two trends identified above.¹⁶⁸ On the one hand, intellectual property law has expanded to the point where it affords some form of protection to virtually the entire university output. On the other hand, the university has begun to make structural and organizational decisions that will permit it to profit from these proprietary rights in an efficient and systematic manner. The maximalist university willing to exploit the bulk of its research is thus gearing up to make use of an increasingly protectionist intellectual property system that is capable of providing legal devices for accomplishing its goals.

How can responsible administrators reconcile these developments with the pristine functions of the university's academic mission? And what of the minimalist university, faithful to the spirit of Pajaro Dunes, that strives to maintain its balance and integrity as an institution of higher learning? Recent studies have begun to explore these questions in the context of biotechnology and the biomedical sciences.¹⁶⁹ The next section of this Article examines selected problems that the exploitation of proprietary rights in computer software poses for university professors and administrators who remain concerned about the integrity of

164. Gibson & Smilor, *The Role of the Research University in Creating and Sustaining the U.S. Technopolis*, in Blacksburg Conference, *supra* note 24.

165. See *infra* notes 426-39 and accompanying text.

166. See Gibson & Smilor, *supra* note 164, in Blacksburg Conference, *supra* note 24. The plans of the ambitious university are likely to be seconded by local authorities who see them as an investment in economic development. Carried to an extreme, this partnership enables the town to reassert much of the influence over the gown that it lost in the 1950s and 1960s. *Id.*

167. See, e.g., Brooks, *supra* note 10, 51-53; see also Eisenberg, *supra* note 11, at 197-205.

168. See *supra* notes 116-49, 155-67 and accompanying text.

169. See Eisenberg, *supra* note 11, at 177; Korn, *supra* note 11, at 191.

their institutional environment.

II. BEHAVIORAL ANOMALIES OF FUNCTIONAL COPYRIGHTS IN THE RESEARCH ENVIRONMENT

In considering whether to protect and how to exploit new technologies that fall in between its traditional patent and copyright policies, even a minimalist university has to consider that such technology may eventually become the most lucrative of all, especially when measured by revenue gained per dollar of investment in research and development. All universities appreciate the commercial opportunities inherent in current biogenetic engineering projects. This type of research, however, remains relatively capital intensive; it requires lengthy periods of gestation; and it is complicated by bureaucratic regulation. Computer software and microelectronics, in contrast, can yield large returns from comparatively modest levels of investment, and the development of successful but rapidly obsolescent products of this kind in a university environment is far less complicated than the development of biotechnology.¹⁷⁰

A university that evaluates its commercial opportunities from this angle will discover that it probably has overlooked or undervalued the software its faculty has been generating.¹⁷¹ It may also find little patent consciousness on campus concerning software,¹⁷² largely because of the imprudent efforts of the United States Patent and Trademark Office (PTO) in the 1970s to exclude computer programs from the broad statutory classes of patentable subject matter.¹⁷³ The extent to which both the courts and the PTO have now reversed direction and are moving to recapture lost ground,¹⁷⁴ at times by recognizing questionably broad

170. See, e.g., K. HODKINSON, *supra* note 2, at 135.

171. Operating systems research is reportedly a major field of study at leading domestic and foreign universities. Menell, *Tailoring Legal Protection for Computer Software*, 39 STAN. L. REV. 1329, 1357 (1988).

172. See, e.g., Maier, *supra* note 59, at 152.

173. See 35 U.S.C. § 101 (1982); see also *Parker v. Flook*, 437 U.S. 584 (1978); *Gottschalk v. Benson*, 409 U.S. 63 (1972); Maier, *supra* note 59, at 152-53. The Supreme Court's decisions in *Benson* and *Flook* affirmed Patent and Trademark Office (PTO) decisions that had denied eligibility. The PTO's theory of unpatentability "had its origins in bureaucratic concerns over workload, rather than in careful theoretical analysis. . . . Worry about workload and backlog motivated the PTO to lead the fight against software patentability." Maier, *supra* note 59, at 152-53; see also Kidwell, *Software and Semiconductors: Why Are We Confused?*, 70 MINN. L. REV. 533, 544-49, 565-70 (1985) (assessing the capability problem that allegedly impedes patent protection of computer programs). See generally Chisum, *The Patentability of Algorithms*, 47 U. PITT. L. REV. 959 (1986) (arguing that algorithms should be patentable subject matter and criticizing the *Flook* and *Benson* decisions).

174. See, e.g., *Diamond v. Diehr*, 450 U.S. 175, 188-89 (1981); *In re Abele*, 684 F.2d 902 (C.C.P.A. 1982); *In re Pardo*, 684 F.2d 912 (C.C.P.A. 1982); *Paine, Webber, Jackson & Curtis Inc. v. Merrill Lynch, Pierce, Fenner & Smith, Inc.*, 564 F. Supp. 1358, 1367, 1368 (D. Del. 1983);

claims, is still news to much of the academic community, although some computer scientists have begun to complain that patent protection of computer programs is becoming too strong and counterproductive.¹⁷⁶

Most software designs, however, will lack the inventive step needed to qualify for an enforceable patent, and originators will therefore look to copyright law for any proprietary rights they may have.¹⁷⁶ Even when a patent issues, concurrent copyright protection may be available, with the copyright covering at least the detailed instructions and the patent protecting against unauthorized programs that "use the idea claimed in the patent algorithm."¹⁷⁷ Recourse to copyright law will then expose

Maier, *supra* note 59, at 157-59 (stating that "[s]oftware patentability is a de facto reality today, as the PTO now commonly issues patents for software inventions"; reviews examples of these inventions). Design patents on computer screen displays have also been granted. *See generally* Kluth & Lundberg, *supra* note 131.

Failure to patent innovative software could cause serious financial losses and embarrassment after its commercial value becomes apparent, if the opportunity to satisfy the statutory prerequisites has been needlessly forfeited. *Cf.* Massachusetts Inst. of Technology v. AB Fortia, 227 U.S.P.Q. (BNA) 428 (Fed. Cir. 1985) (holding that a paper teaching the claimed cell culture was a printed publication within 35 U.S.C. § 102(b) (1982), which rendered the patent obvious). A university should, therefore, start from the assumption that ways can now be found to patent any software that contains a big idea, even if the validity of these broad-claim patents remains untested. *See infra* note 177. To preserve the chances that a patent will issue, investigators working with software should be advised of standard procedures concerning predisclosure screening, in conformity with the university's overall intellectual property policy.

175. *See, e.g.,* Newell, *The Models Are Broken, The Models Are Broken!*, 47 U. PITT. L. REV. 1023, 1025-34 (1988) (responding to Chisum, *supra* note 173, and warning that the patenting of algorithms could affect basic research and retard computer science); *see also* R. Stallman, *Why Software Ownership Is Bad for Society*, Address at the University of Texas (1987) (copy on file at the Vanderbilt Law School). Newell and Stallman are distinguished professors of computer science at Carnegie-Mellon University and the Massachusetts Institute of Technology, respectively. The Massachusetts Institute of Technology will reportedly sponsor a symposium on "Software Patents: A Horrible Mistake?" in March 1989.

176. *See, e.g.,* Marks, *Software Development as a University Enterprise*, at 1 (manuscript pagination) in Blacksburg Conference, *supra* note 24; *supra* text accompanying note 65. Practitioners imply that the PTO's current attitude toward patent applications having a software component is indulgent. *See generally*, Sumner, *supra* note 64 (discussing broad claims, a wide range of specific implementations, code concepts, and user interfaces).

177. Chisum, *supra* note 173, at 1015-17; *see also* Maier, *supra* note 59, at 158 (stating that basic organization and manner of operation are in principle protectable by a patent); *supra* note 176. The precise scope of patent protection is still unclear, however, and could be weaker than expected. *See, e.g.,* Texas Instruments, Inc. v. United States Int'l Trade Comm'n, 805 F.2d 1558 (Fed. Cir. 1986); *supra* note 69 and accompanying text.

As the prospects for patent protection of computer software are consolidated and the dangers of overprotecting computer software in copyright law become better understood, the line of demarcation between these two regimes may become controversial over time. *See, e.g.,* Samuelson, *Reflections on the State of American Software Copyright Law and the Perils of Teaching It*, 12 COLUM.-VLA J.L. & ARTS (forthcoming 1989) (recognizing this problem). The same controversy could arise under a *suñ generis* solution unless the problem of cumulation were carefully worked out in advance. *Cf.* Hinckley, *NEC v. Intel: Will Hardware be Drawn into the Black Hole of Copyright?*, 3 COMPUTER & HIGH-TECH L. J. 23, 30, 34 (1987) (stressing difficulties of demarcation between hardware and software).

university administrators to an array of unfamiliar problems stemming from the idiosyncratic behavior of functional copyrights in the research environment.

A. Ownership and Authorship of the Software Enterprise

While courts today seem prone to regard computer programs in virtually any format as copyrightable subject matter,¹⁷⁸ universities seeking to assert the proprietary rights arising from this tolerant disposition may encounter delicate problems of ownership that require careful attention. As previously noted, most universities customarily allowed faculty members to retain copyrights in their literary and artistic works while asserting an employer's right of ownership in patentable inventions developed within the framework of departmental research.¹⁷⁹ Administrators will now discover that, by applying these traditional policies to computer software, universities may have given away the rights to valuable industrial property masquerading as literary works.¹⁸⁰

1. Academics as Employee Authors

Some commentators believe that the Copyright Act of 1976 will undo past generosity and restore ownership of all faculty-generated copyrights to the universities by operation of law. These commentators contend that, because professors must publish or perish, their publica-

While a discussion of cumulation lies beyond the scope of this Article, it should be mentioned in passing that the task of separating patent-like protection of industrial designs from overlapping protection of "applied art" in copyright law has proved to be one of the thorniest and most intractable issues still standing in the way of a unified copyright law for the European Community. See generally Reichman, *supra* note 5, part II; Reichman, *Before the Copyright Act*, *supra* note 61, at 1167-70 (comparative view of cumulation in the context of industrial designs).

178. This copyrightable subject matter includes computer operating systems and application programs, even if perceptible only by a machine, as well as associated text and diagrams, and even file structures. See, e.g., *Whelan Assocs. v. Jaslow Dental Laboratories, Inc.*, 797 F.2d 1222 (3d Cir. 1986), *cert. denied*, 479 U.S. 1031 (1987); *Apple Computer, Inc. v. Formula Int'l Inc.*, 725 F.2d 521 (9th Cir. 1984); *Apple Computer, Inc. v. Franklin Computer Corp.*, 714 F.2d 1240 (3d Cir. 1983). Microcode also has been held copyrightable. See *NEC Corp. v. INTEL Corp.*, No. C-84-20799-WPG (N.D. Cal. Feb. 5, 1989); *Karjala*, *supra* note 105, at 68-69; see generally *Hinckley*, *supra* note 177.

179. See *supra* note 41 and accompanying text. An example is Stanford University. See *STANFORD UNIVERSITY PATENTS, COPYRIGHTS AND OTHER RESEARCH PROPERTY: A WORKING GUIDE FOR THE STANFORD RESEARCH COMMUNITY 7-8* (1982) [hereinafter *STANFORD POLICY*]. The Stanford policy states:

In keeping with tradition the University does not claim ownership of works for which the intended purpose is to disseminate the results of academic research or scholarly study; ownership of these works vests in the creator. Similarly, the University claims no ownership of popular nonfiction, novels, poems, musical compositions, or other works of artistic imagination.

Id. at 8.

180. See *infra* note 197 and accompanying text.

tions are an occupational requirement and therefore "works made for hire" as defined in Section 101 of the 1976 Act.¹⁸¹ Title to these works vests initially in the employer and not the author.¹⁸² Because scholarship affects decisions concerning tenure, promotion, salary, and other benefits, this line of reasoning allows one to conclude that universities already own all the literary and artistic works their faculties produce.¹⁸³

Yet this result seems rather surprising under a Copyright Act that aimed to strengthen authors' rights, especially when the legislative history conveys no intention to disturb the "teachers' exception" to the works-for-hire doctrine that was firmly established under the 1909 Act.¹⁸⁴ To equate a general duty to write with a duty to produce specific works for a university distorts the nature of academic employment and downgrades the professorial rank to that of an ordinary staff member. Professors are expected to advance their universities' reputations for high-quality scholarship by publishing suitable research of their own, largely because scientific publications enhance the ability of these same universities to attract the kinds of funds and personnel that ensure fulfillment of their educational missions. That professors are attracted to teaching because research support is provided or that they write to obtain tenure and retain its full benefits hardly entitles a university to regard itself as the author of a scholarly product over which it has exercised no direct supervisory control whatsoever.¹⁸⁵ In ascertaining the

181. 17 U.S.C. § 101 (1982) (works made for hire); see, e.g., DuBoff, *An Academic's Copyright: Publish and Perish*, 32 J. COPYRIGHT Soc'y 17, 24-34 (1984); Simon, *Faculty Writings: Are They "Works Made For Hire" Under the 1976 Copyright Act?*, 9 J.C. & U. L. 485, 502-09 (1983). But see Dreyfuss, *supra* note 41, at 597-600.

182. According to 17 U.S.C. § 101 (1982), a "work made for hire" is a work "prepared by an employee within the scope of his or her employment." In such cases, "the employer or other person for whom the work was prepared is considered the author for purposes of this title, and, unless the parties have expressly agreed otherwise in a written instrument signed by them, owns all of the rights comprised in the copyright." *Id.* § 201(b). The academic work product will seldom qualify as a "commissioned work" within the meaning of § 101.

183. Simon stresses that universities indirectly exert a form of quality control over faculty writing, that universities are the "motivating factor" behind such writing, and that universities bear the bulk of the pertinent costs. Simon, *supra* note 181, at 502-05.

184. See, e.g., *Hays & MacDonald v. Sony Corp.*, 847 F.2d 412, 416-17 (7th Cir. 1988) (noting failure of legislative history to mention teacher's exception); Dreyfuss, *supra* note 41, at 597-99; see also DuBoff, *supra* note 181, at 26 (noting that Congress did not consider the effect of works-for-hire provisions on teachers and arguing that courts should engraft the old exception onto the 1976 statute).

185. For cases emphasizing a supervisory function in regard to software, see, e.g., *Evans Newton, Inc. v. Chicago System Software*, 793 F.2d 889 (7th Cir.), *cert. denied*, 107 S. Ct. 434 (1986); *BPI System, Inc. v. Leith*, 532 F. Supp. 208 (W.D. Tex. 1981). See also *Aldon Accessories Ltd. v. Spiegel, Inc.*, 738 F.2d 548 (2d Cir.) (this case, unrelated to software, expands the concept of supervisory control), *cert. denied*, 469 U.S. 982 (1984). That universities absorb the costs of preparing scholarly works, see Simon, *supra* note 181, at 504, reflects on the low salaries they pay, especially during the formative period of a young academic's career. Like medical insurance and other benefits, this support is provided as a *sine qua non* to attract scholars into teaching despite

scope of university employment for purposes of copyright ownership, moreover, one finds no evidence to suggest that trade usage had altered the well-established teacher exception at the time the 1976 Act was adopted.¹⁸⁶

The courts will probably follow the late Professor Nimmer's lead and preserve the academic's ownership of his or her general literary and artistic output,¹⁸⁷ even though the current provisions on works for hire give rise to diverse and conflicting interpretations.¹⁸⁸ This position need not automatically dispose of ownership issues concerning new technologies such as computer software, however, because the status of these technologies as copyrightable subject matter did not become fully established until after the adoption of the 1976 Act.¹⁸⁹ To the extent that trade usage affects the way courts view the scope of employment for determining copyright ownership of new technologies, it might well establish an emerging exception to the "teacher exception" rule as under-

the salary level, not as a *quid pro quo* for a grant of proprietary rights in specific scholarly products.

186. The "teacher exception" would thus form part of the standard bargain-in-fact as it existed in 1976. See RESTATEMENT (SECOND) OF CONTRACTS §§ 3,223 (1981). Because custom was clearly a major factor in the pre-1976 disposition, see Simon, *supra* note 181, at 485-86, there is no reason to displace custom by an overly harsh reading of the statute not bolstered by any evidence of legislative intent to change the previous situation.

If scholarly works are not employee works as defined by § 101 of the 1976 Act, the validity of contractual provisions that seek to reverse this status by characterizing the academic output as a "work made for hire" seems doubtful. Congress mandated that a copyright "vests initially in the author or authors of the work," 17 U.S.C. § 201(a) (1982), and the statute appears to restrict the role of contract to the transfer of rights comprised in the copyright after it has vested in the "author." *Id.* § 201(b); see, e.g., W. PATRY, *LATMAN'S THE COPYRIGHT LAW* 120 (6th ed. 1986). By the same token, the scholar's work product could not normally qualify as a commissioned work falling within the nine specific categories mentioned in § 101 (works made for hire), and the statutory language should invalidate contractual provisions that attempt to characterize works outside these categories as commissioned works made for hire. *Id.* §§ 101, 201(a), 201(b); see, e.g., *Community for Creative Non-violence v. Reid*, 846 F.2d 1485 (D.C. Cir.), *cert. granted*, 109 S. Ct. 362 (1989); *Easter Seal Soc'y for Crippled Children & Adults, Inc. v. Playboy Enter., Inc.*, 815 F.2d 323 (5th Cir. 1987), *cert. denied*, 108 S. Ct. 1280 (1988). But see *Aldon Accessories Ltd. v. Spiegel, Inc.*, 738 F.2d 548 (2d Cir. 1984), *cert. denied*, 469 U.S. 982 (1984). See generally W. PATRY, *supra*, at 118-25. An exception exists for "instructional texts," however, which do fall within the nine categories of possible commissioned works set out in 17 U.S.C. § 101. Such a work would be considered a work made for hire if the university and the academic originator so agreed in writing.

187. See, e.g., *Hays & MacDonald v. Sony Corp.*, 847 F.2d 412, 416-17 (7th Cir. 1988) (indicating in dictum that the court was prepared to hold that the teacher exception survived the 1976 Revision of Copyright Law on the theory that such works are not prepared for the employer); *Weinstein v. University of Ill.*, 811 F.2d 1091 (7th Cir. 1987); 1 M. NIMMER & D. NIMMER, *supra* note 42, § 5.03[B][1][b][i], at 5-17 & n.31.

188. See generally Hardy, *Copyright Law's Concept of Employment—What Congress Really Intended*, 35 J. COPYRIGHT Soc'y 210 (1988). According to Dreyfuss, *supra* note 41, at 603, "[i]t is hard to think of a setting in which employer authorship is more of a legal fiction." She adds that "new claims for copyright ownership could substantially alter the creative environment for a large segment of the university community." *Id.* at 592.

189. See *supra* note 120.

stood at the time the General Revision was drafted.¹⁹⁰

If a faculty member's output does not become a work made for hire by operation of law, some universities concerned about software and other intermediate technologies may break with tradition altogether and oblige instructors to relinquish copyright ownership of research results as a condition of their employment contracts. These provisions may attempt to characterize all academic output as university owned by virtue of a professor's status as employee-author;¹⁹¹ or they may impose a transfer to the university of any proprietary rights in written works that vest in the instructor during that instructor's period of employment.¹⁹² Whether such clauses will survive attack under either copyright law or the requirement of mutual assent in contracts law remains to be seen.¹⁹³ At the very least, a transfer of all the professor's rights, if otherwise valid, should remain subject to the author's termination right after a period of thirty-five years.¹⁹⁴

Other universities go to the opposite extreme by continuing to treat software as a literary work like other literary works, which are exempt from university ownership under the traditional dispensation.¹⁹⁵ This treatment may result more from confusion or uncertainty than from a deliberate policy decision.¹⁹⁶ It nonetheless exposes a university to nasty disputes about ownership if faculty-developed software later displays great commercial value, as reportedly occurred at the California Institute of Technology. There the creator of a successful program invoked the "teacher exception" for literary works while the university argued that software possessed a dual nature that made it more like "hard" inventions.¹⁹⁷ In the end, the professor left the university, and

190. See *infra* notes 197-205 and accompanying text.

191. See *supra* note 186 (questioning the validity of this approach).

192. 17 U.S.C. § 201(d) (1982); see, e.g., Dreyfuss, *supra* note 41, at 627, n. 126. An example of the second approach is the University of Florida Contract.

193. See, e.g., *supra* note 186. For a spirited attack on involuntary transfers abroad that might cast a domestic shadow as well, see 17 U.S.C. § 201(e) (1982).

194. See 17 U.S.C. § 203 (1982). But if the work is deemed a work made for hire, the employee-author obtains no termination right. *Id.* § 203(a).

195. See, e.g., Harvard Statement, *supra* note 27, at ¶ 4 (listing software among copyrightable works to be controlled by faculty creators). It is not clear whether this provision has survived the most recent policy formulation.

196. See *Who Owns the Idea*, OMNI, March 1985, at 35 [hereinafter *Idea*] (elaborating on the confusion at several leading universities). Columbia University expressly excluded software from its STATEMENT OF POLICY ON PROPRIETARY RIGHTS IN THE INTELLECTUAL PRODUCTS OF FACULTY ACTIVITY (1984). Other universities had simply remained silent on the problem as of this writing. See, e.g., INDIANA UNIVERSITY FOUNDATION, *supra* note 41.

