St. Mary's Law Journal

Volume 19 | Number 4 Article 7

1-1-1988

Copyright Protection for Intellectual Property Rights to Recombinant Deoxyribonucleic Acid: A Proposal Comment.

Donna Smith

Copyright Protection for the Intellectual Property Rights to Recombinant Deoxyribonucleic Acid: A Proposal

I. Intellectual Property Protection for Biotechnological Inventions

A. *Introduction*

Biotechnology is the application of biological processes, systems, or organisms to technically useful operations, primarily in the manufacturing and service industries.[1] Although the term became popular in the mid-1970's with the emergence of molecular biology and manipulative genetics,[2] bio-

1. *See* J. Coombs, Dictionary of Biotechnology 41 (1986). Biotechnology is defined as "the application of organisms, biological systems or biological processes to manufacturing and service industries." *Id.* Biotechnology has also been defined by the National Science Foundation as the application of advanced biological science techniques, including recombinant DNA, monoclonal antibodies, genetic engineering, tissue culture, cell fusion and other biologically related areas and advanced bioengineering for development, research, and production of commercial processes and products. *See* Review and Analysis of International Biotechnology Regulations 2 (1986).

2. *See* J. Coombs, Dictionary of Biotechnology 128 (1986)(genetic manipulation is insertion of DNA gene into organism in which it does not naturally occur, but in which it is capable of continued propagation resulting in some change in the manipulated organism). Manipulative genetics is also called recombinant DNA technology or genetic engineering. *Id.*

technology has actually existed for thousands of years.[3] Today, the application of biotechnology can be seen in innumerable aspects of modern society, including food service,[4] chemical,[5] agricultural,[6] and waste treatment industries.[7] Traditionally, the intellectual property rights[8] of the products and processes of biotechnology have been protected by federal patent law.[9] In

---

Gene manipulation techniques involve the insertion of a DNA gene from a particular species (or an artificial gene synthesized in the laboratory) into a separate organism. *Id.* For a general discussion of manipulative genetic techniques see B. ALBERTS, D. BRAY, J. LEWIS, M. RAFF, K. ROBERTS, & J. WATSON, MOLECULAR BIOLOGY OF THE CELL 185-94 (1983).

3. *See generally* H. PEPPLER, MICROBIAL TECHNOLOGY 404 (1967) (fermentation to produce alcoholic beverages is widely used biological process, flourishing for centuries); M. TREVAN, S. BOFFEY, K. GOULDING, & P. STANBURY, BIOTECHNOLOGY: THE BIOLOGICAL PRINCIPLES 3 (1987). The ancient Egyptians were employing biotechnology when they applied molded bread to infected wounds, and determined pregnancy based on the germination rate of barley and wheat exposed to urine. *Id.*

4. *See generally* N. DESROSIER, ELEMENTS OF FOOD TECHNOLOGY 1 (1977)(biotechnology applied to production, processing, packaging, distribution, utilization, and preparation of foods); 3 G. RUSSELL, BIOTECHNOLOGY AND GENETIC ENGINEERING REVIEWS 175-76 (1985)(bread, cheese, oriental fermented foods and alcoholic drinks manufactured using traditional biotechnological techniques); S. SILVER, BIOTECHNOLOGY: POTENTIALS AND LIMITATIONS 73 (1986)(biotechnology used in milk-processing and food fermentations).

5. *See generally* J. BU'LOCK & B. KRISTIANSEN, BASIC BIOTECHNOLOGY 359 (1987)(biotechnology applied to produce large quantities of citric acid and amino acids); GENETIC TECHNOLOGY: A NEW FRONTIER 85 (Office of Technology Assessment 1982)(biotechnology used to produce organic chemicals including plastics, organic solvents, synthetic fibers, and synthetic rubber).

6. *See generally* S. OLSON, BIOTECHNOLOGY: AN INDUSTRY COMES OF AGE 30-31 (1986)(biotechnology used to genetically alter animals and plants resulting in faster growth and greater nutritional content); 4 G. RUSSELL, BIOTECHNOLOGY AND GENETIC ENGINEERING REVIEWS 377 (1986)(recombinant DNA techniques used to construct new and better crop varieties).

7. *See generally* 1 N. BLAKEBROUGH, BIOCHEMICAL AND BIOLOGICAL ENGINEERING SCIENCE 321 (1967)(microbial process used to treat sewage and industrial waste); 1 G. RUSSELL BIOTECHNOLOGY AND GENETIC ENGINEERING REVIEWS 262 (1984)(genetically altered microorganisms aid waste treatment by enhancing recycling of materials).