197. See *Idea supra* note 196 (discussing the *Symbolic Manipulation Program*, authored in part by Professor Stephen Wolfram, who abandoned the project and the university in the wake of disputed claims to ownership). For the dual nature of software, see: Galbi, *supra* note 65, at 281; Davidson, *supra* note 100, at 1037; and Davidson, *Protecting Software: A Comprehensive Analy-*

the program was never fully perfected.

A more sensible policy is for universities to recognize the hybrid nature of computer software and other intermediate technologies and then to formulate their own *sui generis* positions concerning proprietary rights—positions that deviate from their standard, and one hopes more liberal, provisions on copyrights in general. Stanford University's guidelines, for example, start by acknowledging software as copyrightable subject matter. The guidelines, however, go on to characterize software as a special case that is normally either a work for hire, a work contracted for by the university, or a work made with significant use of university resources, all of which serve to render copyright protection "inadequate."¹⁹⁸

Whether accurate or not, this evaluation further serves to rationalize the grouping of software with computer data bases and firmware produced at Stanford, which are all assimilated to a subcategory known as "tangible research property."¹⁹⁹ This subcategory includes additional items such as biological materials, circuit diagrams, engineering drawings, integrated circuit chips, and prototype devices and equipment.²⁰⁰ While this classificatory scheme makes mincemeat of the world's established intellectual property framework, it nonetheless achieves the desired result by virtue of a special policy applicable to all "tangible research property." This property is "normally . . . either owned by Stanford or . . . subject to the ownership and other provisions of contracts and grants."²⁰¹

Fashioning special agreements of this kind remains a tricky business at best. For example, policy statements in faculty manuals or the like are not usually signed by faculty members. If the manual deviates from what the Copyright Act provides and the Copyright Act requires a signature to validate the deviation, either the author or the university, absent timely remedial measures, may be denied the benefits of a policy thought to apply but never embodied in a signed instrument.²⁰²

sis, 23 JURIMETRICS J. 337, 375 (1983) [hereinafter Davidson, *Protecting Software*].

198. STANFORD POLICY, *supra* note 179, at 8.

199. *Id.* at 8, 9. The parallel with tangible embodiments of know-how is clear. *See supra* notes 85-88 and accompanying text.

200. STANFORD POLICY, *supra* note 179, at 9.

201. *Id.* at 9. Restrictions on distribution are then applied. Especially stringent are the restrictions on commercial distribution, which must be arranged with the coordination of an Office of Technology Licensing. *Id.* at 9-10. Under the Stanford scheme, the University thus assumes ownership of software but shares the royalties with the creator, his department, and his school, as normally occurs with patents. School officials claim this policy satisfies the faculty, but there are published assertions to the contrary. *See Idea, supra* note 196. Vanderbilt University also classifies software as "Tangible Research Property," and the University "reserves its financial rights." VANDERBILT UNIVERSITY FACULTY MANUAL, *supra* note 41, at 60.

202. *See, e.g.*, 17 U.S.C. § 101 (1982) ("work made for hire"); *id.* § 201(b) (1982) (ownership

A decision to exempt software and other intermediate technology from the standard ownership provisions of a university's copyright policy, moreover, leads too conveniently to a further decision to draw on the university's standard ownership provisions concerning patentable industrial property. Yet, it is widely believed that neither the "employed to invent" and "shop right" doctrines of patent law²⁰³ nor the work-for-hire provisions of copyright law adequately respond to the exigencies of software producers,²⁰⁴ and there is still no agreement on how a truly fair deal should be structured.²⁰⁵ Meanwhile, a university that

of works made for hire); Marks, *supra* note 176, at 4, in Blacksburg Conference, *supra* note 24; *supra* note 186.

203. Although the basic rules of ownership theoretically favor the inventor who conceives or reduces an invention to practice during the course of employment, these rules are offset in practice by the power of the employer to obtain title contractually or specifically to hire the employee to exercise "inventive faculties" on the employer's behalf. Even without these exceptions, the employer may enjoy a "non-exclusive and nontransferable royalty-free license ('shop right') to use the employee's patented invention." 5 D. CHISUM, *supra* note 19, § 22.03, at 22-9.

The shop right, however, is an uncertain right. *See id.* § 22.03[3]. For the shop right in the research setting, compare State Board of Education v. Bourne, 150 Fla. 323, 7 So. 2d 838 (1942) (concerning a plant pathologist who was assigned to work on the breeding of sugar cane hybrids and who retained all rights in hybrids of sugar cane as against employer) with State v. Neal, 152 Fla. 582, 12 So. 2d 590 (1943) (concerning a researcher hired to study the digestibility of citrus waste and to make animal feed from it; holding that the employment was specific enough to give patent rights to the employer).

204. For example, see Articles 45-46 of the French Copyright Law of 1985, *supra* note 121, which drastically alter the ownership provisions flowing from copyright law in a quasi-copyright or neighboring rights milieu without expressly preserving moral rights and without importing the safeguards of patent law.

205. For example, the policy adopted at Carnegie-Mellon University in 1985 reportedly allows the university an option on both patentable and copyrightable property for a period of 120 days. Copyrights in educational materials, such as textbooks and instructional software, are then normally returned to creators, while commercial software (defined as software that performs a function for the user) will be copyrighted by the University if a market for the item is anticipated. *See* Memo from Vanderbilt Development Office (Jan. 27, 1986) (on file at the Vanderbilt Law School).

Another possibility is for a university to exact royalties consistent with its support by contractual arrangement while continuing to recognize copyright ownership of the academics who create computer programs as a research product. *See, e.g.,* Dreyfuss, *supra* note 41, at 640-41 n.179. This approach has the advantage of ensuring the parent university of a share in the proceeds even if the creator moves to another university and takes his copyright with him. *Id.* But the terms of such contracts are difficult to evaluate prior to the creation of the work, when the level of direct university support may have been minimal. Experience demonstrates that attempts to negotiate profit-sharing agreements on the basis of quasi-ownership claims after the true value of a copyrighted work has become known are risky and may not be conducive to good relations with an instructor-author who has become more marketable.

Even if it turns out that academic ownership of copyrighted works is, on the whole, a more efficient basis for the dissemination of research, as Professor Dreyfuss's study suggests, *see generally id.*, it remains to be seen whether the exploitation of university-generated software, viewed as industrial property in disguise, would be equally efficient under the normal ownership rules of literary and artistic property law, *see, e.g., infra* notes 363-68 and accompanying text (growing resort of universities to spin-off companies in order to attract venture capital and develop new

refashions its copyright policy with a view to claiming ownership of software will also feel tempted to claim title to all copyrightable subject matter authored by its faculty members, and the latter may lack the bargaining power to resist this tactic.

2. Pitfalls of the Collective Endeavor

Plenty of practical difficulties remain even after the university formulates an appropriate ownership policy. For example, any official policy can govern only software developed within the scope of a professor's or staff member's employment or with the use of university equipment and resources.²⁰⁶ This restriction posed fewer problems in the days when industrial and scientific innovation typically required shopwork that occurred during working hours and was difficult to hide. Today's software development, however, need not require visible use of the employer's facilities, or at least not the same degree of use. Many professors claim to have created their software at home, outside regular office hours and beyond the scope of employment. These claims pose delicate evidentiary questions that can taint the university's relations with a key faculty member even if a court holds for university ownership in the end.²⁰⁷

When software is developed within the scope of university employment, copyright ownership may still be in doubt because of questions about who the real authors were, especially when a team of principal investigators and graduate students collaborated on the work.²⁰⁸ A high-level source code produced within a university department is often a collective endeavor of this kind. If the finished product becomes a "joint work,"²⁰⁹ for example, each contributor automatically acquires an undivided estate in the entire work along with the power to license it as the contributor deems fit.²¹⁰ Joint authors merely owe one another a duty to account for proceeds earned by their work, which must be

technologies). See also Memo from University of Colorado Foundation, at 2 (copy on file with Author) (suggesting that faculty often prefer that the Foundation play an active role in protecting and developing disclosures with longer range commercial potential, which are patented by the Foundation).

206. See 17 U.S.C. §§ 101, 201(b)(1982); *supra* note 203.

207. See, e.g., *In re Simplified Information Sys., Inc.* (Simplified Information Sys. v. Cannon), 89 Bankr. 538 (Bankr. W.D. Pa. 1988); see also *Evans Newton Inc. v. Chicago Sys. Software*, 793 F.2d 889 (7th Cir.) (stressing supervisory control in determining work-for-hire status), *cert. denied*, 479 U.S. 949 (1986); Dreyfuss, *supra* note 41, at 602 (stressing evidentiary problems).

208. See, e.g., Marks, *supra* note 176, at 3, in Blacksburg Conference, *supra* note 24.

209. See 17 U.S.C. § 101 (1982) (stating that "[a] 'joint work' is a work prepared by two or more authors with the intention that their contributions be merged into inseparable or interdependent parts of a unitary whole").

210. *Id.* § 201(a) (stating that "[t]he authors of a joint work are co-owners of copyright in the work"); see 1 M. NIMMER & D. NIMMER, *supra* note 42, § 6.06[A], at 6-14.

shared, and none of them may license the work in a manner that destroys its value to the others.²¹¹

The statutory definition of a "joint work" requires the authors' intent to merge "their contributions . . . into inseparable or interdependent parts of a unitary whole."²¹² The legislative history emphasized a need to clarify the nature of these intentions at the time of creation. The case law, however, continues to allow room for manipulation after the fact²¹³ based on allegations that the end product partook of a "common design."²¹⁴

Recent controversies involving the joint efforts of university personnel are hardly reassuring in this regard. In one case, the joint authorship doctrine foiled the efforts of a junior scholar in nuclear medicine to prevent her former mentor, a senior scholar in the same field, from distributing a syllabus that resulted from their previous collaboration.²¹⁵ In another case, one of several authors of an article on clinical education in hospital pharmacology sued his fellow investigators and the university because they had failed to credit him as lead author in the published version of the work. Despite university funding of the project, the court treated the article as a joint work rather than a work made for hire and held that the defendants were entitled to revise the article and to change the order in which the authors were listed.²¹⁶

The broad doctrine of joint authorship applied in these cases could easily extend to the development of major source codes. If it did, each co-owner of copyright would obtain the right to make and publish his own derivative works from programs originally developed in a university department.²¹⁷ Because of the practical and commercial importance of the improved programs that normally are derived from an initial breakthrough, the ability of a university to maximize profits from its ownership of program copyrights could turn on its ability to limit the

211. See, e.g., *Weissmann v. Freeman*, 684 F. Supp. 1248 (S.D.N.Y. 1988); *Shapiro, Bernstein & Co., Inc. v. Jerry Vogel Music Co., Inc.*, 73 F. Supp. 165, 168 (S.D.N.Y. 1947); see generally 1 M. NIMMER & D. NIMMER, *supra* note 42, §§ 6.11, 6.12[A]. Termination of transfers would require a majority vote under 17 U.S.C. § 203(a)(1) (1982).

212. See *supra* note 209.

213. See, e.g., *Community for Creative Non-violence v. Reid*, 846 F.2d 1485 (D.C. Cir.), *cert. granted*, 109 S. Ct. 362 (1989); *W. PATRY, supra* note 186, at 115-16 (citing authorities).

214. See, e.g., *Weissmann*, 684 F. Supp. at 1260 (declining to reject the common design doctrine in *Edward B. Marks Music Corp. v. Jerry Vogel Music Co.*, 140 F.2d 266 (2d Cir. 1944) (12th Street Rag doctrine)). *But see* 1 M. NIMMER & D. NIMMER, *supra* note 42, § 6.03 (criticizing this doctrine).

215. *Weissmann*, 684 F. Supp. at 1248.

216. *Weinstein v. University of Ill.*, 811 F.2d 1091 (7th Cir. 1987); see also *Community for Creative Non-violence*, 846 F.2d at 1485.

217. See, e.g., *Weinstein*, 811 F.2d at 1091; 17 U.S.C. §§ 103, 106(2) (1982) (derivative works).

number of joint owners and to control the pace at which derivative products are marketed.²¹⁸ Even though close cooperation between the university and faculty members who create a computer program seems indispensable to maximizing profits, the interests of the parties will not always converge and conflicts between them could threaten the success of any commercial undertaking.²¹⁹

To reduce the risk that graduate students might later assert proprietary rights, the university could require a waiver in advance; some administrations already seem to be implementing this procedure.²²⁰ The validity of such a waiver, however, is not altogether free from doubt, at least when the student pays his own way (a situation that occurs less frequently in the *graduate* environment). Even if a waiver were initially valid, the student who later made a demonstrably significant contribution to the project might still have grounds for asserting a proprietary claim²²¹ on the theory that the Copyright Act of 1976 vests initial ownership of copyright in the *author*.²²² Under the termination provisions of the same Act, moreover, even a valid transfer of copyright by students to the university could fail to obviate posterior ownership disputes over longer lived software innovations.²²³

B. Eligibility and the Scope of Protection for Industrial Literature

Beyond these threshold problems of authorship and ownership, generally troublesome questions about the proper scope of protection for copyrighted computer software²²⁴ become even more perplexing in a research environment. These questions are, of course, mostly obviated whenever university software qualifies for patent protection. Any programmer who satisfies the hard prerequisites of patent law earns the

218. See, e.g., Dreyfuss, *supra* note 41, at 640 (noting that when group research projects are conceived, departmental interest in simplifying dissemination may require university ownership).

219. See, e.g., *id.* at 624-26.

220. Universities that appear to claim rights in student works, at least when the student receives financial aid, include the Massachusetts Institute of Technology (MIT), see MASSACHUSETTS INSTITUTE OF TECHNOLOGY COPYRIGHT POLICY ¶¶ D, E, F, (1979) [hereinafter MIT POLICY] and Indiana University, see INDIANA UNIVERSITY FOUNDATION, *supra* note 41.

221. See, e.g., Hardy, *supra* note 188, at 257-58 (stating that graduate students are not workers for hire in the usual sense of the term).

222. See 17 U.S.C. § 201(a) (1982).

223. See *id.* § 203.

224. See, e.g., Nimmer, Bernacchi & Frischling, *A Structured Approach to Analyzing the Substantial Similarity of Computer Software in Copyright Infringement Cases*, 20 ARIZ. ST. L.J. 625, 628-34 (1988); Nimmer & Krauthaus, *Copyright and Software Technology Infringement: Defining Third Party Development Rights*, 62 IND. L.J. 13, 60-62 (1986); see also Karjala, *supra* note 105, at 34-36, 62-96; Menell, *supra* note 171, at 1329, 1346-72; Wharton, *Use and Expression: The Scope of Copyright Protection for Computer Programs*, 5 COMPUTER L.J. 433, 467-68 (1985). For additional and insightful economic analysis, see Menell, *An Analysis of the Scope of Copyright Protection for Application Programs*, 41 STAN. L. REV. (forthcoming May 1989).

hard protection it provides in the form of exclusive rights to make, use, and sell the patented software invention.²²⁵ Such a patent would rarely cover the coded instructions, which are unlikely to satisfy the nonobviousness requirement and would thus continue to depend on copyright law; but the patent should protect exceptionally innovative design features pertaining to organization, structure, and methods of operation.²²⁶ A patent might also prevent third parties from introducing certain programs that achieve comparable results with differing code structures, and in this case independent creation would provide no defense to an action for infringement.²²⁷

The tough form of protection afforded by a software patent does raise tensions with basic academic values,²²⁸ but these tensions are no different in principle from those encountered in working with other intermediate technologies, notably biotechnology.²²⁹ Because the distinction between pure and applied research is not well defined in either field, the exclusive rights a patent confers can extend farther into the laboratory than is possible in the more conventional applications of science to industry.²³⁰ More aggressive judicial development of an "experimental use" exception to patentability could offset some of these tensions and help to reconcile the goals of scientific progress with those of patenting new technological research.²³¹

When a university relies on copyright law to protect computer pro-

225. See 35 U.S.C. § 271(a) (1982); see also Maier, *supra* note 59, at 158.

226. See Maier, *supra* note 59, at 158. Exceptionally innovative screen displays would also qualify for design patents. See, e.g., Kluth & Lundberg, *supra* note 131. The standards of patentability, of course, must be met in each case. Maier suggests that coded instructions would benefit indirectly from protection of the key functional elements, Maier, *supra* note 59, at 158, but this conclusion may assume a too favorable reading of the doctrine of equivalents.

227. See, e.g., Maier, *supra* note 59, at 158-59 (noting that this result contrasts with the soft protection of copyright law). But see Texas Instrument cases, cited *supra* note 69; Becker, *supra* note 69, at 47-50 (warning that broad claims may be narrowly construed for infringement purposes).

228. See, e.g., R. Stallman, *supra* note 175, at 5-6. Along with some constraints on the computer scientist's freedom to publish, a degree of secrecy in the laboratory will probably be needed. See *supra* notes 46-49 and accompanying text.

229. See, e.g., Eisenberg, *supra* note 11, at 190-95, 197-200, 206-17.

230. See, e.g., Newell, *supra* note 175, at 1026, 1033. Newell stated that "[a]ll of computer science is directly related to use. There is essentially no gap, no matter how pure or basic the science is." *Id.*; see also Eisenberg, *supra* note 11, at 195, 217-20. Eisenberg notes: "In this field [biotechnology], the traditional dividing line between basic and applied research is blurred. Not only has the historical time lag between the two collapsed, but it has become difficult to characterize given research problems as belonging in one category or the other." *Id.* at 195.

231. See, e.g., Chisum, *supra* note 173, at 1019 (noting that the absence of a well-defined exemption to the novelty requirement for research and experimentation in patent law is troublesome for computer technology and fields such as chemistry and biotechnology); Eisenberg, *supra* note 11, 219-26 (discussing ambiguities of case law concerning experimental use doctrine). But see *supra* note 175 (discussing views of those who fear that patent protection of computer software inhibits scientific progress).

grams, in contrast, the tensions with academic principles and values become far more subtle and complex.

1. "Originality" and the Burdens of Overlapping Claims

On the bright side, copyright protection arises automatically from the act of creation, without cost to or extra effort by the authors, and it is not compromised by premature publication or disclosure.²³² Because the copyright paradigm affords soft protection on soft conditions for a long period of time and does not require either novelty or nonobviousness, every academic programmer can, in principle, protect the original expression of his or her program provided that it has not been copied from another's work.²³³ Programmers cannot, however, copyright the ideas, methods, discoveries, or principles embodied in their work,²³⁴ and the fair-use defense builds an exemption for scholarly and scientific pursuits into the basic protective framework of the copyright system.²³⁵

While this doctrinal apparatus works tolerably well in the realm of traditional literary and artistic works for which it was devised,²³⁶ it can produce mischievous results when applied to computer programs, especially in the university environment. For example, because there is no requirement of objective novelty to distance one work from another or from the prior art and because all programmers can copyright their own original expressions, independently created contributions may cluster about unprotectable core ideas, each of which overlaps the others.²³⁷ All

232. 17 U.S.C. § 102(a) (1982) (stating that "[c]opyright protection subsists . . . in original works of authorship fixed in any tangible medium of expression"); *id.* § 101 (defining "fixed" and "created"); *id.* § 408(a) (making registration permissive, not mandatory). For works created between January 1, 1978 and March 1, 1989, the copyright can be invalidated after five years if the work is distributed publicly without notice. *See id.* §§ 401, 405. For works created after March 1, 1989, even publication without notice will not invalidate the copyright. *See Berne Convention Implementation Act of 1988*, Pub. L. No. 100-568, § 7, 102 Stat. 2853 (eliminating technical forfeiture because of public distribution without copyright notice).

233. *See, e.g., Goldstein, Infringement of Copyright in Computer Programs*, 47 U. PITT. L. REV. 1119, 1120 (1986). Independent creation thus constitutes a perfect defense to every claim of infringement, even though a second comer achieves comparable results by similar or different means. *See, e.g., 1 M. NIMMER & D. NIMMER, supra note 42, § 201[A]*. This follows because copyright law protects only the mode of expression in "original work[s] of authorship" and not the underlying ideas. 17 U.S.C. § 102(a), (b) (1982).

234. *See* 17 U.S.C. § 102(b) (1982); *infra note 288*.

235. *See* 17 U.S.C. § 107 (1982); *see also* W. PATRY, *THE FAIR USE PRIVILEGE IN COPYRIGHT LAW* 361-65, 385-408 (1985); Gordon, *Fair Use as Market Failure: A Structural and Economic Analysis of the Betamax Case and Its Predecessors*, 30 J. COPYRIGHT SOC'Y 253 (1983). *See generally* Raskind, *The Uncertain Case for Special Legislation Protecting Computer Software*, 47 U. PITT. L. REV. 1131, 1175-82 (1986).

236. *See* Brown, *supra note 101*, at 580-89, 606-09.

237. *See, e.g., Plains Cotton Coop. Ass'n v. Goodpasture Computer Serv., Inc.*, 807 F.2d 1256 (5th Cir.), *cert. denied*, 108 S. Ct. 80 (1987); *Universal Athletic Sales Co. v. Salkeld*, 511 F.2d 904 (3d Cir.), *cert. denied*, 423 U.S. 863 (1975); *Q-Co. Indus. v. Hoffman*, 625 F. Supp. 608 (S.D.N.Y.

these contributions can then support individual claims to protection that are subject to no prior specification or examination, nor to disqualification for prior use or disclosure.

As applied to literary and artistic works this approach results in many protectable versions of a common plot, theme, situation, or landscape, each of which reflects its creator's unique personality and subjective imagination.²³⁸ As applied to utilitarian works, however, the Holmesian premise of diversification through subjective novelty²³⁹ breaks down²⁴⁰ because the motives underlying the act of independent creation have little or nothing to do with expressing the human personality as such.²⁴¹ On the contrary, subjective personalization in the utilitarian milieu tends to produce white elephants that are either dysfunctional or readily undersold by products built around more streamlined or standardized solutions.²⁴²

When minimally creative designs of utilitarian objects attract copy-

1985).

238. See, e.g., *Franklin Mint Corp. v. National Wildlife Art Exch., Inc.*, 575 F.2d 62 (3d Cir. 1978).

239. See, e.g., *Bleistein v. Donaldson Lithographing Co.*, 188 U.S. 239 (1903) (holding independently created literary and artistic works are innately differentiated by the unique personalities of their authors); *Alfred Bell & Co. v. Catalda Fine Arts, Inc.*, 191 F.2d 99, 102-03 (2d Cir. 1951).

240. See *L. Batlin & Son, Inc. v. Snyder*, 536 F.2d 486, 490-92 (2d Cir.) (en banc) (requiring quantitative creativity for reproductions of commercial designs already in the public domain and denying eligibility to products of "physical skills"), *cert. denied*, 429 U.S. 857 (1976); see also *Chamberlin v. Uris Sales Corp.*, 150 F.2d 512, 513 (2d Cir. 1945) (Frank, J.); *infra* notes 254-58 and accompanying text. See generally Reichman, *After the Copyright Act*, *supra* note 61, at 297-321 ("Quantitative Creativity in the Second Circuit").

241. That expression of the human personality constitutes an essential feature of the Holmesian analysis is routinely and conveniently overlooked in the modern context. See *Bleistein*, 188 U.S. at 239, 250. The court stated:

The copy is the personal reaction of an individual upon nature. Personality always contains something unique. It expresses its singularity even in hand-writing, and a very modest grade of art has in it something irreducible, which is one man's alone. That something he may copyright unless there is a restriction in the words of the act.

Id.; see also Goldstein, *supra* note 233, at 1123 (stating that the "premise of patent law is that high standards and a high level of protection reward investment in substantial technological improvements"; premise of copyrights is that, given low standards and a low level of protection, authors "will direct their efforts and be free to direct their efforts towards expressively different works"); Reichman, *After The Copyright Act*, *supra* note 61, 276-83 (discussing the distinction between creative works and products of skilled efforts in comparative legal theory).

242. See, e.g., Conference Report, LaST Frontier Conference on Software Protection, Arizona State University College of Law, Science and Technology, February 13-14, 1989, at 4 (first full Committee Draft, February 28, 1989), to be reprinted in *JURIMETRICS J.* (1989) [hereinafter Conference Report] (noting that "the predominant, if not exclusive, goal in the design of computer programs is the achievement of functional objectives, such as speed of computing, efficient use of memory, optimization of input/output functioning, and ease of testing, maintenance, and enhancement"). The Conference Report is a proposed consensus statement about the application of traditional copyright principles to computer programs, to be signed by 10 law professors; citations are only to those portions of the text that had obtained full consensus at the time of writing.

right protection in the form of two-dimensional graphic or verbal representations, and these designs are subsequently embodied in three-dimensional utilitarian objects,²⁴³ a copyright paradigm devised to regulate the market for literary and artistic works can become a tool for restraining trade on the general products market.²⁴⁴ Uncritical application of the pure theory of copyright law to works having an industrial character²⁴⁵ will oblige courts to validate miniscule variations on the prior art as "original works of authorship" that other authors copy at their peril,²⁴⁶ even though the range of marketable variations in utilitarian products is limited by functional exigencies and by market expectations of performance.²⁴⁷ Given both the lack of any predetermined metes and bounds around the copyrightable estate and the existence of a judicial bias against close imitation, any grant of exclusive reproduction rights may extend beyond the modest quantum of originality used to qualify for protection and invest first comers with colorable claims to nonprotectable matter,²⁴⁸ including functionally efficient solutions that

243. Although the "dual nature" of computer programs is now clear and conceded even by those who favor strong protection for computer software, *see supra* note 100, the Copyright Act of 1976 insisted on a technical definition of "useful articles" that exempted industrial literature from the separability test otherwise employed to restrict the copyrightability of industrial art. *See* 17 U.S.C. § 101 (1982) (defining "useful articles" as "article[s] having an intrinsic utilitarian function that is not merely to portray the appearance of an article or to convey information" (emphasis added)); *id.* (defining "Pictorial, graphic, and sculptural works" (codifying separability tests for designs of useful articles)); *id.* (defining "literary works" (including "computer programs," as defined, but containing no test of separability)); *see also infra* notes 291-96 and accompanying text (comparing "unity of art" doctrine in France with "unity of literature" approach in the United States); *infra* note 288 (reinterpreting *Baker v. Selden*).

244. *See, e.g.,* B. KAPLAN, AN UNHURRIED VIEW OF COPYRIGHT 55 (1966) (noting "dangers of injecting copyright into complex, going market mechanisms"); Reichman, *Before the Copyright Act*, *supra* note 61, at 1197 (discussing the "two-market conundrum" of commercial designs); *see also* Reichman, *supra* note 5, part II.

245. For the conventionally broadest application of the originality doctrine to artistic works, *see Alfred Bell*, 191 F.2d 99. For the broadest applications to commercial designs, viewed as "works of applied art" under the 1909 Act, *see* Reichman, *After the Copyright Act*, *supra* note 61, at 298-303 ("Excesses of the Copyright Approach"). For the broadest applications to literary works in the period since passage of the 1976 Act, *see* *West Publishing Co. v. Mead Data Central, Inc.*, 799 F.2d 1219 (8th Cir. 1986), *cert. denied* 107 S. Ct. 962 (1987) and *NEC Corp. v. Intel Corp.*, No. C-84-2079-WPG, slip op. at 4-5 (N.D. Cal. Feb. 6, 1989) (originality of microcode).

246. *See, e.g.,* Laurie & Keefauver, *Protection of Computer Software* (American Group of A.I.P.P.I Report Q57, 1989), reprinted in Arizona State University College of Law, Cases & Materials for LaST Frontier Conference on Software Protection 230, 233 (Feb. 13-14, 1989) [hereinafter LaST Frontier Conference] (stating that function task and programming language narrow the available range of implementing expression); *id.* at 234 (stating that independent creation is a chimerical defense in the area of compatible software); *see also* *NEC Corp.*, No. C-84-2079-WPG (recognizing the problem in regard to microcode, but applying the lowest standard of originality).

247. *See* Conference Report, *supra* note 242, at 3-4; *see also* discussion *supra* note 247.

248. *See, e.g.,* Nimmer, Bernacchi, & Frischling, *supra* note 224, at 628 (noting "numerous common programming techniques found in a wide variety of programs"); *id.* at 642-43 (advising courts that program elements dictated by external considerations are tainted by "[l]ack of

prudent second comers will feel obliged to work around in order to forestall actions for infringement.²⁴⁹

Unlike patent law, in short, which allows second comers to use freely all unpatentable innovations, the amorphous nature of copyright protection dictates that when any programmer's modest quantum of protectable originality overlaps the protectable quantum of other programmers working in the same field, complaints about "copying" become feasible.²⁵⁰ In this and other ways, the copyright paradigm extends its protective mantle deeper into the application phases of computer science than is possible when only patent law applies.²⁵¹ Because it is difficult to separate basic from applied research in this field,²⁵² the exercise of overly broad and exclusive reproduction rights at

[o]riginality"); *id.* at 643-49 (including hardware standards, software standards, computer manufacturers' design standards, "target industry practices," and computer industry programming practices in the list of nonoriginal program elements).

249. See, e.g., *NEC Corp.*, No. C-84-2079-WPC; *Pearl Sys., Inc. v. Competition Elec. Inc.*, 8 U.S.P.Q.2d (BNA) 1520 (S.D. Fla. 1988); *Hinckley*, *supra* note 177, at 38, 50-55 (discussing implications of copyright protection for microcode as presented in *NEC Corp. v. Intel Corp.*, 645 F. Supp. 590 (W.D. Ga. 1986) (opinion withdrawn)); see also *Digital Communications Assocs. v. Softkone Distrib. Corp.*, 659 F. Supp. 449 (N.D. Ga. 1987); *Broderbund Software, Inc. v. Unison World, Inc.*, 648 F. Supp. 1127 (N.D. Cal. 1986); *Williams v. Arndt*, 626 F. Supp. 571 (D. Mass. 1985); *E.F. Johnson Co. v. Uniden Corp.*, 623 F. Supp. 1485 (D. Minn. 1985).

Taken one by one, arguments can be advanced to justify the results in each of these cases. Taken all together, the degree of copyright protection potentially available to minor functional variations on core or standard technical ideas appears alarming. See, e.g., *Karjala, United States Adherence to the Berne Convention and Copyright Protection of Information-Based Technologies*, 28 JURIMETRICS J. 147, 149-50 (1988); *Menell*, *supra* note 171, at 1339-46 (noting the dangers of legal protection for product standards); *supra* note 248; see also *Samuelson, Why the "Look and Feel" of Software Should Not Be Protected by Copyright Law* (unpublished paper), reprinted in *LaST Frontier Conference*, *supra* note 246, at 443-54 (stating that "[i]f 'unoriginal' material is not protectable by copyright, then it should not be inadvertently swept back in by application of a 'look and feel' test").

250. See, e.g., *Karjala*, *supra* note 249, at 149 (noting that advances in software design are always similar to prior works); *Nimmer, Bernacchi & Frischling*, *supra* note 224, at 628-34 (discussing technical difficulties in determining substantial similarity of computer programs); *Conference Report*, *supra* note 242, at 4 (warning courts not to extend protection to functional or utilitarian features); see also *Goldstein*, *supra* note 233, at 1122 (stating that "copyright [law], designed to promote the arts, casts too low and wide a net properly to promote technology").

251. See *Newell*, *supra* note 175, at 1026 (stating that "[a]ll of computer science is directly related to use"); *id.* at 1032-33 (refuting the "black box" thesis of *Davidson*, *supra* note 100). *Newell* states:

As anyone in computer science knows, the boundary between data and program—that is, what is data and what is procedure—is very fluid. In fact, . . . there is no principle distinction in terms of form or representation of which is which. What counts is the total body of knowledge represented somehow in the assembled symbolic expressions. *This totality determines the ultimate behavior of the machine.* . . . Because of this, what is outside his [Davidson's] black box and what is inside it is open to great manipulation, either to avoid or to create copyright problems, as the case may be.

Id. at 1033 (emphasis added).

252. See *supra* note 175 and accompanying text (view of *Newell*).

the application phase can then fuel claims of infringement having serious repercussions at a more theoretical level.²⁵³

Aware of these contradictions, some courts have sought to modify the standard doctrine of originality as applied to both utilitarian and factual works under the 1976 Act. In particular, the Court of Appeals for the Second Circuit has sporadically developed a "substantial creativity" requirement for works of applied art;²⁵⁴ for derivative works in general,²⁵⁵ and, more recently, for so-called factual compilations of a utilitarian nature.²⁵⁶ An insistence on "substantial creativity" rather than just independent creation in this line of cases aims to preserve elbow room for competitors and to reduce the possibilities for harassment inherent in grants of exclusive rights to miniscule variations on the prior art.²⁵⁷ The Ninth Circuit has tried to reach comparable results by means of a deliberately expansive reading of the subject-matter exclusions under Section 102(b) of the 1976 Act in cases dealing with factual and functional works of a utilitarian character.²⁵⁸

253. See, e.g., *Plains Cotton Coop. Ass'n v. Goodpasture Computer Serv., Inc.*, 807 F.2d 1256 (5th Cir.), *cert. denied*, 108 S. Ct. 80 (1987); *Williams v. Arndt*, 626 F. Supp. 571 (D. Mass. 1985); *SAS Inst., Inc. v. S & H Computer Sys., Inc.*, 605 F. Supp. 816 (M.D. Tenn. 1985); see also *supra* notes 175, 230, 251 (views of Newell and Stallman, computer scientists).

254. See, e.g., *Kieselstein-Cord v. Accessories by Pearl, Inc.*, 632 F.2d 989, 994 (2d Cir. 1980) (stating that "most belt buckles would not meet the basic requirements of originality and creativity"); *L. Batlin & Son, Inc. v. Snyder*, 536 F.2d 486 (2d Cir.) (en banc), *cert. denied*, 429 U.S. 857 (1976); see also *John Muller v. New York Arrows*, 802 F.2d 989 (8th Cir. 1986) (holding logo not copyrightable for lack of creative contribution); *Kuddle Toy, Inc. v. Pussycat-Toy Co.*, 183 U.S.P.Q. (BNA) 642 (E.D.N.Y. 1974); *Gardenia Flowers, Inc. v. Joseph Markovits, Inc.*, 280 F. Supp. 776 (S.D.N.Y. 1968). See generally Reichman, *After the Copyright Act*, *supra* note 61, at 271-75, 303-08, 312-21, 329-30.

255. See, e.g., *Durham Indus., Inc. v. Tomy Corp.*, 630 F.2d 905, 909-11 (2d Cir. 1980) (holding that the *Batlin* standards of originality and creativity, initially applied to works copied from the public domain, would now extend to works derived from other works still in copyright, for which "the originality requirement imposed by the Constitution and the Copyright Act has particular significance"); see also *Eden Toys, Inc. v. Florelee Undergarments Co.*, 697 F.2d 27, 33-34 (2d Cir. 1982); *Norris Indus., Inc. v. Int'l Tel. & Tel. Corp.*, 696 F.2d 918, 920 n.2 (11th Cir. 1982) (copyright office applying the *Batlin* standard of originality but not adjudicating the issue), *cert. denied*, 464 U.S. 818 (1983); Reichman, *After the Copyright Act*, *supra* note 61, at 342-43 (discussing this aspect of *Durham*); *id.* at 320 n.281, 342 n.430 (suggesting the desirability of limiting *Batlin* to cases of commercial design, a suggestion that this Article disavows).

256. See *Financial Information, Inc. v. Moody's Investors Servs., Inc.*, 808 F.2d 204, 207-08 (2d Cir. 1986) (holding that the arrangement of information on bond redemption cards was not an original work of authorship).

257. See *Durham Indus.*, 630 F.2d 905; *L. Batlin & Son*, 536 F.2d 486; see also *Toro Co. v. R & R Prod. Co.*, 787 F.2d 1208 (8th Cir. 1986) (holding that a parts numbering system was not an original work of authorship).

258. See, e.g., *Worth v. Selchow & Righter Co.*, 827 F.2d 569 (9th Cir. 1987) (holding a sweat-of-the-brow selection not copyrightable), *cert. denied*, 108 S. Ct. 1271 (1988); *Cooling Sys. & Flexibles, Inc. v. Stuart Radiator, Inc.*, 777 F.2d 485 (9th Cir. 1985) (stressing the narrow range of protectable expression in factual works); *Landsberg v. Scrabble Crossword Game Players, Inc.*, 736 F.2d 485 (9th Cir.), *cert. denied*, 469 U.S. 1037 (1984). The Ninth Circuit's approach, however, can

The extension of a quantitative creativity doctrine to computer programs as "works of applied literature" is both logical and appropriate. It would, indeed, simply build upon an early opinion of the Second Circuit, in which Judge Jerome Frank applied a substantial creativity criterion to limit the eligibility of a set of rules for playing a game.²⁵⁹ It would also enable courts to avoid the logical paradox that arises when they imply that close or slavish imitation can produce a finding of infringement even when only noncopyrightable elements have been taken.²⁶⁰ Recently, the Register of Copyrights managed to convince one federal district court that a videogame should be denied copyright protection for lack of sufficient creativity.²⁶¹ The Ninth Circuit has also found no protectable subject matter in a videogame.²⁶² Whether courts in this country will further develop threshold barriers to limit the protectability of computer programs that rely on solutions that are standard or commonplace in the trade, as has occurred in the Federal Republic of Germany,²⁶³ remains to be seen.²⁶⁴

convert noncopyrightable subject matter into copyrightable matter in cases of close imitation. See *infra* note 260.

259. *Chamberlin v. Uris Sales Corp.*, 150 F.2d 512, 513 (2d Cir. 1945) (Frank, J.) (requiring "substantial originality," which can only mean substantial creativity). Judge Frank authored the famous opinion in *Alfred Bell & Co. v. Catalda Fine Arts, Inc.*, 191 F.2d 99 (2d Cir. 1951), which lowered the doctrine of originality to its least exigent level for works of art; his opinion in *Chamberlin* was cited with approval by the Second Circuit en banc in *Batlin*. For the view that the extension of the *Alfred Bell* doctrine from an artistic to an industrial milieu works mischief, see *Kuddle Toy*, 133 U.S.P.Q. (BNA) 642 (Dooling, J.).

260. For example, see the *Cooling Systems* and *Landsberg* opinions in the Ninth Circuit, *supra* note 258, and even the *Frybarger* opinion, *infra* note 262. The logical paradox mentioned in the text was rightly rejected by the Second Circuit in *Batlin v. Snyder* and its progeny, *supra* notes 254-55, which recognized that minimally creative commercial designs do not necessarily satisfy the *Bleistein* postulate. See *supra* notes 241-42 and accompanying text. For signs that the Ninth Circuit is inching toward a more restrictive view of the eligibility requirement, as applied to borderline subject matter, see *infra* note 262 and accompanying text (*Frybarger* and *Worth* opinions).

261. See *Atari Games Corp. v. Oman*, 695 F. Supp. 1204 (D.D.C. 1988) (denying a videogame copyrightability for lack of creativity, and holding that it was not an original work of authorship within 17 U.S.C. § 102(a) (1982)).

262. *Data East USA, Inc. v. Epyx, Inc.* 862 F.2d 204 (9th Cir. 1988); see *Frybarger v. International Business Mach. Corp.*, 812 F.2d 525 (9th Cir. 1987) (holding that each of the similar features in question was a basic idea of videogames; indispensable expression of basic ideas was not identical and therefore was unprotectable). It follows that there was no "original work of authorship" within the meaning of 17 U.S.C. § 102(a) (1982). See also *Worth v. Selchow & Righter Co.*, 827 F.2d 569 (9th Cir. 1987) (holding that sweat-of-the-brow selection was not copyrightable), *cert. denied*, 108 S. Ct. 1271 (1988); *Herbert Rosenthal Jewelry Corp. v. Kalpakian*, 446 F.2d 738, 742 (9th Cir. 1971) (holding that the idea and expression of jewelry design were inseparable; protecting the expression would confer a monopoly on the idea).

263. See *Sudwestdeutsche Inkasso Kb. v. Bappert und Burker Computer GMBH*, 1 ZR 62/83 (Federal Supreme Court [BGH], 9 May 1985), 1985 GRUR 1041, 17 INT'L REV. INDUS. PROP. & COPYRIGHT L. (IIC) 681 (1986); "Baustatikprogramm" Decision (Federal Supreme Court, 26 June 1986), 1985 GRUR 1049, 1052; see also "Wergeplaene" Decision, 1 ZR 160/84 (Federal Supreme

Meanwhile, in a field in which innovation occurs through sequential and cumulative improvements,²⁶⁵ every researcher making use of another researcher's prior art can expose himself to potential liability for infringement, or at least to litigation, absent explicit authorization for use.²⁶⁶ This exposure prompts university lawyers to consider obtaining defensive permission from researchers already working in a given area,²⁶⁷ but this practice can cause the very litigation that it seeks to avoid. Once a university routinely decides to exploit its software commercially, moreover, there is no guarantee that it will honor requests for permission from other universities' departments that later may become competitors. In addition, there is a built-in temptation to demand substantial fees from other universities even for research purposes.²⁶⁸

2. Uncertain Efficacy of the Traditional Defenses

To be sure, independent creation remains a perfect defense to any action for infringement of copyrighted computer programs.²⁶⁹ But how often does independent creation accurately characterize a university research environment in which "innovation occurs through sequential and cumulative improvements"?²⁷⁰ Computer scientists always borrow from

Court, 20 Nov. 1988) and "Topographische Land Karten" decision, 1 ZR 23285 (Federal Supreme Court, 2 July 1987). While the *Inkasso* decision limited copyright protection to programs demonstrating an "obviously above-average creative achievement," the lower courts have reportedly been less strict regarding the creative level. In practice, "it is sufficient that an expert versed in computer programs confirms the existence of a certain novelty that could not be achieved by an 'average computer programmer.'" Lehman, *The Legal Protection of Computer Programs in Germany: A Summary of the Present Situation*, 19 INT'L REV. INDUS. PROP. & COPYRIGHT L. (IIC) 473, 474-76 (1988). But see Kindermann, *supra* note 120, at 206 (suggesting that some BGH decisions have relaxed the standard of eligibility for borderline utilitarian works and downplaying the importance of the *Inkasso* decision). In these and earlier cases, the Supreme Court in the Federal Republic of Germany has attempted to align the standard of eligibility for computer programs with the higher standard of creativity previously applied to industrial designs (applied art) and engineering diagrams. See, e.g., Reichman, *After the Copyright Act*, *supra* note 61, at 333-40 ("Partial Cumulation in the German Manner"). This alignment goes too far. In contrast, the *Batlin* standard of substantial creativity, recommended in the text, remains a soft and workable standard that avoids the rigidity of the *Inkasso* standard in the Federal Republic.