8. *See* E. KINTNER & J. LAHR, AN INTELLECTUAL PROPERTY LAW PRIMER 1-2 (2d ed. 1982). Intellectual property rights are those legal rights which arise when "products of the mind," or ideas are communicated in some form to society, affecting wide areas of commerce. *Id.* Intellectual properties include copyright, patent, trademark, and trade secrets which are designed to foster economic and intellectual growth and development by introducing new technology products into our economic system. *See* Gambrell, *Overview of Ownership Conflicts that Arise with Respect to Intellectual Property*, in SORTING OUT THE OWNERSHIP RIGHTS IN INTELLECTUAL PROPERTY: A GUIDE TO PRACTICAL COUNSELING AND LEGAL REPRESENTATION 9, 10-11 (A Monograph Published by: The Section of Patent, Trademark, and Copyright Law American Bar Association 1980).

9. *See* E. HANSON, RECOMBINANT DNA RESEARCH AND THE HUMAN PROSPECT 80 (1983)(biotechnological innovations exist because of patent system). Recently, biopatents have been issued for human "T cell" monoclonal antibody, process for making sex determination using monoclonal antibody, and a DNA probe which detects oncogenes in chromosomal

the field of molecular biology, however, a new science has developed called recombinant DNA technology or genetic engineering.[10] Although patent protection has been granted for the recombinant DNA process and products,[11] it is likely that recombinant DNA development in the future may face problems satisfying patent requirements.[12]

Deoxyribonucleic acid (DNA) is the genetic molecule which carries hereditary information in chromosomes.[13] The process of making recombinant DNA (rDNA) begins by taking DNA from a known organism and exposing it to an enzyme which cuts the DNA into small fragments, each of which contains the genetic code for a particular protein.[14] These fragments are then inserted into self-replicating circular DNA molecules called plasmids.[15] The resulting rDNA plasmid can be inserted into a cell where it continues to replicate and direct, through the code within the DNA frag-

---

DNA. *See* Coleman, *BioPatents*, 5 BIOTECHNIQUES 734, 734-35 (1987)(overviewing patents issued during summer of 1987 for biotechnological advances).

10. *See generally* Barkstrom, *Recombinant DNA and the Regulation of Biotechnology: Reflections on the Asilomar Conference, Ten Years After*, 19 AKRON L. REV. 81, 81 (1985)(genetic engineering, synonymous with recombinant DNA technology developed in early 1970s as result of research at Stanford University).

11. *See* Misrock, Coggio, & Dulak, *The Exercise of Patent Rights Through Multiple Exclusive Field-of-Use Licensing*, 11 RUTGERS COMPUTER AND TECH. L.J. 383, 385 (1985)(patent protection granted for recombinant DNA process and its products). *See generally* Cohen, Chang, Boyer, & Helling, *Construction of Biologically Functional Bacterial Plasmids in Vitro*, 70 PROC. NAT'L ACAD. SCI. U.S.A. 3240 (1973)(stating experimental protocol for making recombinant DNA).

12. *See* J. SIGALOS, INTELLECTUAL PROPERTY PROTECTION FOR BIOTECHNOLOGY INNOVATIONS 1, 8 (1987)(patent claims for recombinant DNA may be invalid as lacking utility).

13. *See* E. AMBROSE & D. EASTY, CELL BIOLOGY 101 (2d ed. 1977)(DNA is genetic material for all life forms except certain viruses); *see also* E. DE ROBERTIS, W. NOWINSKI, & F. SAEZ, CELL BIOLOGY 25 (5th ed. 1970)(DNA molecule contains genetic information transmitted from one organism or cell to another). *See generally* B. ALBERTS, D. BRAY, J. LEWIS, M. RAFF, K. ROBERTS & J. WATSON, MOLECULAR BIOLOGY OF THE CELL ch. 3 (1983)(describing process by which genetic information in DNA molecule translated into actual protein).

14. *See* GENETIC ENGINEERING, HUMAN GENETICS, AND CELL BIOLOGY: EVOLUTION OF TECHNOLOGICAL ISSUES: BIOTECHNOLOGY 9 (Science Policy Research Division, Congressional Research Service 1980)(restriction enzyme cuts DNA into segments, each containing the gene code for specific proteins).

15. *See* 2 H. BOYER & S. NICOSIA, GENETIC ENGINEERING 59 (1978); *see also* R. RODRIGUEZ & R. TAIT, RECOMBINANT DNA TECHNIQUES: AN INTRODUCTION 3 (1983)(DNA fragments inserted into extrachromosomal, autonomously replicating, circular DNA molecules called plasmids); 2 J. SETLOW & A. HOLLAENDER, GENETIC ENGINEERING: PRINCIPLES AND METHODS 133 (1980)(plasmids DNA molecules which can be modified by insertion of DNA fragment). These plasmids are self-replicating in that they are capable of making exact duplicates of themselves. *See* 1 J. WATSON, N. HOPKINS, J. ROBERTS, J. STEITZ & A. WEINER, MOLECULAR BIOLOGY OF THE GENE 202 (4th ed. 1987).

ment, synthesis of the particular protein.[16] Large quantities of useful proteins such as viral vaccines,[17] interferon,[18] and human insulin can be produced using this method.[19]

This comment will address the feasibility of obtaining copyright protection, as opposed to traditional patent protection, for intellectual property rights to rDNA. First, an historic overview of federal patent law will be presented. Second, this comment will address patent protection for biotechnological innovations. This will include a discussion of the problems confronted in obtaining patent protection for biotechnological inventions, focusing upon the problems in satisfying patent requirements for rDNA. Copyright protection for rDNA will then be examined as a possible alternative to patent protection. Finally, a comparison of copyright and patent protection for rDNA will be made, concluding that copyright protection is a viable alternative for protecting intellectual property rights in rDNA.