264. The first decision on microcode, arising in the Ninth Circuit, has insisted on applying the lowest possible standards of originality and creativity, devised for works of art, to the least creative and most standardized form of computer program. See *NEC Corp. v. INTEL Corp.*, No. C-84-20799-WPG, slip op. at 4-5 (N.D. Cal. Feb. 5, 1989).

265. See *infra* note 270.

266. See *supra* note 250 and accompanying text.

267. See, e.g., Marks, *supra* note 176, at 3, in Blacksbury Conference, *supra* note 24 (emphasizing the need for permissions).

268. See *id.*

269. See Conference Report, *supra* note 242, at 8-10 ("Guidelines for Program Development").

270. Karjala, *supra* note 105, at 39; see also, Nimmer & Krauthaus, *supra* note 224, at 30, 61;

one another; indeed, they must do so to remain scientifically valid.²⁷¹

a. *Aberrations of the "Unity of Literature" Approach*

When a second researcher analyzes previously copyrighted software, the knowledge he gains enables the aggrieved owner of copyright to establish that the second comer had "access" to the program—that is, a legal opportunity to copy it.²⁷² Proof of access can lead to heightened judicial scrutiny of program similarities and, at least in courts that apply the strong-arm tactics some commentators recommend,²⁷³ to a presumption of copying even when mostly unprotectable similarities are detected.²⁷⁴ In short, if expert witnesses detect similarities in a second program, its academic originators may have difficulty proving independent creation despite the paper trail that they are likely to leave behind.²⁷⁵

If the second programmer or his university invokes the fair use defense, this doctrine should, of course, provide a refuge so long as a dispute over proprietary rights remains in a purely academic setting.

Note, *Copyright Infringement of Computer Programs: A Modification of the Substantial Similarity Test*, 68 MINN. L. REV. 1264, 1291 (1984).

271. See, e.g., Karjala, *supra* note 249, at 149 (observing that "advances necessarily include much that is taken from the existing base"); Samuelson, *supra* note 177 (stressing that the nature of technologies, which are built upon each other, requires technicians to look at prior work); see also Menell, *supra* note 171, at 1357 & n.163 (remarking on the extent to which university research has contributed to the development of operating systems programs during the period in which universities were relatively indifferent to the availability of legal protection; querying effects of new-found interest in commercialization of university research). See generally Stallman, *supra* note 175 (discussing the spirit of scientific cooperation and the disincentives of hoarding information).

272. Once ownership of a protected work is established, a successful action for infringement typically requires proof of access plus substantial similarity. Direct proof of infringement is seldom available. See, e.g., 3 M. NIMMER & D. NIMMER, *supra* note 42, § 13.01[B].

273. See Conley & Bryan, *A Unifying Theory for the Litigation of Computer Software Copyright Cases*, 63 N.C.L. REV. 563 (1985); Davidson, *supra* note 100, at 1080-604, 1115 (discussing black box model); see also Note, *supra* note 270, at 1294-1302 (iterative test). But see Goldstein, *supra* note 233, at 1124-26 (arguing that only thin protection is available for computer programs).

274. See, e.g., Whelan Assocs., Inc. v. Jaslow Dental Laboratories, Inc., 797 F.2d 1222 (3d Cir. 1986), *cert. denied*, 107 S. Ct. 877 (1987); SAS Inst., Inc. v. S & H Computer Sys., Inc., 605 F. Supp. 816 (M.D. Teun. 1985); E.F. Johnson Co. v. Uniden Corp., 623 F. Supp. 1485 (D. Minn. 1985); Williams v. Arndt, 626 F. Supp. 571 (D. Mass. 1985). But see Aliotti v. R. Dakin & Co., 831 F.2d 898 (9th Cir. 1987) (rejecting the theory that strong proof of access diminishes the level of substantial similarity required to establish infringement); Conference Report, *supra* note 242, at 8, 10 (stating that access does not show infringement until and unless some protected elements are demonstrably taken).

275. See, e.g., Karjala, *supra* note 249, at 149 (stating that substantial similarity between "current advance and some prior work is the rule and not the exception"); see also Goldstein, *supra* note 233, at 1126 n.29 (noting that infringement requires unlawful appropriation, not proof of copying alone; criticizing M. Kramer Mfg. Co. v. Andrews, 783 F.2d 421 (4th Cir. 1988) in this regard).

These disputes, however, are more likely to arise after a software project is exploited commercially, with or without the support of the originator's university, in which case the question of who copied what will surface in a business context. Conflicting claims over technical revisions, improvements, and adaptations are of primary concern here, because these efforts will result in the commercial payoff and determine who controls any software packages that are derived from the original project and geared to different market segments.²⁷⁶ At this point the bottom falls out of the fair use defense because the Supreme Court has fashioned a nearly conclusive presumption that unauthorized use of another's work for commercial gain is unfair by definition if the elements of infringement have been established.²⁷⁷

This leaves the idea-expression defense and a body of precedents affording functional works relatively "thin" protection in copyright law.²⁷⁸ These two notions traditionally worked hand in hand. The functionality of a work would induce the courts to narrow the quantum of actionable expression; to perceive infringement only in the presence of close imitation;²⁷⁹ and to override the exclusive rights of reproduction if they indirectly prevented third parties from using functional features embodied in or conveyed by otherwise copyrightable works of art and literature.²⁸⁰ No matter which of these solutions courts have adopted in

276. See, e.g., *Q-Co. Indus., Inc. v. Hoffman*, 625 F. Supp. 608 (S.D.N.Y. 1985); cases cited *supra* note 274; see also *Maier, supra* note 59, at 158; *Menell, supra* note 171, at 1336 (noting greatly increased demand for general purpose application packages); *Stallman, supra* note 175, at 4.

277. See, e.g., *Sony Corp. v. Universal City Studios, Inc.*, 464 U.S. 417 (1984); see also *Harper & Row, Publishers, Inc. v. Nation Enter.*, 471 U.S. 539 (1985). But see *Raskind, supra* note 235, at 1175-82 ("Toward a Proper Application of Fair Use to Software"); *infra* note 288.

278. See, e.g., *Baker v. Selden*, 101 U.S. 99 (1879); *Affiliated Hosp. Prods., Inc. v. Merdel Game Mfg. Co.*, 513 F.2d 1183, 1189 (2d Cir. 1975); *Continental Casualty Co. v. Beardsley*, 253 F.2d 702 (2d Cir.), *cert. denied*, 358 U.S. 816 (1958); *Chamberlin v. Uris Sales Corp.*, 150 F.2d 512 (2d Cir. 1945); *Kepner-Tregoe, Inc. v. Carabio*, 203 U.S.P.Q. (BNA) 124 (E.D. Mich. 1979) (thin copyrights); *Goldstein, supra* note 233, at 1121-22.

279. See *supra* note 278; *Goldstein, supra* note 233, at 1124 (discussing judicial tendencies to protect a narrow range of "equivalents" in such cases so that underlying function is not monopolized). The Conference Report states:

[T]he quantum of protectable expression . . . varies with the nature of the work. Courts have treated artistic works . . . as predominantly expressive . . . Works in which functional elements predominate, such as rulebooks, architectural plans, and business forms, generally exhibit only limited expressive elements and have correspondingly received less protection under copyright law.

Conference Report, *supra* note 242, at 3 (quoting tentative draft).

280. See, e.g., *Baker v. Selden*, 101 U.S. at 103. The Court stated:

The copyright of a book on perspective, no matter how many drawings and illustrations it may contain, gives no exclusive right to the modes of drawing described. . . . The fact that the art [is] described in the book by illustrations of lines and figures which are reproduced in practice in the application of the art, makes no difference. Those illustrations are the mere language employed by the author to convey his ideas more clearly. Had he used words of

particular cases, their reasoning uniformly has stressed the need to ensure that manufacturers of borderline utilitarian works could not employ the copyright law, with its low threshold of eligibility, to monopolize functional features that failed to meet the much stricter criteria for patent protection.²⁸¹

Notwithstanding this robust tradition derived from the Supreme Court's decision in *Baker v. Selden*,²⁸² the promoters of strong copyright protection for computer software²⁸³ have so far managed to convince influential courts that software deserves a better deal and that more aggressive standards of infringement should apply.²⁸⁴ These courts believe that copyright protection for the coded instructions alone is too weak; and that the concept of "copyrightable expression" may embrace even functional and standardized features of user interfaces²⁸⁵ or ele-

description instead of diagrams (which merely stand in the place of words), there could not be the slightest doubt that others, applying the art to practical use, might lawfully draw the lines and diagrams which were in the author's mind, and which he thus described by words in his book.

The copyright of a work on mathematical science cannot give to the author an exclusive right to the methods of operation which he propounds, or to the diagrams which he employs to explain them, so as to prevent an engineer from using them whenever occasion requires.

The very object of publishing a book on science or the useful arts is to communicate to the world the useful knowledge which it contains.

Id. (emphasis added); see also H. BALL, *THE LAW OF COPYRIGHT AND LITERARY PROPERTY* 126, 274-77, 281, 391-95 (1944)(citing cases); A. WEIL, *AMERICAN COPYRIGHT LAW* 191, 209, 411-12 (1917); *infra* note 288 and accompanying text.

281. See cases cited *supra* note 278. The Court in *Baker v. Selden* stated: "To give to the author of the book an exclusive property in the art described therein, when no examination of its novelty has ever been officially made, would be a surprise and a fraud upon the public. That is the province of letters-patent, not of copyright." *Baker v. Selden*, 101 U.S. at 102.

It should be stressed that the Supreme Court expressly exempted true literary and artistic works from the sweep of its opinion:

Of course, these observations are not intended to apply to ornamental designs, or pictorial illustrations addressed to the taste. Of these it may be said, that their form is their essence, and their object, the production of pleasure in their contemplation. This is their final end.

They are as much the product of genius and the result of composition, as are the lines of the poet or the historian's periods. On the other hand, the teachings of science and the rules and methods of useful art have their final end in application and use; and this application and use are what the public derive from the publication of a book which teaches them.

Id. at 103-04.

282. 101 U.S. 99 (1879).

283. See *supra* note 273; see also Clapes, Lynch, & Steinberg, *Silicon Epics and Binary Bards: Determining the Proper Scope of Copyright Protection for Computer Programs*, 34 *UCLA L. REV.* 1493 (1987); Davidson, *Protecting Software*, *supra* note 197; Hauptman, *A Perspective on "Look and Feel" and "SSO"*, Paper Presented to the LaST Frontier Conference on Software Protection, Center for the Study of Law, Science and Technology, Arizona State College of Law (February 13-14, 1989).

284. Despite disagreement among commentators and "a variety of analytical styles[,] the cases indicate a widespread and highly protectionist attitude toward intellectual creations involving computer software." Karjala, *supra* note 105, at 35; see cases cited *infra* note 286.

285. See, e.g., *Digital Communications Assocs., Inc. v. Softkone Distrib. Corp.*, 659 F. Supp.

ments of structure, sequence, and organization.²⁸⁶ These courts are also persuaded that the old idea-expression doctrine assimilates all posterior judicial limitations on the exclusive rights to reproduce utilitarian works.²⁸⁷ In reality, doctrines overriding the reproduction rights were functionally and historically distinct until a leading commentator's strained reading of *Baker v. Selden* began to narrow the issues from the 1950s on.²⁸⁸

449 (N.D. Ga. 1987); *Broderbund Software, Inc. v. Unison World, Inc.* 648 F. Supp. 1127 (N.D. Cal. 1986); Hauptman, *supra* note 283.

286. See, e.g., *Whelan Assocs., Inc. v. Jaslow Dental Laboratories, Inc.*, 797 F.2d 1222 (3d Cir. 1986), *cert. denied*, 107 S. Ct. 877 (1987); *Pearl Sys., Inc. v. Competition Elec., Inc.*, 8 U.S.P.Q.2d (BNA) 1520 (S.D. Fla. 1988); *SAS Inst., Inc. v. S & H Computer Sys., Inc.*, 605 F. Supp. 816 (M.D. Tenn. 1985); see also *Apple Computer, Inc. v. Franklin Computer Corp.*, 714 F.2d 1240, 1253 (3d Cir. 1983) (problem of functional compatibility), *cert. dismissed*, 464 U.S. 1033 (1987).

287. See *Whelan Assocs.*, 797 F.2d 1222; *supra* notes 285-86.

288. See 1 M. NIMMER & D. NIMMER, *supra* note 42, § 2.18[A], [B] (carrying forward an interpretation of *Baker v. Selden* that was launched in the earliest editions of Professor Nimmer's celebrated treatise). Following the Supreme Court's 1879 decision in *Baker v. Selden*, a few courts perverted its teaching about *infringement* into a de facto substantive prerequisite of *eligibility* that disqualified works "intended for use." See *id.* § 2.18[B][1]. But a "purpose test" or "end use test" of this kind confuses the concept of a *work* of authorship with its *material support* (see 17 U.S.C. § 202 (1982)) and is rejected by all developed copyright systems. See, e.g., F. PERRET, *supra* note 75, at 238-42. This end-use test of eligibility properly was rejected by the United States Supreme Court in *Mazer v. Stein*, 347 U.S. 949 (1954); and it was Professor Melville Nimmer's efforts to justify and explain this decision that led him to reinterpret the larger tradition derived from *Baker v. Selden*. See 1 M. NIMMER & D. NIMMER, *supra* note 42, §§ 2.18[C][2], 2.18[D].

Unfortunately, Professor Nimmer's efforts to dispatch *Baker v. Selden* as a false barrier to eligibility led him to introduce an even greater fallacy than the purpose test by assimilating the entire *Baker v. Selden* tradition at the infringement stage to the much earlier idea-expression dichotomy. See *id.* § 2.18[D] (stating that *Mazer's* emphasis on the idea-expression distinction constitutes "The Proper Limits of *Baker v. Selden*"). Based on this interpretation, *Baker v. Selden* would have been superfluous at the time it was handed down, because the idea-expression doctrine dates back to the earliest origins of both domestic and foreign copyright law, and it was readily available to the Court if that was the point it had wanted to make. See, e.g., E. DRONE, *A TREATISE ON THE LAW OF PROPERTY IN INTELLECTUAL PRODUCTIONS IN GREAT BRITAIN AND THE UNITED STATES* 93 (1879) (reprint ed. 1972) (restricting literary property to "the intellectual creation . . . embodied in . . . language" and recognizing "no property in thoughts, conceptions, ideas, sentiments . . . apart from their association"); F. PERRET, *supra* note 75, at 134-58 (reviewing idea-expression distinction in comparative copyright law).

In reality, the historical role of *Baker v. Selden* was to override the exclusive reproduction rights as applied to utilitarian works in a very particular set of circumstances. These were cases in which the standard defenses (including idea-expression) appeared insufficient to guarantee a third party's right to use functional features embodied in the work because that use seemed to entail an unauthorized reproduction of the protected work, including its actionable subject matter. The decision in *Baker v. Selden* authorized the reproduction in the event of such a conflict in order to facilitate use of the unprotectable utilitarian features as such. See *Baker v. Selden*, 101 U.S. at 103. The Court stated:

The fact that the art [is] described in the book by illustrations of lines and figures which are reproduced in the application of the art, makes no difference . . . Had he used words of description instead of diagrams . . . there could not be the slightest doubt that others, applying the art to practical use, might lawfully draw the lines and diagrams . . . which he [the

How this curious state of affairs came about and whether it will

author] thus described by words in his book . . . The copyright of a work on mathematical science cannot give . . . an exclusive right to the methods of operation . . . or to the diagrams he employs to explain them, so as to prevent an engineer from using them whenever occasion requires.

Id. (emphasis added); see *supra* note 280 (quoting the passage in full); see also H. BALL, *supra* note 280, at 124 (discussing idea-expression); *id.* at 125-26 (discussing cases in which the reproduction right was overridden to permit use of nonprotectable matter); *id.* at 274-82 (illustrating override of reproduction right as a special instance of fair use derived from *Baker v. Selden*); *id.* at 396-98 (noninfringement of technical drawings, citing *Baker v. Selden*, among others); A. WEIL, *supra* note 280, at 191, 411-12 (emphasizing the role of *Baker v. Selden* as a limitation on the reproduction right and not as a test of copyrightability).

To the extent that *Baker v. Selden* limited the reproduction right in this way, it subordinated copyright protection of functional works to the predominance of the patent paradigm. See *supra* note 281 (quoting *Baker v. Selden*, 101 U.S. at 103-04); see also 17 U.S.C. § 113(b) (1982) (codifying one branch of this same tradition). From the modern perspective, the role of *Baker v. Selden* was simply to prevent the reproduction right from operating as a *de facto droit de destination*, or right to control end use, in the borderline zone of utilitarian works. Such a right of end use is, perhaps, justifiable for artistic works. Compare, e.g., F. GOTZEN, HET BESTEMMINGSRECHT VAN DE AUTEUR (French summary 1975) (describing and supporting the right to control end use) and Desormont, *The Author's Right to Control the Destination of Copies Reproducing His Work*, 12 COLUM.-VLA J.L. & ARTS 481, 502-04 (1988) with I. M. NIMMER & D. NIMMER, *supra* note 42, § 2.18[A] (noting: "Thus, the mere fact that rights granted under the Copyright Act may indirectly result in a monopoly of use of the copyrighted work will not prevent the enforcement of such rights, notwithstanding the absence of an expressly granted 'right of use'"). See generally Annual Study Session of the Association Litteraire et Artistique Internationale (ALAI), *On "Issues Involving the Distribution of Exemplars of Protected Works."* Munich (Oct. 5-8, 1988) (proceedings forthcoming 1989) (dealing with the *droit de destination*). But such a right becomes pernicious when it enables the copyright owner to control the end use of functional features embodied in or conveyed by a utilitarian work.

The pristine application of *Baker v. Selden*, in other words, was as a species of "fair use" devised for utilitarian works and understood as such by Nimmer's immediate predecessors. See, e.g., H. BALL, *supra* note 280, at 274-78 (routinely citing *Baker v. Selden* in context of fair use of "Books on Science or the Useful Arts"); cf. Conference Report, *supra* note 242, at 9-10 (tentative draft) (suggesting enlarged role for fair use doctrine to permit reverse engineering of computer programs). In this sense *Baker v. Selden* expressed a general limiting principle, applicable to the reproduction rights in utilitarian works of both art and literature, from which the more specific rules pertaining to designs of useful articles were derived and codified in the bizarre language of 17 U.S.C. § 113(b) (1982). See Reichman, *Before the Copyright Act*, *supra* note 61, at 1201-08 (explaining the evolution of § 113(b) as codified in the 1976 Act).

That *Baker v. Selden* meant something different from the Nimmer interpretation was still clear to Professor Kaplan of Harvard in the mid-1960s. See B. KAPLAN, *supra* note 244, at 63-66 (stating that "the privilege extends to exact copies," criticizing the "regrettable backsliding" to idea-expression in *Continental Casualty*, and approving that "buildings . . . may . . . be copied down to the last square foot of glass-front" despite the existence of copyrighted blueprints); see also *id.* at 49, 57 (disapproving any notion of a right to control end use). It was partly the insistence of Kaplan (and of his ally at the time, Professor Arthur Miller) on the need to clarify the application of *Baker v. Selden* to computer programs that delayed further action on the General Revision Bills as they stood in 1967. See, e.g., *Copyright Law Revision: Hearings on S. 597 Before the Subcomm. on Patents, Trademarks, and Copyrights of the Senate Comm. on the Judiciary*, 90th Cong., 1st Sess. 579-81 (1967) [hereinafter *CLR Senate Hearings*], reprinted in 9 OMNIBUS COPYRIGHT REVISION LEGISLATIVE HISTORY [hereinafter *LEGISLATIVE HISTORY*] (statement by B. Kaplan, Co-chairman, Legal Task Force, Interuniversity Communications Council (EDUCOM)); *CLR Senate Hearings*, *supra*, at 570-78, reprinted in *LEGISLATIVE HISTORY*, *supra* (Statement by

last long are topics beyond the scope of this Article.²⁸⁹ Professor Karjala suggests that courts are worried that the software industry is the last

EDUCOM Board of Trustees and Legal Task Force, opposing protection for computer programs partly because third parties "must be given the accompanying privilege to replicate the program in order to carry out the process or practice the art" under *Baker v. Selden*; *id.* at 572-73, reprinted in LEGISLATIVE HISTORY, *supra* (Testimony and Statement of Arthur Miller, Co-chairman, EDUCOM Legal Task Force, opposing copyright protection of computer programs partly because it would extend "patentlike protection under the guise of copyright" to the functional process and because no provision prevents the copyright from "incorporat[ing] the art, process or scheme . . . fixed in the program"). For a critical view of Miller's later conversion to the maxiprotectionist camp, see Samuelson, *supra* note 126, at 506 n.182.

However, the clarification put forward by the Copyright Office and eventually enacted by Congress simply restated the subject-matter exclusions built around the idea-expression doctrine that now appear in 17 U.S.C. § 102(b) (1982). In other words, Congress codified only that much of *Baker v. Selden* as overlapped the idea-expression approach elaborated by Professor Nimmer. See 1 M. NIMMER & D. NIMMER, *supra* note 42, § 2.18[D] (stating that "[t]he present Copyright Act properly codifies this more limited reading of *Baker v. Selden*"). Congress also deliberately exempted works that "convey information" from the definition of useful articles in § 101 and from the limitations of § 113(b), in keeping with the Copyright Office's "unity of literature" approach to computer programs enunciated in the early 1960s. See Cary, *Copyright Registration and Computer Programs*, 11 BULL. COPYRIGHT SOC'Y 362 (1964) (Cary was Deputy Register of Copyrights); Copyright Office of the United States, *Copyright Registration for Computer Programs-Announcement from the Copyright Office*, reprinted in 11 BULL. COPYRIGHT SOC'Y 361 (1964); *supra* note 243.

Because Professor Nimmer was the only leading American academic to embrace the French "unity of art" thesis with regard to industrial art, see Reichman, *Before the Copyright Act*, *supra* note 61, at 1211 n.347, he could hardly object to a "unity of literature" approach to industrial literature. See *infra* notes 291-96 and accompanying text. On the contrary, Nimmer was consistent, even if the schizoid law that he helped to shape was not. Compare 17 U.S.C. § 101 (1982) (defining pictorial, graphic, and sculptural works to exclude industrial art on the basis of a separability criterion and dualist principles) and *id.* § 113(b) (expressly permitting use or reverse engineering of useful articles portrayed in two-dimensional form, notwithstanding the making of an unauthorized reproduction) with *id.* § 101 (defining literary works to include industrial literature without reservation or reference to separability from utilitarian functions) and *id.* § 101 (defining "useful articles" to exclude articles that "convey information") and *id.* § 113(b) (no express limitation on the reproduction right with regard to verbal or symbolic portraits of mechanical or utilitarian articles). For further discussion, see also *supra* note 242; and Wharton, *supra* note 224, at 454-55 (recognizing problem of computer programs as verbal "blueprints for machines" and the operation of machines).

That *Baker v. Selden* itself squarely rejected any distinction between the treatment of verbal blueprints and the limitations on graphic blueprints is a point that cannot be overemphasized:

Had he used words of description instead of diagrams (which merely stand in the place of words), there could not be the slightest doubt that others, applying the art to practical use, might lawfully draw the lines and diagrams . . .

Baker v. Selden, 101 U.S. at 103. Moreover, Professor Nimmer expressly conceded that Congress, in enacting § 102(b) without reference to *Baker v. Selden*, did not intend to exhaust or reject the larger tradition epitomized by this case. See 1 M. NIMMER & D. NIMMER, *supra* note 42, § 2.18[B] n.15 (stating that "[t]he full *Baker v. Selden* doctrine, discussed in this subsection, is neither accepted nor rejected by the Act . . ." and its "application is rather left to the courts"). What is sorely needed at the present juncture is for the courts to develop a clearer and more aggressive application of this larger tradition.

289. See generally Samuelson, *supra* note 59 (explaining and criticizing the CONTU REPORT, *supra* note 110); Samuelson, *supra* note 126 (suggesting that the Semiconductor Chip Protection Act of 1984 indicates the direction that software protection should take in the future).

bastion of American technological superiority and that the current protectionist zeal is motivated by an implicit view of appropriate international trade policy.²⁹⁰ If this view is correct, a close parallel exists between this situation and the aberrations that occurred toward the end of the nineteenth century, when France pressed the Berne Union countries to absorb industrial designs into their domestic copyright laws under the banner of a "unity of art" rationale.²⁹¹

The tenacious opposition of the United States eventually halted this movement and led to the reconfirmation of industrial designs as subject matter within the ambit of the Paris Convention for the Protection of Industrial Property.²⁹² Ironically, the decision of the French Government in 1985 to assimilate computer programs to the treatment of applied art under the Berne Convention²⁹³ could similarly impede the "unity of literature" doctrine launched by the United States Copyright Office in 1964.²⁹⁴ France's decision could also pave the way for *sui generis* protection of industrial literature in the medium or long term,²⁹⁵ as attested by the draft law on computer programs that Switzerland nearly adopted.²⁹⁶

b. Too Much Protection for Too Many Software Designs

Meanwhile, it seems undeniable that the structure, sequence, and organization of a computer program is precisely the kind of subject matter that patent law ought to have embraced in the 1970s, but failed

290. Karjala, *supra* note 105, at 35 (Professor Karjala thinks overprotection of this kind is counterproductive). For an express view of international trade policy, couched in these terms, that has exerted considerable influence, see J. Gorlin, A Trade-Based Approach for the International Copyright Protection for Computer Software (Sept. 1, 1985) (unpublished paper) (copy on file at the Vanderbilt Law School). At least one author predicts that the protectionist wave in copyright law will recede once patent law more fully exercises its new role in the field of software. Maier, *supra* note 59, at 161. But this scenario is doubtful if nonobviousness retains its traditional force. See *supra* notes 176-77 and accompanying text.

291. See Reichman, *Before the Copyright Act*, *supra* note 61, at 1153-58; *supra* notes 74-75 and accompanying text.

292. Reichman, *Before the Copyright Act*, *supra* note 61, at 1159 n.85, 1161 n.91, 1165.

293. See *supra* notes 121-22 and accompanying text (cases of France and Switzerland).

294. See, e.g., J. Gorlin, *supra* note 290, at 41 n.42 (observing that if a GATT Code on Intellectual Property "[h]ad been in effect, the United States could have used the GATT as a forum for consultations with France on the present draft bill granting 25 year copyright protection for software"). For the position of the Copyright Office in 1964, see *supra* note 288.

295. Much depends on whether computer programs are seen as *necessarily* falling within the Berne categories of literary or scientific works and whether the French attempt to draw a *parallel* between computer programs and the subcategory of applied art will stick. If it does, unauthorized copies of software made in France after 25 years might become freely exportable to other European Economic Community countries under cover of the Treaty of Rome. *But see* Kindermann, *supra* note 120, at 220 (suggesting that the French provisions may boomerang against domestic authors of computer programs).

296. See *supra* note 122 and accompanying text.

to do so;²⁹⁷ and that the drafters of Section 102(b) of the 1976 Act had precisely this kind of subject matter in mind when they denied protection to methods of operation, procedures, and processes.²⁹⁸ Nevertheless, because some courts (but not others) have acquiesced in protectionist deviations from traditional copyright principles,²⁹⁹ software producers in certain jurisdictions stand to obtain a relatively hard form of protection for a long period of time on the softest possible terms.³⁰⁰ As far as use of another's innovative research results is concerned, this protection can make the software copyright more broadly restrictive and intrusive than if the first comer had actually obtained a patent.³⁰¹

If a sui generis law were enacted, its drafters would have tried to

297. See *supra* note 173 and accompanying text. For an excellent analysis, see Ghidini, *I Programmi per computers fra brevetto e diritto d'autore*, 1984 GIURISPRUDENZA COMMERCIALE 251, 256-69. Professor Ghidini accurately foresaw most of the problems posed by the *Whelan* decision before it arrived on the scene.

298. See Goldstein, *supra* note 233, at 1125. "To use the jargon of the patent lawyers, section 102's statement of what copyright does not protect virtually 'reads on' section 101's statement of what computer programs are." *Id.* See generally *supra* note 288 (discussing testimony at Senate Hearings in 1967).

299. Compare *Whelan Assocs., Inc. v. Jaslow Dental Laboratories, Inc.* 797 F.2d 1222 (3d Cir. 1986) (protecting structure, sequence, and organization), *cert. denied*, 497 U.S. 1031 (1987) with *Plains Cotton Coop. v. Goodpasture Computer Serv., Inc.*, 807 F.2d 1256 (5th Cir. 1987) (declining to do likewise) and *Synercom Technology, Inc. v. University Computing Co.*, 426 F. Supp. 1003 (N.D. Tex. 1978) (holding structure not copyrightable). For other limiting principles, see: *Vault Corp. v. Quaid Software*, 847 F.2d 255 (5th Cir. 1988) (copying of plaintiff's program in memory for purposes of analyzing its manner of operation held privileged under the archival exemption of § 117(2); the court found no per se infringement of reproduction rights under § 106 merely because the program was put to unintended uses); *Q-Co. Indus., Inc. v. Hoffman*, 625 F. Supp. 608 (S.D.N.Y. 1985) (allowing use of idea despite some evidence of reproduction); and *E.F. Johnson Co. v. Uniden Corp.*, 623 F. Supp. 1485 (D. Minn. 1985) (conceding legitimacy of reverse engineering in principle, though iterative test of infringement applied).

300. See, e.g., Conference Report, *supra* note 242, at 6 (criticizing this result); see also Goldstein, *supra* note 233, at 1123, 1126. Goldstein stated that "in the copyright lexicon, 'idea' is no more than a metaphor for elements generally belonging in the public domain. The functions that *Whelan* was disposed to characterize as protectable expression are more accurately characterized as unprotectable ideas." *Id.*; see also Karjala, *supra* note 249, at 159-60 (discussing the protection of technological efficiencies in copyright law).

301. See, e.g., Karjala, *The First Case on Protection of Operating Systems and Reverse Engineering of Programs in Japan*, 10 EUR. INTEL. PROP. REV. (EIPR) 172, 174 (1988) [hereinafter Karjala, *First Case*] (stating that "[t]o protect operating system programs even where copying or near-copying is necessary to achieve compatibility . . . can result in a long-term monopoly for the first to achieve *de facto* standard status" (emphasis in original)); Karjala, *supra* note 249, at 149 (discussing the overprotective effects of the substantial similarity test). That copyright protection of computer programs could block the progress of the art was predicted by a high-level commission of experts reporting to the French government in 1983. See Working Group, National Institute of Industrial Property (INPI), *Toward the Protection of Computer Software: Present Situation and Proposals [Vers une protection des logiciels informatiques: Situation actuelle et propositions]*, Extracts of the Report of the Working Group Established under the Auspices of INPI (France) [hereinafter INPI REPORT], reprinted in 23 INDUS. PROP. 348, 353 (1984).

balance public and private interests in a deal that reflects the economics of software innovation rather than the standard economic assumptions underlying the patent and copyright models.³⁰² In the absence of such a law, university investigators and administrators, like their counterparts in the private sector, face a bewildering and contradictory mix of legal devices that tend innately to foster conditions of overprotection or underprotection.³⁰³ Arguably, the full patent approach confers too much protection on too few software designs;³⁰⁴ the traditional copyright approach gives too little protection to too many software designs,³⁰⁵ and the rough-and-tumble copyright approach of this brave new era affords far too much protection to far too many software designs.³⁰⁶

As a result, university personnel working with computer technologies find themselves in a quandary. When their own program is at stake, they and their universities will want strong protection in order to preserve their commercial advantages. When someone else's program is in question, they will want soft protection in order to borrow as freely as possible and to conduct research without legal interference.³⁰⁷ They will also demand the right to make improvements and even to commercialize the end product of these improvements,³⁰⁸ while claiming they have not violated the first comer's exclusive rights to make reproduc-

302. See, e.g., Samuelson, *supra* note 126, at 501-31. See generally Menell, *supra* note 171, at 1359-72; Menell, *supra* note 224 (discussing economics of software).

303. See, e.g., Hoffman & Karny, *Can Justice Keep Pace with Science?*, 10 EUR. INTELL. PROP. REV. (EIPR) 355-58 (1988). For a discussion of parallel cycles in the realm of industrial art and their deeper implications for world intellectual property law, see Reichman, *supra* note 5, part II.

304. See, e.g., Kidwell, *supra* note 173, at 544-49; *supra* note 176 and accompanying text.

305. See Conference Report, *supra* note 242, at 3-4; *supra* note 278 and accompanying text.

306. See, e.g., Conference Report, *supra* note 242, at 6 (criticizing broad protection of computer programs). *But see* Clapes, Lynch & Steinberg, *supra* note 283, at 1576-84 (declaring broad copyright protection to be appropriate and critical for the development of computer programs). For a contrasting viewpoint, see Latman, *Fifteen Years After Mazer v. Stein: A Brief Perspective*, 16 BULL. COPYRIGHT SOC'Y 278, 285-86 (1969) (claiming that the doctrine of separability, without a *sui generis* design law, gives too much protection to too few industrial designs).

307. *Cf.*, e.g., Landes & Posner, *Economic Analysis*, *supra* note 12, at 16. Landes and Posner noted the same point:

[t]o the extent that a later author is free to borrow material from an earlier one, the later author's cost of expression is reduced; and from an *ex ante* viewpoint, every author is both an earlier author from whom a later author might want to borrow material and the later author himself. In his former role, he desires maximum copyright protection for works he creates; in his latter role he prefers minimum protection for works created earlier by others. In principle, there is some level of copyright protection that balances these two competing interests optimally . . .

Id.

308. See, e.g., *SAS Inst., Inc. v. S & H Computer Sys., Inc.*, 605 F. Supp. 816 (M.D. Tenn. 1985); Stallman, *supra* note 175.

tions and to prepare derivative works.³⁰⁹

How these tensions will work out in specific cases remains to be seen, but the proliferation of docketed infringement actions suggests a growing propensity among commercial software producers to sue and be sued.³¹⁰ In the long run, the software industry itself may well demand a different, more tailor-made form of protection that is closer to the approach that France began to develop in 1985,³¹¹ especially if foreign technology begins to make bigger inroads on the world market and domestic firms find themselves hoisted on their own protectionist petards.³¹² Meanwhile, if the aggressive mentality fashionable in the

309. 17 U.S.C. §§ 106(1)-(2), 117 (1982). Another problem on the horizon is the use of "tool" programs that interact with data stored in other programs to produce a new work. *See, e.g.*, Marks, *supra* note 176, at 3, in Blacksburg Conference, *supra* note 24; *see also* Telerate Sys. Inc. v. Caro, 7 U.S.P.Q.2d (BNA) 1740 (S.D.N.Y. 1988).

310. *See, e.g.*, Lotus Dev. Corp. v. Mosaic Software, Inc., No. 87-0074-K (D. Mass. Jan. 12, 1987); Lotus Dev. Corp. v. Paperback Software Int'l, No. 87-0076-K (D. Mass. Jan. 12, 1987), *noted in* Goldberg, *Copyright Protection for Computer Software*, Paper Presented to the LaST Frontier Conference on Computer Software, Center for the Study of Law, Science and Technology, Arizona State University College of Law (February 13-14, 1989); Apple Computer Inc. v. Microsoft Corp. No. C-88-20149-RPA (N.D., Cal. Mar. 17, 1987); Ashton-Tate v. Fox Software, Inc., No. 88-6837-TJH (C.D. Cal. Nov. 18, 1988); *see also* Dvorak, *Sue You, Sue Me*, PC MAG., Apr. 28, 1987, at 65; Schwartz, *Software Industry Stalled by Suits*, NAT'L L.J., June 29, 1987, at 3; *Apple's Copyright Lawsuit Is Seen As Effort to Lock In Technical Lead*, Wall St. J., Mar. 11, 1988, § 2, at 21, col. 4.

311. *See supra* notes 121-22 and accompanying text; *see also* Conference Report, *supra* note 242, at 21, which notes that experts are divided regarding the optimal level of protection for computer programs. The Conference Report then states:

If, over time the current regime of intellectual property protection for software is found to be unsatisfactory, the possibility that some tailor-made statute might provide a better system of protection will have to be faced, perhaps in conjunction with . . . similar problems posed by other new technologies.

Id. at 21. *But see generally* Clapes, Lynch, & Steinberg, *supra* note 283; Gorlin, *supra* note 290; Kindermann, *supra* note 120 (all of whom endorse the broadest forms of copyright protection). For the record, Clapes, Lynch, Steinberg, and Kindermann are all senior patent attorneys in different branches of IBM, the world's leading supplier of business machines; Gorlin and Hauptman are consultants to the same corporation. For the different views of a senior patent attorney employed at that same corporation in 1969, see Galbi, *supra* note 65.

312. *See, e.g.*, COMMISSION OF THE EUROPEAN COMMUNITIES, GREEN PAPER ON COPYRIGHT AND THE CHALLENGE OF TECHNOLOGY—COPYRIGHT ISSUES REQUIRING IMMEDIATE ACTION, COM (88) 172/final, at 170, 175 (Brussels June 7, 1988) [hereinafter GREEN PAPER] (advocating suitable legal environment to enable "[c]ommunity industry to catch up with its competitors"). While the Commission blandly assumes copyright law to be the appropriate vehicle, it also blandly assumes: that reverse engineering is consistent with this modality, *id.* at 183; that protocols and user interfaces could be specifically excluded from protection, *id.* at 184; that copyright law should not interfere with the legitimate development of compatible systems, *id.* at 184; and that copyright protection, by requiring different implementations of basic structural solutions, will have no impact on standardization or efficiency, *id.* at 185. In short, the Commission's working vision of copyright protection for computer programs diverges so significantly from that promoted by maxiprotectionists in the United States that it goes a long way toward meeting the concerns of those favoring a sui generis approach! It also glosses over the deeper significance of the French decision to treat computer programs as a sort of neighboring right, on a parallel with works of applied art. *See supra*

private sector is transferred to the university environment, administrators relying on copyright law to commercialize computer software could expose themselves to the risk of considerable litigation, which could cause the pace of software research and development to slacken over time.³¹³

C. *Distribution Without Dissemination*

If Congress decided to protect intermediate technologies with a sui generis regime, it could provide universities with a marketable certificate of title to a discrete body of innovative know-how that would be no harder to police than existing forms of industrial property.³¹⁴ A university that qualified for such a title might then be in a position to license these technologies, including computer software, for commercial distribution without undue constraints on the freedom of faculty and students to publish or otherwise disclose their contributions. Instead, because Congress chose to protect computer programs in copyright law, universities face all the legal uncertainties described above plus the practical difficulties of enforcement that make trade secret law, and the practice of actual secrecy, a routine part of current software protection.³¹⁵

1. Dual Protection of Source Codes as Trade Secrets

Third parties seeking to compete with the vendor of an innovative and successful computer program labor under considerable disadvantages when denied access to the creator's original source code. The complete source code normally is composed in high-level (*i.e.*, human-readable) language. It explains why the originator devised the various sets of solutions in particular ways and why he or she combined them into an overall configuration that differs from other design solutions that may appear plausible to a second comer.³¹⁶

note 121 and accompanying text. However, a Directive on Computer Programs issued by the Commission reportedly takes a hard-line, full copyright approach.

313. At least one computer scientist believes that the pace of development has already slowed down as scientists "hoard information" in order to maximize profits from proprietary rights. See Stallman, *supra* note 175, at 2, 4-5.

314. See, e.g., Galbi, *supra* note 65; Samuelson, *supra* note 126, at 472-76, 519-31. See generally Kingston, *Innovation Patents and Warrants*, *supra* note 82, in PATENTS IN PERSPECTIVE, *supra* note 82, at 68, 79-80.

315. See, e.g., Bender, *supra* note 147, at 919-31, 939-54, 958; Samuelson, *supra* note 126, at 518-19.

316. See, e.g., G. DAVIS, SOFTWARE PROTECTION 15-19 (1985); H. HANNEMAN, THE PATENTABILITY OF COMPUTER SOFTWARE 23-25 (1985); Davidson, *supra* note 100, at 1080-1100.

a. *Nondisclosure as a Business Imperative*

A would-be competitor who is denied access to the originator's source code may nonetheless reconstruct a skeletal version of it by using special computer programs to decompile and reverse engineer the object code contained in any copy of the program that the competitor happens to obtain. The reconstructed source code, though imperfect and perhaps distorted, can reveal the structure, sequence, and organization of the original design. Lacking the explanations contained in the originator's source code, however, a second comer still has to master its internal logic on his own in order to equal its efficiency without duplicating its copyrightable components.³¹⁷

Acquiring this knowledge costs money and takes time. The ultimate technical success and consumer appeal of the competitor's substantially different design also remain to be demonstrated. To some extent, reverse engineering obliges a second comer to reinvent parts of a wheel that worked well in the past but that may not work equally well in their reinvented form.³¹⁸

To minimize these risks, competitors seeking to capitalize on a first comer's successful program are prone to shorten the originator's lead time by duplicating crucial segments of a complex program as revealed through decompilation. This strategy ensures rapid functional success at a relatively low cost, and it reduces the risk of ultimate technical failure. The cruder forms of appropriation by these means are the most likely to trigger liability for copyright infringement under the emerging judicial decisions.³¹⁹ Artful infringers can make it difficult and expensive for a plaintiff to demonstrate actionable copying to the satisfaction of a court or jury.³²⁰

317. See, e.g., Davidson, *supra* note 100, at 1094-1099; Karjala, *First Case*, *supra* note 301, at 174-77. The right to make such a version from a licensed copy, however, would often be restricted in the license agreement. Once made, the reconstructed source code lacks the deeper underlying concepts of the originator and the commentary to explain it. The second comer who has to spend a lot of time figuring out why the originator did what he did and then how to do it differently may find a license cheaper than reverse engineering. The legal significance of working from a reconstructed source code is not yet settled. See *infra* notes 324-26 and accompanying text.

318. See Davidson, *supra* note 100, at 1080-81, 1090-94 (noting that "[t]his black box approach does require the wheel to be continually reinvented . . . [as] the price to be paid for properly rewarding innovation").

319. See *id.* at 1095-97. "Thus, decompilation puts would-be copiers in a bind: if they decompile, their development will be faster, but they may have left 'smoking guns' in their code: if they do not decompile, they are cleansed from copyright infringement but they may have extreme difficulty in achieving compatibility." *Id.* at 1096; see also Clapes, Lynch & Steinberg, *supra* note 283, at 1506-10.

320. Clapes, Lynch & Steinberg, *supra* note 283, at 1575-78; see also *Whelan Assoc., Inc. v. Jaslow Dental Laboratories, Inc.*, 797 F.2d 1222 (3d Cir. 1986), *cert. denied*, 479 U.S. 1031 (1987); *E.F. Johnson Co. v. Uniden Corp.*, 623 F. Supp. 1485 (D. Minn. 1985).

Copyright infringement is not, however, a necessary consequence of reverse engineering merely because it serves to shorten the originator's lead time.³²¹ A third party with knowledge of the source code, for example, can freely use the ideas and other unprotectable matter it contains in order to enhance functional efficiency and to accelerate market entry.³²² While implementing such a scheme may require considerable effort (which reinforces the originator's own competitive advantages)³²³ careful avoidance of clearly protectable matter should, in principle, suffice to derail an originator's action for infringement.³²⁴ Even if some

321. See Conference Report, *supra* note 242, at 9-10 (treating reverse engineering as a form of fair use); *supra* note 288 (implications of pristine version of *Baker v. Selden*); see also *Bonito Boats, Inc. v. Thunder Craft Boats, Inc.*, 109 S. Ct. 971 (1989) (stressing the role that reverse engineering of unpatented technology plays in fulfilling the goals of the patent system).

322. See, e.g., *Plains Cotton Coop. v. Goodpasture Computer Servs., Inc.*, 807 F.2d 1256 (5th Cir. 1987); *Q-Co. Indus., Inc. v. Hoffman*, 625 F. Supp. 608 (S.D.N.Y. 1985); Conference Report, *supra* note 242, at 4-5. The end product may so improve upon the original that its incremental efficiencies will increase its marketability at the expense of the first comer's own product. In an environment of sane and healthy competition, this result would be regarded as optimal. See, e.g., Note, *supra* note 270, at 1291-94; see also Raskind, *supra* note 235, at 385-403 (discussing § 906(a) of the Semiconductor Chip Protection Act of 1984).

323. See, e.g., Davidson, *supra* note 100, at 1096-98.

324. Conference Report, *supra* note 242, at 4-5; see also Karjala, *First Case*, *supra* note 301, at 175-77 (noting that the inability to reverse engineer unprotected ideas and methods would be inconsistent with copyright law and the treatment of traditional technology); Laurie & Everett, *Protection of Trade Secrets in Object Form Software: The Case for Reverse Engineering*, 1 COMPUTER L. 4-8 (1984); sources cited *supra* note 322.

If the competitor obtains useful knowledge by reverse engineering the object-code version of a program otherwise legally obtained, but uses only noncopyrightable matter in the competing product, he nonetheless may have executed an unauthorized reproduction along the way. The extent to which a reproduction for analytical purposes that leads to little or no demonstrable use of protectable expression in the final product could trigger a finding of infringement remains controversial. Compare, e.g., Davidson, *supra* note 100, at 1093-99 (denying that such reverse engineering can be fair use or otherwise exempt from infringement) with Conference Report, *supra* note 242, at 9-10 and Karjala, *supra* note 105, at 78-88, 90-92 and Laurie & Everett, *supra* (expressing belief that reverse engineering of unprotectable matter is either not infringement under § 102(b) or is fair use under § 107 of the 1976 Copyright Act) and Note, *supra* note 270, at 1264.

The ability to make copies for reverse engineering purposes under the shelter of 17 U.S.C. § 117 (1982) was arguably strengthened by *Vault Corp. v. Quaid Software*, 847 F.2d 255 (5th Cir. 1988), which reinforces the notion that § 117 need not and should not conflict with § 102(b). For the view that the fair use doctrine codified at 17 U.S.C. § 107 further buttresses the case for reverse engineering, see Raskind, *supra* note 235, at 1175-82; and *supra* note 288. But see W. PATRY, *supra* note 235, at 399-402.

If the subject-matter exclusions of § 102(b) mean what they say and if *Baker v. Selden*, means what it meant before recent obfuscations, see *supra* note 288, then reverse engineering of the object code embodied in or near the mechanically functioning components should not constitute actionable infringement unless a significant quantum of protectable matter is carried over to the competing product. Otherwise, the reproduction right of §106 will enable some copyright owners to control indirectly the end use of the utility features embodied in utilitarian works, contrary to the pristine teaching of *Baker v. Selden*. See *supra* note 288 (elaborating on the historical role of *Baker v. Selden*); cf. 17 U.S.C. § 113(b) (statute derived from the larger principles of *Baker v. Selden*, which serves to legitimate copies of buildings and useful articles made from any three-

actionable matter is borrowed, a third party who takes the trouble to vary significantly the formal aspects of a program may have done all that is necessary to avoid the substantial similarity test of copyright infringement³²⁵ that traditionally is applied to utilitarian works.³²⁶

It follows that licensors seeking to maximize the commercial yield from innovative software are well advised not to disclose the underlying source code whenever possible.³²⁷ Because physical possession of the program enables a licensee to reconstruct a simplified version of the source code through reverse compilation, the licensor must surround his innovative know-how with a bevy of contractual provisions that will later enable him to depend on state trade-secret laws in addition to the federal copyright law.³²⁸ Whether appeals to dual protection will ultimately survive attacks based on federal preemption of state intellectual property law remains to be seen.³²⁹ For the moment, the law of trade secrets is reportedly relied upon to protect more software than either patent or copyright law acting alone.³³⁰

dimensional embodiments of them for purposes of reverse engineering; Reichman, *Before the Copyright Act*, *supra* note 61, at 1201-08 (discussing the evolution of the present version of § 113(b) in context of proposed design legislation).

325. See, e.g., *Plains Cotton Coop. v. Goodpasture Computer Serv., Inc.*, 807 F.2d 1256 (5th Cir. 1987); *Q-Co. Indus., Inc. v. Hoffman*, 625 F. Supp. 608 (S.D.N.Y. 1985). *But see* *Whelan Assoc., Inc. v. Jaslow Dental Laboratories, Inc.*, 797 F.2d 1222 (3d Cir. 1986).

326. See cases cited *supra* note 278 (addressing "thin" copyright doctrine); see also Conference Report, *supra* note 242, at 3-4; Goldstein, *supra* note 233, at 1123-24 (supporting narrow range of equivalents lest function be monopolized); Karjala, *supra* note 105, at 94-96.

327. See, e.g., Karjala, *First Case*, *supra* note 301, at 176 (arguing that the prevention of source code distribution helps to maintain monopoly over both copyrightable and noncopyrightable components of computer program).

328. See Laurie & Keefauver, *supra* note 246, reprinted in LaST Frontier Conference, *supra* note 246, at 234-35 (arguing for the validity of such provisions). See generally 1 D. BENDER, *supra* note 120, § 4A.01 to § 4A.03 (Chapter 4A entitled "Tradeseecret, Contractual and Extralegal Protection of Software"); Bender, *supra* note 147, at 958.

329. Compare, e.g., Bender, *supra* note 147, at 934-39, 953-58 (asserting that trade secret rights in copyrighted matter are not against copyright policy, will not invalidate the copyright, and are not generally preempted under 17 U.S.C. § 301 (1982), even though computer programs would be a logical candidate for preemption if other prerequisites were met) with Samuelson, *supra* note 126, at 518-19 (labeling dual protection in copyright and trade secret law as "highly questionable").

330. 1 D. BENDER, *supra* note 120, ¶ 4A.01, at 4A-2.1 to 4A-3. For illustrative cases in which trade secret law played a crucial role, see *Telerate System, Inc. v. Caro*, 8 U.S.P.Q.2d (BNA) 1740 (S.D.N.Y. 1988) (plaintiff showed likelihood of proving that its "protocol" governing communications between its computer and remote terminals was trade secret that defendants had misappropriated); and *Q-Co. Industries*, 625 F. Supp. 608 (while use of plaintiff's ideas did not constitute copyright infringement, means of obtaining them amounted to misappropriation under liberal reading of state trade secret law). *But see* *Plains Cotton*, 807 F.2d 1256 (use of ideas was neither copyright infringement nor misappropriation under strict reading of state trade secret law.)

b. *Ethics of Nondisclosure in the Business of Blab*

Even a minimalist university that seriously wants to protect software must resort to trade secret laws (and actual secrecy) to preserve the confidentiality of its source code, or it may soon have little left to exploit. It must also defend its trade secret with a battery of contractual restrictions on the use and disclosure of the materials made available to outsiders.³³¹ It will then have to combine these provisions with any copyright or patent protection that it can obtain;³³² and it should not overlook the possibility of reinforcing its bundle of rights with trademark protection as well.³³³

Suddenly, faculty and administrators caught in this situation will find themselves dealing with a host of new technical problems that are unfamiliar and operationally burdensome. They are also certain to face conflicts with their academic mission³³⁴ and other possible conflicts of interest³³⁵ that minimalist universities have always vowed to avoid. For example, as occurred in the California Institute of Technology dispute mentioned above,³³⁶ a university that claims ownership of the copyright in computer software can try to suppress publication of the program even when the instructor who created it opts for free and unfettered dissemination. Whether or not a portent of the future, this incident illustrates the tensions liable to arise when universities invoke trade secret law to buttress any proprietary interests that they may acquire in a faculty member's copyrightable know-how.

At bottom, a university's mission is to teach and disseminate knowledge, while trade secret law requires a regime of absolute secrecy. Under such a regime, neither the professor nor his graduate students

331. See, e.g., Marks, *supra* note 176, at 5, in Blacksburg Conference, *supra* note 24. For a comparable view, see Eisenberg, *supra* note 11, at 216, which discusses the need for secrecy in biotechnology.

332. See, e.g., Bender, *supra* note 147, at 939-58 (discussing dual protection).

333. A university that owns patentable software may require ancillary measures of this kind to buttress the effectiveness of its patent, while the nonpatentable elements of the program could depend entirely on such measures. See, e.g., Maier, *supra* note 59, at 161 (describing the mesh of copyright and patent protection that will provide a "unique continuum of intellectual property protection in the software environment"); see also Marks, *supra* note 176, at 5, in Blacksburg Conference, *supra* note 24. But see Samuelson, *supra* note 126, at 517-19 (arguing that the overlap between patent law, copyright law, and trade secret law in software is undesirable from a policy perspective).

334. See, e.g., Stallman, *supra* note 175.

335. See, e.g., Marks, *supra* note 176, at 5, in Blacksburg Conference, *supra* note 24.

336. See, e.g., Dreyfuss, *supra* note 41, at 601; *supra* note 197 and accompanying text. When the creator of the program took steps to disseminate it to other physicists, the university reportedly invoked a posterior claim of copyright ownership to prevent the distribution of copies that threatened its financial interest. In the end, the instructor left the university and the program was never perfected. See Dreyfuss, *supra* note 41, at 616 (citing Kolata, *Caltech Torn by Dispute over Software*, 220 SCIENCE 932, 933-34 (1983)).

can publish,³³⁷ and the former may even refrain from teaching the latter the latest developments in the field. Unless faculty members take these steps, the law will not defend their secrets from misappropriation by commercially immoral means that serve to facilitate or avoid the task of reverse engineering.³³⁸ On the contrary, trade secret law protects only secrets that are kept from the public by all reasonable means at the proprietor's disposal.³³⁹ Once these secrets are out, there is no further need to reward innovators with unlimited exemptions from the normal workings of the competitive marketplace.³⁴⁰

In effect, a regime of actual or legal secrecy imposed upon the academician in order to promote his and the university's proprietary rights in computer software is tantamount to what happens when the national security organs arrive on campus and inform the scientific community that they can no longer reveal the nature of the important work they are carrying out.³⁴¹ Academics can live with this sort of regime, but not very well.³⁴² Their reputations wax with publications and wane without them,³⁴³ while the attainment of commercial success from marketing computer programs is never surefire.³⁴⁴ Meanwhile, if the legal regime requires professors to refrain from teaching and discussing the program with graduate students not privy to a secrecy agreement,³⁴⁵ these students may not want to study in that department anymore.

Nor can faculty members in this position console themselves with the thought that their proprietary rights will at least help to organize the development of computer science in the most efficient manner,³⁴⁶ as

337. UNIF. TRADE SECRETS ACT, § 1 comment, 14 U.L.A. 537, 543 (1979).

338. Trade secret law does not protect against reverse engineering. *See id.* § 1, 14 U.L.A. at 542; *see also* *Kewanee Oil Co. v. Bicron Corp.*, 416 U.S. 470, 476 (1974).

339. UNIF. TRADE SECRETS ACT § 1(4)(ii), 14 U.L.A. at 542 (1979) (now adopted in 20 states); *Revcor, Inc. v. Fame, Inc.*, 85 Ill. App. 2d 350, 355, 228 N.E.2d 742, 745 (1967); *see supra* note 93.

340. *Aronson v. Quick Point Pencil Co.*, 440 U.S. 257 (1979); *Lear, Inc. v. Adkins*, 395 U.S. 653 (1969); *see also* *Bonito Boats, Inc. v. Thunder Craft Boats, Inc.*, 109 S. Ct. 971 (1989).

341. In the past, the pattern had been for the government to set up a separate shop just outside the campus for delicate research. *Muller, supra* note 41, at 146-47.

342. *See generally* D. NELKIN, *supra* note 1, at 1-23, 71-90.

343. *See* Merton, *supra* note 14, in *THE SOCIOLOGY OF SCIENCE*, *supra* note 14, at 293, 336-37.

344. *See* Marks, *supra* note 176, at 5, in *Blacksburg Conference*, *supra* note 24. Marks stated:

In a software distribution system that places minimal emphasis on enforcing copyright restrictions, participating faculty cannot routinely expect to reap great economic rewards. Consequently, college and university policies are likely to emphasize scholarly credit for participating in development of computer software, and consideration of work in software development will inevitably become routine in tenure evaluations and other assessments of scholarly achievement.

Id.

345. *See id.* "Arrangements with the principal investigator's colleagues and graduate students require special care." *Id.*

346. D. Bok, *supra* note 21, at 150 (noting that "[s]ecrecy, of course, is anathema to scientific

arguably occurs with the patenting of more traditional research results.³⁴⁷ Thus far, software has developed rapidly in a free-exchange environment; the optimum level of incentive remains undetermined,³⁴⁸ and the current mix of patent, copyright, and trade secret laws may actually harm, rather than advance, the cause of innovation both here and abroad.³⁴⁹

Whatever the optimum level of protection turns out to be, reliance on trade secret law arguably retards scientific progress by inhibiting disclosure of the art or a releasing of it to the public domain.³⁵⁰ It also conditions this progress on the practice of reverse engineering that characterizes industrial competition³⁵¹—hardly a reassuring prospect in the university environment. Add to this the chilling effect on software innovation that may result from the current penchant for copyright litigation³⁵² and from the failure of such litigation to yield doctrinal solutions solid enough to ward off future litigation, and there is a lot to trouble the conscientious university with a minimalist bent.

2. Licensing, Servicing, and the Spin-Off Corporations

Should administrators at the minimalist university nonetheless decide that the game of software protection is worth the candle—a point of view that makes a lot of sense—they must prepare to cope with other problems that are certain to complicate their lives. To begin with, they must locate potential buyers for commercially unproven software designs, a task for which regular university personnel are singularly ill

progress”).

347. See *supra* notes 12, 13-17 and accompanying text.

348. Conference Report, *supra* note 242, at 19-20.

349. See, e.g., Karjala, *supra* note 249, at 149 (stating that application of copyright protection to computer programs “may well stifle rather than stimulate further advances”); Menell, *supra* note 224 (forthcoming article will present more economic evidence to show risk of counterproductive overprotection in copyright law). See generally Stallman, *supra* note 175. Nor is it certain that any short-term trade advantages accruing to an exporting country that overprotects in copyright law will not boomerang in the medium or long term when that country’s domestic industry must compete with advanced foreign technology invoking the same measure of overprotection in the name of national treatment. See, e.g., Reichman, *Intellectual Property in International Trade: Opportunities and Risks of the GATT Connection*, Paper delivered at the Vanderbilt Symposium on Trade-Related Aspects of Intellectual Property, Vanderbilt Law School, Nashville, Tennessee, March 23-24, 1989, 22 VAND. J. TRANSN’L. L. (forthcoming 1989) [hereinafter Reichman, GATT Connection].

350. See, e.g., Karjala, *First Case*, *supra* note 301, at 176 (stating that “[c]omputer programs are the technology for using computers, and limitations on source code distribution can seriously impede the flow of technological knowledge concerning their development and use”).

351. See, e.g., Dreyfuss, *Dethroning Lear: Licensee Estoppel and the Incentive to Innovate*, 72 VA. L. REV. 677, 736-39 (1986).

352. See *supra* note 310 and accompanying text.

equipped.³⁵³ In this endeavor, universities need to help each other by networking and trading information about software users, distributors, and investors. They might also devise a data bank for member universities that have technology to market, which could operate like the Online Computer Library Center (OCLC) does for library collections.³⁵⁴ Even under the best of circumstances, marketing sophisticated technology requires a professional staff in the development office, skilled attorneys in the legal counsel's office, highly specialized outside attorneys, plus considerable time, effort, and expense.³⁵⁵ Marketing also demands the close cooperation of program originators who must explain and demonstrate their products in coordination with other university officers while still keeping a regular academic schedule.

Once a buyer is found, one can sometimes license software on a nonexclusive basis while retaining all other rights to the innovation. Universities prefer this route because it encourages diffusion of research results.³⁵⁶ One drawback, however, is that this approach multiplies the possibilities of exposing any trade secrets that the program may harbor. It also weakens copyright protection by multiplying opportunities for authorized access to the program, which could support competitors' later claims of independent creation, and by devaluing the ideas embodied in the program, which copyright law cannot protect. Nonexclusive licenses are perhaps suitable for experimental applications by trustworthy users, but their consistency with strong protection for a commercially valuable program in the university context remains undemonstrated.³⁵⁷

An exclusive license with the originator retaining all rights to the source code reduces insecurity, but it often presupposes the establishment of a close relationship between the university and the firm chosen to exploit the innovation.³⁵⁸ Computer programs are inherently unstable and always in need of further adaptation.³⁵⁹ The private corporation

353. See, e.g., Cawood, *supra* note 24, in Blacksburg Conference, *supra* note 24.

354. Such an effort called I-TEC, is being attempted in Illinois. See Giannisis, Willis & Maher, *supra* note 161, in Blacksburg Conference, *supra* note 24.

355. See Gihson & Smilor, *supra* note 164, in Blacksburg Conference, *supra* note 24.

356. See *Pajaro Dunes Statement*, *supra* note 13, at 536.

357. Exclusivity will restrict the grantor's own rights, especially the right to compete. See, e.g., Hansen, *Software Distribution, Remarketing and Publishing Agreements*, 4 *COMPUTER L.J.* 625, 635-36, 647 (1984).

358. See, e.g., Marks, *supra* note 176, at 5, in Blacksburg Conference, *supra* note 24. An institutional role in marketing may also be necessary to ensure that the university and faculty members have opportunities to exploit and control follow-up projects derived from or related to the original project.

359. See, e.g., Stallman, *supra* note 175, at 4-5; see also Samuelson, *Modifying Copyrighted Software: Adjusting Copyright Doctrine to Accommodate a Technology*, 28 *JURIMETRICS J.* 179, 206-08 (1988).

needs the computer scientist to adapt, explain, and debug, even if it manages to obtain direct access to the source code.³⁶⁰ Thus, when a university retains the source code in order to enhance protection, it may need to provide consultation and technical servicing (often on an emergency basis) to the company that further develops and exploits the original software innovation. Faculty and selected students may then need to enter an ongoing business relationship with the purchasing firm. Unless the university demonstrates a willingness to provide the kind of servicing that a potential investor needs, the university department may lose the professor who created the software and some of his students to boot, because they are now sorely needed by the exploiting company.³⁶¹

There are different ways to cope with this problem. The university can enter into a joint venture. It can purchase equity in the licensee or in a new corporation in which the licensee is the primary participant.³⁶² It can also set up its own spin-off company to manage the source code and service the licensee.³⁶³ In general, the bigger the software innovation, the more desirable it is for the university to possess some kind of equity or participatory interest in the exploiting company that will reinforce bare proprietary rights under intellectual property law as well as any contractual rights that define the university's overall objectives.³⁶⁴

Participation in a spin-off company further ensures that the university will continue to receive royalties from any programs that are substantially derived from its initial project over time.³⁶⁵ The right to these royalties is important because software development resembles

360. See, e.g., Hansen, *supra* note 357, at 635, 636-39.

361. See, e.g., Marks, *supra* note 176, at 5-6, in Blacksburg Conference, *supra* note 24. Stanford's software distribution policy is a noble effort to balance all needs and demands. Stanford sets up three tiers of distribution intensity. At the first tier, software is provided on a cost-recovery basis under a nonexclusive license to academics and government agencies. At the second tier, a nonexclusive license is granted for internal use by industrial firms for an annual royalty, but no maintenance services are offered. Only at the third tier can a purchaser obtain maintenance services. At that stage, Stanford grants a license to a private firm that develops and markets the software to end users. This system allows an end user of a commercially valuable program to keep the software in peak condition, while allowing Stanford to keep its faculty at work on traditional tasks. STANFORD UNIVERSITY, SOFTWARE DISTRIBUTION (1987). See generally Hansen, *supra* note 357.

362. See Wilson & Szygenda, *supra* note 159, in Blacksburg Conference, *supra* note 24.

363. See Gregory & Sheahan, *supra* note 158, in Blacksburg Conference, *supra* note 24.

364. *Id.* "A spin-off company is defined as a company producing a product or service which originated from research at a university . . . Spin-off firms form only a tiny fraction of the approximately 600,000 new companies being formed annually in the U.S. However, with many . . . states . . . expecting universities to be a greater force in economic development . . ., spin-off companies can be catalyst[s] for regional economic development." Preliminary Announcement, Second Conference on the University Spin-off Corporation, to be held at the Virginia Polytechnic Institute and State University, Blacksburg, Virginia (May 16-17, 1989).

365. See, e.g., Marks, *supra* note 176, at 5-6, in Blacksburg Conference, *supra* note 24.

certain daughter sciences that produce an array of commercially valuable applications from an initial breakthrough.³⁶⁶ In addition, the external corporation may be subdivided into a bewildering array of nontransparent compartments, each keeping secrets from the other; this makes it hard for the faculty creator or the university administrator to keep tabs on the source code once an exclusive license is signed. Equity participation, though not a panacea, provides the university with greater control over all income-generating opportunities.³⁶⁷

None of these problems is insoluble, nor are they necessarily more daunting than other legal problems that universities must routinely face. The point is that, in resolving the peculiar problems that attend the protection and exploitation of computer software, the university as a whole and the originating department in particular are likely to become enmeshed in the affairs of the private firms that assume the task of commercial exploitation. The needs of the corporation may then begin to influence future work undertaken in the department by faculty

366. See, e.g., Evenson, *supra* note 56, at 333-34; *infra* note 378. Of course, licensing contracts should provide for future participation, while the Copyright Act of 1976 will vest the "author" with the exclusive right to prepare derivative works. See 17 U.S.C. §§ 106(2), 201(a) (1982). Retention of the complete source code will also make the exploiting company more dependent on the originator for a period of time. But this dependence will not last indefinitely, and the more expertise the licensee acquires through various means, both legal and illegal, the more eager he will become to move off on his own without the encumbrances imposed by the licensor. The licensee is aided in this effort by the policies of trade secret law, which encourage reverse engineering, and by the limits of copyright law, which certainly permit reverse engineering by laborious or "clean room" techniques and arguably by the less laborious forms of reverse compilation discussed in the text. See *supra* notes 317-26 and accompanying text. Copyright law also encourages courts to recognize the point at which the second comer's work ceases to be a derivation and becomes a new work in its own right. See, e.g., 1 M. NIMMER & D. NIMMER, *supra* note 42, at § 3.01; see also Conference Report, *supra* note 242, at 8-10.

367. By keeping the source code, by providing technical services, and by obtaining an ownership interest in the exploiting company, the university will, however, expand its potential liabilities even as it solidifies its legal protection. Commercial software applications of any complexity are apparently never fully delivered as warranted, never fully operational, and never free of bugs and defects. See generally Rodau, *Computer Software Contracts: A Review of the Caselaw*, 2 SOFTWARE L.J. 77 (1987); see also Hansen, *supra* note 357, at 636-39. Concomitantly, the commercial lore that regulates these matters, perhaps infected by the same virus, grows increasingly complex without ever clearly establishing what constitutes defective delivery of a computer program, when a breach of warranty will lie, and what measure of damages is appropriate. Universities and academics, as software providers, will inevitably make and break similar promises and warranties concerning their own technical contributions; they must accordingly limit their liability to the extent the law permits and adequately insure against losses that cannot be avoided.

Universities must also be on guard lest their own academics borrow too freely from their predecessors, as academics are wont to do. Otherwise, even the university that has negotiated a suitable indemnification clause may find itself liable for copyright infringement and the misappropriation of trade secrets. See, e.g., S & H Computer Sys. v. SAS Inst., Inc., 568 F. Supp. 416 (M.D. Teun. 1983); Marks, *supra* note 176, at 4-5, in Blackburg Conference, *supra* note 24 (noting that academics' impatience with literary property rights in software makes it necessary for the university to monitor and enforce legal restrictions on use).

members who now wear two hats.³⁶⁸

IV. TECHNOLIS AND THE IMPENDING CONSECRATION OF MAXIMALIST LOGIC

A. *Temptations of the Minimalist Holdouts*

Recall that the minimalist university set out to preserve the integrity of its academic role and, in keeping with the spirit of Pajaro Dunes, preferred to rely on patenting for the bulk of its research applications.³⁶⁹ Suddenly, current concern for the protection of computer software (*i.e.*, for an elusive bundle of rights in tangible manifestations of applied scientific know-how) threatens to take the university very far down the road toward direct involvement in commercialized research. All aspects of this undertaking—selling the idea, finding venture capital, negotiating the license or other legal arrangements, servicing applications and refinements of the original idea, controlling what the university delivers in relation to what it has promised and warranted—constitute a big job for any committee of academics who meet once a month to evaluate the elegance of their colleague's work.³⁷⁰ The efforts a university must make to produce and exploit winning software, in other words, require an organization and a structure capable of systematically protecting and exploiting this particular form of know-how in a professional manner and with a commitment to achieving commercial success.³⁷¹

1. Indirect Benefits of Gearing Up

Similar demands make it burdensome for universities to exploit other valuable intermediate technologies in addition to software. To make the most of the opportunities available to them, university administrators must reach deep into the laboratories to identify and pro-

368. See N. WADE, *supra* note 20, at 60-62.

369. See *Pajaro Dunes Statement*, *supra* note 13; *supra* notes 35-38 and accompanying text.

370. See, *e.g.*, Cawood, *supra* note 24, in Blacksburg Conference, *supra* note 24. The peculiar nature of software (and of kindred intermediate technologies) impinges on the magnitude of the university's involvement in still other ways that are worth noting. For example, predicting the commercial success of any given software venture is even harder than deciding which patented inventions of a more traditional character are the most likely to succeed. As with industrial designs, in other words, there is a capricious element in the public's acceptance of particular software packages that no demonstration of superior functional capabilities can entirely eliminate. Producers able to launch a stream of innovations onto a given market segment thus seem more likely to succeed in the end than those who confine their promotional efforts to a few programs thought to be the most promising at any given point in time. Cf. Reichman, *Before the Copyright Act*, *supra* note 61, at 1235-36 (discussing the case of industrial designs).

371. See, *e.g.*, Beier, *Government Promotion*, *supra* note 12, at 561-62 (stressing the reasons universities generally need "an active and well organized patent and licensing policy").

tect promising innovations from the start. They must reach deep into the business world to ensure that some of the targeted projects actually realize their commercial potential. And they must maintain a sizable infrastructure to coordinate relations between the laboratory and industry over a fairly long period of time.³⁷²

Outside the universities, of course, the commercial exploitation of know-how is hardly a new phenomenon. Some component of know-how inheres in the development of most patented technology, and industries often license the patent in order to acquire the know-how.³⁷³ At other times, the patent functions as the centerpiece of a larger technology transfer that integrates patent rights with contractual rights to the pertinent know-how.³⁷⁴ What distinguishes the present situation is that proprietary rights are increasingly asserted in valuable applications of scientific know-how that are developed in a university environment and that do not benefit sufficiently from the practices and procedures organized around the patent system.³⁷⁵

Once minimalist universities gear up to deal with the additional burdens of protecting and exploiting know-how, whether embodied in computer software, industrial designs, or products of genetic engineering, they are apt to perceive the many traditional innovations that they failed to exploit in the past because of insufficient nurturing. That patentable inventions do not develop themselves commercially may come as a surprise to administrators who have preferred to follow a hands-off policy.³⁷⁶ They now discover that such inventions do not walk out of the laboratory and into the university review committee or out of the committee and into refinements, prototypes, and models; that the pertinent business plans do not write themselves; and that venture capital is not always parked outside the door. In other words, by waiting for patentable projects to come along and then attempting to license a select few, the minimalist university has probably ignored what the true patenting potential of its own laboratories could have been had it taken greater pains to close the gap between the laboratory and private industry.³⁷⁷ Now these same universities are increasingly tempted to close this gap in the fields of software, biogenetic engineering, and certain other intermediate technologies.

372. See generally *id.* at 561-64.

373. See, e.g., Kingston, *Innovation Patents and Warrants*, *supra* note 82, in PATENTS IN PERSPECTIVE, *supra* note 82, at 79-80.

374. *Id.*; see *supra* notes 85-94 and accompanying text.

375. See *supra* notes 94-114, 148-53, 162-63, 175-77 and accompanying text.

376. See Beier, *Government Promotion*, *supra* note 12, at 562 (declaring that "this approach has not been successful in practice").

377. See *supra* notes 32-38 and accompanying text.

What universities must do in order to profit from computer software, in other words, is what universities would do to profit from all legally protectable subject matter at their disposal if they were inclined to accept the maximalist view of the university's role in this regard and became truly determined to commercialize their research output.³⁷⁸ In contrast, a maximalist university that had aggressively geared up to exploit its patentable subject matter will already have invested in the kind of infrastructure that should enable it to take the exploitation of software in its stride.³⁷⁹ By the same token, a minimalist university that now gears up to deal with software on a more than passing basis gains the option of adapting any organization it sets in place to a more energetic pursuit of both traditional patents and modern forms of commercially exploitable know-how. While the point of departure for this Article was that a minimalist university was not very interested in availing itself of such opportunities,³⁸⁰ one may well begin to question whether any major university still retains much choice in this matter.

2. The Hidden Costs of High-Mindedness

Suppose, for example, that a high-minded university decides to ignore the potential profits in its laboratories. Sooner or later, an innovation that got away will make millions for somebody else, perhaps through commercial ventures with that university's own faculty members. Meanwhile, the university will have its begging bowl out—pleading for funds and donations, raising tuition, and seeking to enlarge its endowment. In the end, it may have to beseech the government and the foundations for the privilege of doing research of importance to the government and the foundations, which is hardly an improvement in terms of freely determining the university's own research agenda.³⁸¹ Moreover, all those who are importuned for contributions will not cease to remind the purist university that it could have helped itself if it had only taken sensible steps to land the big one that

378. The external commercial process must enter the laboratory early in order to shape the flow of know-how and research toward patentable applications, or increasingly, toward a whole series of applications. *See, e.g.,* Beier, *Government Promotion*, *supra* note 12, at 562. Indeed, the big money today often resides in so-called daughter sciences, which require a lot of nurturing from the earliest stage in order to reap proportionally large rewards. *See, e.g.,* Evenson, *supra* note 56, at 334 (discussing daughter sciences). Once the innovation begins to acquire a potentially patentable physiognomy, the professor needs both early and capable legal advice to know when to stop talking and start filing.

379. *See generally* MIT COPYRIGHT POLICY, *supra* note 220. MIT appears to fit this description.

380. *See supra* notes 36-38 and accompanying text.

381. *See, e.g.,* Samuelson, *supra* note 152, at 14 (stressing the distorting effect of the "entire granting process" involving public or private grants to faculty members).

got away.

The laggards must also contend with the risk that foreigners will appropriate the very innovations that they have let go.³⁸² Unprotected research in scientific journals has always been fair game,³⁸³ but foreign entrepreneurs are unlikely to wait that long. They now stalk the halls of academia and entice professors with offers of financial support in return for grants of exclusive rights to their firms or to some foreign funding agency.³⁸⁴ These blandishments place the investigator in a possible conflict with his own mission, with the policies of his university, and with an increasingly insistent view of the national interest. They require the university to formulate a policy, like it or not, lest it become an involuntary cog in a foreign conglomerate out of reluctance to become an involuntary cog in a domestic conglomerate.

Meanwhile, knowledge of the commercial bonanzas obtained by some universities makes it harder for others to resist these temptations.³⁸⁵ Certain universities that took steps to exploit patents, copyrights, trade secrets, and everything else that came along have grown from small research institutions to giant organizations. These institutions thrive; they have money to fund all the research that interests them, and they boast of an ever more potent administrative capacity for exploiting the fruits of the human intellect.

As these universities become more professional, they grow more successful at commercializing research and they make more money. Stanford University, for example, reportedly collects more than 9.17 million dollars in annual licensing fees; the Massachusetts Institute of Technology collects more than 3 million dollars annually. Even an Ivy League institution such as Cornell, which has achieved no major breakthroughs, has secured annual revenue from royalties of about 850,000 dollars through this process, with rosier prospects just ahead.³⁸⁶ In short, once entered in the account books, maximalist revenues become an acquired taste that can turn the heads of even the staunchest defenders of the minimalist tradition.

382. See, e.g., Schade, *University Technology Transfer Policy and U.S. Competitiveness in International Markets*, in Blackshurg Conference, *supra* note 24. This fear gives rise to big scare tactics regarding computer software. See, e.g., Karjala, *First Case*, *supra* note 301, at 150-51.

383. See, e.g., Brooks, *supra* note 10, at 54 (discussing the case of Japan). Brooks suggests that Japan may now be moving toward greater dependence on its own university system for public research.

384. See, e.g., Schade, *supra* note 382, at 9, in Blackshurg Conference, *supra* note 24 (fearing research "give aways" to both U.S. and foreign companies by professors, sponsored by federal grants, who consult with these companies).

385. See generally Lesser, *supra* note 15.

386. See Gossehn, *Harvard to Invest in Its Faculty's Work*, *Boston Globe*, Sept. 14, 1988, at 43, col. 1; see also Lesser, *supra* note 15, at 369.

B. Redefining the Public Interest

There is little doubt that a minimalist university could better exploit its intermediate technologies with less violence to its overall academic mission if it could protect applied scientific know-how under a sui generis legal regime that was not preoccupied with "inventions" or "artistic works."³⁸⁷ Unfortunately, despite growing interest in such an approach both here and abroad,³⁸⁸ no industrialized country has yet decided³⁸⁹ to enact a full-fledged sui generis regime even for the protection of computer software.³⁹⁰

Although the French Copyright Law of 1985 established a rudimentary framework for such an initiative³⁹¹ and the United States

387. See *supra* notes 41-62, 95-114 and accompanying text.

388. See *supra* note 121-22 and accompanying text. For early supporters of such a regime in the United States, see, e.g.: CONTU REPORT, *supra* note 110, at 27-37 (dissent of Hersey); Galbi, *supra* note 65, at 282-96; Samuelson, *supra* note 126, at 507-31; and Stern, *The Bundle of Rights Suited to New Technology*, 47 U. PITT. L. REV. 1229 (1986). For more recent supporters, see generally Karjala, *supra* note 105; and Menell, *supra* note 171. Foreign supporters of a sui generis approach include: Dietz, *Copyright Protection for Computer Programs: Trojan Horse or Stimulus for the Future Copyright System?*, Paper Delivered at the Conference on the International Legal Protection of Computer Software: Past Practice and Future Policy, Stanford Law School, Palo Alto, Calif. (July 24-26, 1986); see also Cornish, *Legal Protection of Computer Programs in the United Kingdom and Parts of the British Commonwealth*, Paper Delivered to the Conference on the International Legal Protection of Computer Software, *supra*; Hart, *High Technology "Reverse Engineering": The Dual Standard*, 14 N. KY. L. REV. 237 (1987); Vandenberghe, *supra* note 110, at 128-31. But see GREEN PAPER, *supra* note 312, 272-338.

For the broad spectrum of opinion in the German-speaking countries, notwithstanding the ostensible triumph of the "unity of literature" thesis, see Röttinger, *Rechtchutz von computer-programmen* (pts 1-3), 1 INFORMATIK UND RECHT (IUR) 293-300 (1986), 2 INFORMATIK UND RECHT (IUR) 93-102 (1987), 2 INFORMATIK UND RECHT (IUR) 139-49 (1987). But see Ulmer & Kollé, *Copyright Protection of Computer Programs*, 14 INT'L REV. INDUS. PROP. & COPYRIGHT L. (IIC) 159 (1983) (reaffirming the validity of full copyright protection for computer programs, notwithstanding traditionally "thin" protection of utilitarian works, and without noting contradiction between this position and the sui generis treatment of industrial art); Ulmer, *Copyright Protection of Scientific Works with Special Reference to Computer Programs*, 1 INT'L REV. INDUS. PROP. & COPYRIGHT L. (IIC) 56, 64-70 (1971) (early, authoritative, and more cautious affirmation of copyrightability that stresses "thin" protection for scientific works).

In evaluating the pro-copyright optimism that still reigns in certain circles abroad, one must recall that foreign law lags several years behind United States law in this type of litigation, so that United States decisions exaggerating the scope of protection, such as *Whelan v. Jaslow*, 797 F.2d 1222 (3d Cir. 1986), have yet to appear abroad. It is safe to predict that when such decisions do begin to crop up in foreign law, the critical reaction will be even stormier than in the United States. This prediction follows from the historical resistance to the "unity of art" excesses in most of those same countries. See *supra* notes 74-75, 291-92 and accompanying text. For evidence that this reaction is already starting to develop, see Gaudrat, *La Protection des logiciels [Copyright Protection of Computer Software]*, 138 REVUE INTERNATIONALE DU DROIT D'AUTEUR (RIDA) 76, 170-81 (1988).

389. Switzerland had moved toward such a decision. See Ritscher, *supra* note 122. But the Swiss authorities have reportedly settled for a short-term copyright solution on the French model.

390. See generally Kindermann, *supra* note 120, at 204-14.

391. See Kindermann, *supra* note 120, at 206-07; *supra* notes 293-95, 389 and accompanying

Semiconductor Chip Protection Act of 1984 introduced a model that might be adapted to this end,³⁹² the difficulties of elaborating an internationally acceptable solution for computer programs and of accommodating it within the established framework of world intellectual property law should not be underestimated.³⁹³ The long and still unresolved quest for a harmonized regime to protect industrial designs underscores these difficulties. The legal history of industrial design further illustrates the balkanization likely to occur when the excesses of copyright protection for utilitarian works finally induce alarmed states to renounce overprotection in favor of unilateral legal constructs that embody purely domestic conceptions of the public interest.³⁹⁴

There is no escaping the fact that the very intermediate technologies that universities now wish to commercialize have confronted intellectual property law with the many legal hybrids that challenge its established universe of discourse.³⁹⁵ Efforts to incorporate these technologies within existing legal frameworks have undermined basic premises about the workings of the free market economy,³⁹⁶ reopened old controversies surrounding the desirability of the intellectual property system itself,³⁹⁷ and called into question once again the extent to which this body of law actually promotes the public interest.³⁹⁸

text. Observe that this law meets few of the criteria for an ideal law set forth in the text. *See infra* notes 404-07 and accompanying text.

392. *See generally* Samuelson, *supra* note 126.

393. *See, e.g.*, Kindermann, *supra* note 120, at 204; *see also* Keplinger, *supra* note 120, at 126-280. The inability to reach a negotiated settlement in view of North-South tensions is sometimes cited as a primary obstacle. *See, e.g.*, J. Gorlin, *supra* note 290; *see also* O'Brien & Helleiner, *The Political Economy of Information in a Changing International Economic Order*, 34 INT'L ORGANIZATION 445 (1980). *But see* Dreyfuss, *New Information Products*, *supra* note 114, at 16-22 (more optimistic about the possibility of negotiating such treaties); Reichman, GATT Connection, *supra* note 349, at 29-30 (stating that an emergency treaty is feasible in context of Uruguay Round).

394. *See* Reichman, *supra* note 5, part II (discussing the "Cyclical Nature of the Design Phenomenon in All Legal Environments" and "Breaking the Cycle of Under- and Over-Protection"); *see also* INPI Report, *supra* note 301, reprinted in INDUS. PROP., *supra* note 301, at 350 (noting the "latent risk of very heterogeneous national solutions"); Reichman, *Before the Copyright Act*, *supra* note 61, at 1170-74.

395. *See, e.g.*, Hoffman & Karny, *supra* note 303; *supra* notes 107-14 and accompanying text.

396. *See, e.g.*, Brown, *supra* note 101, at 606-09.

397. *See, e.g.*, R. BENKO, *supra* note 12, at 19-25; Breyer, *supra* note 12. Professor Kingston notes that "[a]ccording to the thinkers in the Machlup tradition . . . intellectual property can now do little to encourage innovation, and may even retard it . . . [because] modern products and services contain so much more information than earlier ones." Kingston, *Response*, *supra* note 82, in DIRECT PROTECTION, *supra* note 12, at 278. Kingston, however, rejects this thesis.

398. *See, e.g.*, R. BENKO, *supra* note 12, at 35-46; Hammond, *Quantum Physics, Econometric Models, and Proprietary Rights to Information*, 27 MCGILL L.J. 47, 49-56, 68-72 (1981). Pendleton, *Intellectual Property, Information-based Society and a New International Economic Order—the Policy Options*, 7 EUR. INTEL. PROP. REV. (EIPR) 31 (1988). *Compare* Mandeville & Macdonald, *supra* note 12, in DIRECT PROTECTION, *supra* note 12, at 159 (providing strong protection for inno-

The resulting crisis in world intellectual property law³⁹⁹ has kindled unprecedented interest in resolving the puzzle of know-how—a puzzle that seems to link all the disparate legal hybrids in need of regulatory attention.⁴⁰⁰ Any quest for a solution to the problems of a given legal subcategory, such as computer software, seems unlikely to produce lasting results unless it is self-consciously integrated into this broader inquiry. For example, the parallels between industrial art and industrial literature, respectively the oldest and newest marginal cases under the dominant intellectual property paradigms, are too marked to be ignored.⁴⁰¹ Empirical evidence derived from the study of “applied art” suggests, indeed, that a modified copyright model may prove to be the most suitable vehicle for balancing incentives to invest in technological know-how against a redefined conception of the public interest in a global economic environment.⁴⁰²

Further exploration of these matters would carry the present study too far afield. Here it suffices to emphasize that any legal regime capable of satisfactorily resolving the common problems posed by applied art and applied literature would go a long way toward resolving the problems posed by other intermediate technologies as well. Conversely, any attempt to address specific technologies with ad hoc legal responses that would fail to alleviate the problems posed by industrial art and industrial literature, if applied to these fields, could lead to sterile and perhaps dangerous results in the end.⁴⁰³

vation by the grant of strictly enforceable property rights in technological information could stifle overall innovative process) with Kingston, *supra* note 82, in DIRECT PROTECTION, *supra* note 12, at 287-88 (noting that the principle of patenting is highly conducive to innovation in a dynamic information economy).

399. See, e.g., H. STALSON, INTELLECTUAL PROPERTY RIGHTS AND U.S. COMPETITIVENESS IN TRADE 47-50 (1987); Ladd, *To Cope With the World Upheaval in Copyright Law*, 19 COPYRIGHT 289, 289-91, 293 (1983). This crisis casts a large shadow over the current round of GATT negotiations dealing with trade-related aspects of intellectual property. See, e.g., GREEN PAPER, *supra* note 312, at 218-36 (External Relations). See generally H. STALSON, *supra*, at 62-90; Reichman, GATT Connection, *supra* note 349.

400. See *supra* notes 70-114 and accompanying text.

401. See *supra* notes 109, 121-22, 291-96, 311-12 and accompanying text; Reichman, *supra* note 5, part II (“Premises for International Action to Harness a Disruptive Legal Hybrid”).

402. See generally *id.* part II (“Lessons of the American Experience for the European Community”); see also Ladd, *supra* note 399, at 293 (arguing that international organizations should develop “new kinds of copyright-like protection outside copyright itself” rather than extending traditional copyright law to “technology-containing works”). In the absence of such a model, the same evidence suggests that cycles of over- and under-protection are a behavioral characteristic of all the legal hybrids that fit imperfectly within either the patent or the copyright mold. See generally Reichman, *supra* note 5, part II.

403. In a recent study of industrial design this writer observed:

As the oldest and most disruptive marginal case in the history of intellectual property law, industrial design has left a long record of failed solutions that is eminently worthy of study. While any solution to the puzzle of [applied scientific] know-how will undoubtedly affect in-

Ideally, a legal regime adapted to the needs of computer software and other intermediate technologies would protect the creators' applied innovative ideas without requiring the level of invention needed for patents.⁴⁰⁴ Such a regime would thus leave a broad area of routine improvements free for the public to use while establishing a middle range of protectable innovation in which quantitatively creative contributions to know-how might be sheltered for a relatively short period of time.⁴⁰⁵ It would permit disclosure prior to filing and would legitimate some form of reverse engineering to enable researchers to study each other's work while still preserving their proprietary rights.⁴⁰⁶ It would also provide a marketable certificate of title to a discrete body of innovative know-how that could be sold and policed, in contrast to the amorphous sweep of copyright law, which supports vague claims to any matter judicially characterized as "expression" once an infringement action has been plausibly lodged.⁴⁰⁷

Absent such a regime, university administrators cannot indulge in the assumption that their exploitation of proprietary rights to computer software automatically serves the public interest.⁴⁰⁸ If legal hybrids falling between the patent and copyright paradigms tend inherently to trigger alternating currents of underprotection and overprotection, as occurs in the case of industrial designs,⁴⁰⁹ the resulting "social bargain" remains unbalanced and, perhaps, counterproductive.⁴¹⁰ This follows regardless of whether universities or private enterprise assert the proprietary rights in question. Moreover, ongoing efforts to redefine the larger public interest in the context of new technologies inevitably raise fresh concerns about the ability of universities to reconcile their increasing

dustrial design, investigators could approach the new problems common to all the intermediate technologies with a good deal more self-confidence if progress were made in reducing the disruptive effects of the one intermediate technology that has been around for the longest [period of] time.

Reichman, *supra* note 5, part II (discussing ways of breaking the cycle of under- and overprotection).

404. See *supra* notes 107-14.

405. See *supra* notes 79-114, 250-64 and accompanying text; see also Stern, *supra* note 388, at 1258-67.

406. See, e.g., Conference Report, *supra* note 242, at 9-10; Hart, *High Technology "Reverse Engineering," The Dual Standard*, 2 N. KY. L. REV. 237, 246-48; *supra* notes 316-26 and accompanying text. But see Kindermann, *supra* note 120, at 219-20.

407. See *supra* notes 236-53 and accompanying text.

408. See *supra* notes 12-25, 41-51 and accompanying text (discussing the built-in assumptions that patents and copyrights promote the public interest).

409. See *supra* notes 107-14, 402 and accompanying text.

410. See, e.g., Karjala, *supra* note 105, at 95 (stating that the "simple call for more incentives for software creation does not provide an adequate foundation for estimating the optimal level of protection"); Samuelson, *supra* note 126, at 511-14 (indicating a need for a different social bargain from that which copyright provides).

use of proprietary rights with the traditional functions of the academic mission—namely, to teach and disseminate the thoughts, ideas, and findings of their faculty members.⁴¹¹

C. *The University of Technopolis*

Even if Congress enacted a *sui generis* regime for computer software or approved measures to relieve the pressure on other intermediate technologies, this action would not free the modern university from the kinds of entangling technical and commercial relationships that software development currently engenders. A regime of this type would presumably simplify licensing, make it less essential to retain absolute dominion over the programmer's original source code, and reduce the need for dual protection in trade secret law. Under a tailor-made legal regime, however, effective exploitation of computer software—or of other forms of applied scientific know-how, for that matter—would still require originators to contribute expertise and to participate in the further refinement and adaptation of their discoveries.⁴¹²

Like private industry, therefore, universities that systematically commercialize the new technologies are, to some still unknown extent, serving their own interests and not necessarily those of the public at large. There is nothing intrinsically unworthy in this pursuit, given an age in which the tax collector limits private philanthropy and even public universities are obliged to seek private funding for essential activities. But the pursuit of enlightened self-interest surely must presuppose a sense of self-respect and some vision of the future role of the university as an institution for higher learning.

The problem is not just that universities are collaborating with industry or that they are seeking to profit from their own research activities. It is that they are behaving more and more like corporations.⁴¹³ New possibilities to exploit nearly every form of research have tempted more and more universities to do just that.⁴¹⁴ A maximalist university, having decided that its future lies in commercialized research and development, may now take unprecedented steps to achieve its goals in the manner of any large business enterprise.

411. See, e.g., Lesser, *supra* note 15, at 370 (noting that such tensions become acute in the field of biotechnology, in which universities and business are partners in basic research; the university trains "business scientists . . . as peers and colleagues," and much "basic" research leads to the discovery of patentable inventions); see also Evenson, *supra* note 56, at 330, 332-34 (1983); Note, *Ties That Bind: Conflicts of Interest in University-Industry Links*, 17 U.C. DAVIS L. REV. 895 (1984).

412. See *supra* notes 358-61 and accompanying text.

413. See, e.g., Aarons, *supra* note 155, at 27; Brooks, *supra* note 10, at 54.

414. See, e.g., Lesser, *supra* note 15, at 360-61, 363, 366-70.

At the University of New Hampshire, for example, where the administration wants faculty to be entrepreneurs and actively encourages their commercial endeavors, there is an elaborate support system for faculty "inventors/entrepreneurs" built around the following elements:

1. A university administration that encourages faculty entrepreneurship and university policies that facilitate it.
2. A university Center for Industrial Research and Consulting that provides access to university facilities and services and acts as a conflict of interest buffer and a source of advice and encouragement.
3. An innovation incubator, a physical facility where those in the process of business development can maintain an office and a prototype development area in an environment where such activity is the main enterprise.
4. A network of not-for-profit and for-profit advisory services.
5. A not-for-profit Venture Capital Network . . . (or) "dating service" that seeks to bring together inventors/entrepreneurs and informal investors who are sources of first stage venture capital . . .⁴¹⁵

One could argue that a university so equipped tends in practice to operate as the think tank or creative branch of a corporate conglomerate; that it marshals students and professors for the overriding task of turning ideas into commercial products.⁴¹⁶ The problems with this arrangement need only be suggested. Maximum emphasis on exploiting proprietary rights in the academic work product can divert attention away from the teaching function and retard the free and open exchange of knowledge that is a tenet of scientific progress.⁴¹⁷ Faculty may increasingly experience conflicts of interest between their institutional roles and their entrepreneurial roles, which in turn influence the choice of research direction for the professor, students, and the department.⁴¹⁸

These conflicts pose the further risk that a department may saddle itself with the unprofitable aspects of a given research project while private corporations in which faculty are involved siphon off the profitable yields.⁴¹⁹ Some gifted but nonentrepreneurial scientists may be driven

415. Morrison & Wetzel, *supra* note 24, at 2.

416. For example, the GMI Engineering & Management Institute of Flint, Michigan offers a four-year degree program that makes a conscious effort to "assist fledgling entrepreneurs and evolving firms in developing, adapting, or expanding. . . . Ties, of course, with General Motors remain strong." Kowalski, *Ramifications of Operating a Business & Industry Development Center as an Auxiliary Enterprise*, in Blacksburg Conference, *supra* note 24.

417. See, e.g., D. NELKIN, *supra* note 1, at 25; Lesser, *supra* note 15, at 369-70; see also Eisenberg, *Academic Freedom and Academic Values in Sponsored Research*, 67 TEX. L. REV. 1363, 1371-78 (1988) [hereinafter Eisenberg, *Sponsored Research*].

418. Eisenberg, *Sponsored Research*, *supra* note 417, at 1363, 1371-74, 1376-78; see also D. NELKIN, *supra* note 1, at 25. Eisenberg stresses the following evils: (1) secrecy of research results; (2) distortions of viewpoints and claims by academic researchers "in order to please their research sponsors"; and (3) distortion of the academic research agenda. Eisenberg, *Sponsored Research*, *supra* note 417, at 1374-78.

419. See, e.g., Eisenberg, *Sponsored Research*, *supra* note 417, at 1373 (noting that given the tripartite relation between universities, faculty members, and sponsors, it "is simply not practical

out of teaching, although others may be drawn into teaching because of more competitive salaries.⁴²⁰ There is also a risk that outside venture capitalists may become controllers inside the university and that university administrators may operate as the de facto employees of outside financiers.⁴²¹ From there it seems but a short step to emphasizing commercial success in the tenure process;⁴²² to the formation of revenue-generating departments that act like rainmakers in law firms; and finally, to the recruiting of academics who show promise of entrepreneurial skills, not just scholarship.⁴²³

In short, if carried too far the organization needed to maximize commercial exploitation of research will pervade every aspect of the university's activities and gradually dictate its physiognomy. The institution that results from this process remains a university in name, but it operates like a business enterprise.⁴²⁴ Moreover, this enterprising university will naturally seek to integrate itself into the larger business community, as would any other ambitious corporate citizen. To the extent it succeeds, it may resemble the University of Technopolis, depicted below in a diagram⁴²⁵ that was distributed at the Blacksburg Conference in 1988.⁴²⁶ This diagram of the "Technopolis Wheel" epitomizes both the maximalist's lust for empire and the minimalist's fears

. . . for universities to stand back and let faculty members do as they please," when it enables them "to command scarce university resources for projects of their choice").

420. See, e.g., Samuelson, *supra* note 152, at 14. Brooks believes that "the present environment of the research university may be selecting against a certain type of scholarly individual—one with a truly long-range agenda and vision but a relatively non-aggressive personality and a distaste for 'self-promotion.'" Brooks, *supra* note 10, at 52. This attitude results from the need to make faculty appointments like "hunting licenses" that authorize the appointees "to sally forth and persuade some potential external sponsor in government, industry or a private foundation that they have a worthwhile research program in mind." *Id.* As some authors stress, past dependence on government funding was hardly less corrupting of academic values than cooperation with industry. See, e.g., Rosenzweig, *supra* note 31, in PARTNERS IN RESEARCH, *supra* note 10, at 37; Eisenberg, *Sponsored Research*, *supra* note 417, at 1371-72.

421. See, e.g., D. DICKSON, *supra* note 14, at 78-79 (noting that the research direction of faculty and of their students can be governed by their sponsors' needs).

422. See, e.g., Dreyfuss, *supra* note 41, at 609-10.

423. See, e.g., Lesser, *supra* note 15, at 369 (noting that percentage return to the inventor is a point of competition when universities compete for top academics); *supra* note 420 (view of Brooks). Brooks finds the position of academic researchers who depend on different kinds of outside funding generally inferior to that of industry research workers, who have greater freedom to work on novel programs and new lines of investigation that are funded internally. Brooks, *supra* note 10, at 52.

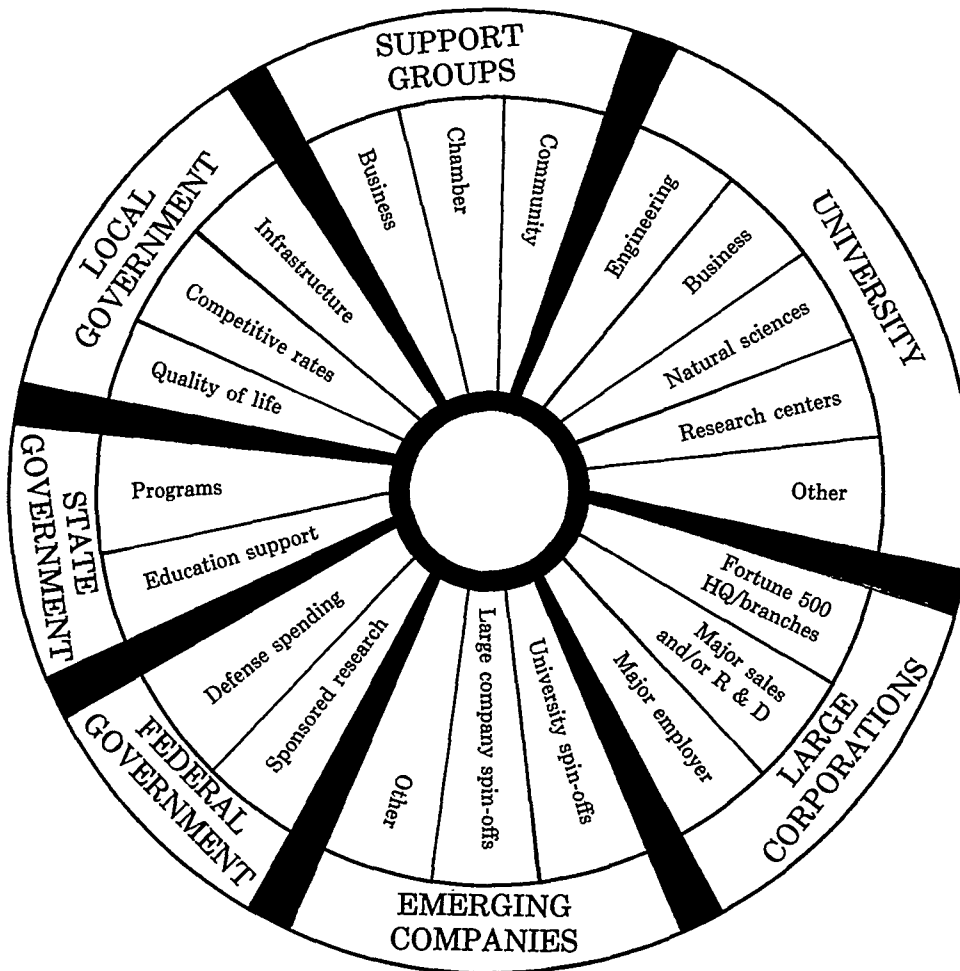
424. See *id.* at 54.

425. See Gibson & Smilor, *supra* note 164, in Blacksburg Conference, *supra* note 24, at 2. The plans of the ambitious university are likely to be supported by local authorities who see them as an investment in economic development. See, e.g., Eisenberg, *Sponsored Research*, *supra* note 417, at 1371-72. Carried to an extreme, this view enables the town to reassert much of the influence over gown that it lost in the 1950s and 1960s.

426. See *supra* notes 157-66 and accompanying text.

of what the future holds in store.

TECHNOPOLIS WHEEL



Source: David Gibson & Raymond Smilor, "The Role of the Research University in Creating and Sustaining the U.S. Technopolis," Blacksburg Conference, 1988.

Proponents of the "Technopolis Wheel" laud its efficiency. They see competition and cooperation between its participating entities as essential for a Technopolis to develop and survive over time.⁴²⁷ They envision a central role for the research university, namely, to "educate

427. Gibson & Smilor, *supra* note 164, in Blacksburg Conference, *supra* note 24, at 3.

. . . and stimulate . . . the scientists and engineers necessary for . . . research activities on leading-edge technologies."⁴²⁸

Critics tend to dismiss the corporate University of Technopolis as a caricature of what a university is supposed to be.⁴²⁹ In this vein, Saul Bellow described today's university as "a major source of the indispensable jargons that flow into public life," a place where "[v]ast powers stream . . . into government," and where "a power base in biotechnology, energy production, electronics" exists.⁴³⁰ In this environment, as one intellectual property expert recently warned, "the mix of work . . . may begin to change as universities subtly redirect their efforts toward works whose financial benefits are more easily captured."⁴³¹ If faculty members then become reluctant to produce works that are less likely to advance mundane goals, it would compound the long-term effects of such a change and hasten the eclipse of the "scholarly individual" who combines vision with "distaste for 'self-promotion.'"⁴³²

Yet, all universities must now engage in the commercial exploitation of research results if only to maintain their standing in the academic world. There is no turning back to some antediluvian state in which researchers were unpreoccupied by such concerns.⁴³³ Nor is it easy to devise a satisfactory model that fits between the minimalist and maximalist extremes expressed, respectively, at Pajaro Dunes in 1982 and Blacksburg in 1988.⁴³⁴

Harvard University, for example, some eight years after it publicly denounced entrepreneurial initiatives, recently organized a multimillion dollar fund to invest in companies that commercialize the work of its faculty members.⁴³⁵ The Johns Hopkins University already possesses a similar fund.⁴³⁶ Even the august University of Chicago is tentatively committed to commercial endeavors on a case-by-case basis, with no clear conception of the future but without necessarily succumbing to

428. *Id.* at 1. Examples given are Silicon Valley, California, a mature technopolis; Austin, Texas, a developing technopolis; and Phoenix, Arizona, an "emerging technopolis." *Id.*

429. *See, e.g.*, Brooks, *supra* note 10, at 53-54; Weiner, *supra* note 14, at 59-60.

430. S. BELLOW, MORE DIE OF HEARTBREAK 10-11 (1987). He adds: "Academics polarize light for copying machines, they get venture capital from Honeywell, General Mills, GT & E, they are corporate entrepreneurs on the grand scale—consultants, big-time pundits, technical witnesses before congressional committees . . . Even I [the fictional narrator], as a Russian expert, occasionally get into the act." *Id.* at 11.

431. Dreyfuss, *supra* note 41, at 630.

432. *See supra* note 420 (quoting Brooks).

433. *See, e.g.*, Beier, *Government Promotion*, *supra* note 12, at 561-64; Lesser, *supra* note 15, at 360, 369-70.

434. *See supra* text accompanying notes 30-38, 157-67.

435. Grosselin, *In '80, Harvard Dropped Plan for Genetic Engineering Firm*, Boston Globe, Sept. 11, 1988, at 43, col. 1.

436. *Id.*

the maximalist heresy.⁴³⁷

What seems most disquieting about this vision of Technopolis and its University is the extent to which it takes for granted the enduring contributions of universities that are more than corporate entities in spirit. It promotes a dangerous assumption that great theoretical breakthroughs will continue to occur in such an environment and that they will provide the maximalist university with an unending stream of innovation to develop efficiently and exploit.⁴³⁸ It is quite conceivable, however, that the more perfectly the Technopolises of the future integrate their universities, the less these universities will attract and nurture the kind of thinkers whose research is not exploitable in the cash-and-carry manner of a corporate balance sheet.⁴³⁹ Will such an environment lead to more innovation and a better future for all, or is it just a prelude to intellectual sterility and decay?

Whatever the answer, it seems fair to ask which institution will assume the role of a true university of higher learning once existing universities are transformed into hybrid business organizations that develop and manage intermediate technologies with the help of hybrid forms of intellectual property law. In this connection, one suspects that the truly great universities of the twenty-first century will not be those that develop and exploit the most lucrative innovations, but rather those that most successfully combine programs facilitating the exploitation of applied scientific know-how with an abiding commitment to basic research, teaching, and the dissemination of knowledge.

437. Giannisis, Willis & Maher, *supra* note 161, in Blacksburg Conference, *supra* note 24; see also Fusfeld, *supra* note 54, in PARTNERS IN RESEARCH, *supra* note 10, at 18.

438. See, e.g., Brooks, *supra* note 10, at 54 (stating that "the universities have few advantages in the conduct of proprietary research, and if they did they would cease to be universities as we have known them").

439. See *supra* note 420 and accompanying text.