B. *The Patent Act*

Congress, in 1952, enacted the first federal patent act, deriving its power from Article I, Section 8, Clause 8 of the United States Constitution.[20] This

---

16. *See* 9 J. SETLOW, GENETIC ENGINEERING: PRINCIPLES AND METHODS 155 (1987)(insertion of recombinant DNA plasmid into host bacterial cell results in synthesis of protein for which DNA codes). The order in which the nucleotides appear in the DNA molecule, "the code," determines the protein that will be ultimately produced. *See* B. ALBERTS, D. BRAY, J. LEWIS, M. RAFF, K. ROBERTS & J. WATSON, MOLECULAR BIOLOGY OF THE CELL 106-111 (1983). Thus, a particular nucleotide sequence always results in the synthesis of the same protein. *See id.*

17. *See* 20 K. DOWNEY, R. VOELLMY, F. AHMAD, & J. SCHULTZ, ADVANCES IN GENE TECHNOLOGY: MOLECULAR GENETICS OF PLANTS AND ANIMALS 479 (1983)(recombinant DNA techniques, successful in producing viral vaccine, for combating foot-and-mouth disease).

18. *See* 4 J. SETLOW AND A. HOLLAENDER GENETIC ENGINEERING: PRINCIPLES AND METHODS 199 (1982)(production of human interferon utilizing bacteria as host cell and recombinant DNA technology). Interferon is a protein which plays an important role in human immune response and cell proliferation). *See id.*

19. *See* M. INOUYE, EXPERIMENTAL MANIPULATION OF GENE EXPRESSION 261-63 (1983)(human insulin, a protein necessary for survival of diabetics, produced by plasmid containing DNA fragment coding for protein).

20. *See* U.S. CONST. art. I, § 8, cl. 8 (authorizing Congressional action to advance science and arts by giving authors and inventors exclusive rights to writings and discoveries for limited time); *see also* Graham v. John Deere Co., 383 U.S. 1, 3, 5 (1966)(Congress implemented consitutional standard of article I, § 8 through 1952 Patent Act); Allegheny Drop Forge Co. v. Portec, Inc., 370 F. Supp. 673, 675 (W.D. Pa. 1974)(Congress' power to grant patent delineated by purpose proclaimed in Constitution), *aff'd*, 541 F.2d 383 (3d Cir. 1976). Although patent statutes have been in existence since 1790, they were not officially codified until 1952. *See In re* Bergy, 201 U.S.P.Q 352, 360 (C.C.P.A. 1979)(first patent statutes in 1790 were revised in 1874 and codified in 1952), *aff'd sub nom.* 447 U.S. 303 (1980). *See generally* Casey, Jr. & Moss, *Intellectual Property Rights and Biotechnology*, 27 IDEA 251, 251-252 (1987)(U.S.

clause grants Congress the power "[t]o Promote the Progress of Science and useful Arts, by securing for limited Times to . . . Inventors the exclusive Right to their . . . discoveries."[21] The 1952 Patent Act, designed to promote new discoveries which ultimately benefit the public, grants to the inventor exclusive rights to the use of his invention for seventeen years.[22] In exchange for this patent, the inventor is required to disclose how the invention is made so that at the end of seventeen years, a person with ordinary skill in that particular art will be able to duplicate the invention.[23] Thus, the seventeen year time period not only rewards the inventor with exclusive rights to his invention for a reasonable time, but concomitantly effectuates the primary goal of patent law: contribution of new and useful knowledge to the public domain.[24]

C. *Patent Protection for Biotechnological Innovations Including Recombinant DNA*

Patentable subject matter includes processes,[25] machines,[26] articles of

---

patent system began its development in nineteenth century); Cooper, *The Patent System and the "New Biology"*, 8 RUTGERS J. COMPUTERS, TECH. & LAW 1, 21 (1980)(Congress enacted first patent act in 1790).

21. U.S. CONST. art. I, § 8, cl. 8; *see also In re* Worrest, 201 F.2d 930, 936 (C.C.P.A. 1953)(Congress has power to promote science and arts through patent grant); McCashen v. Watson, 131 F. Supp. 233, 236 (D.D.C. 1955)(patent grant Congressional expression of Constitutional provision to promote arts and science).

22. *See* 35 U.S.C. § 154 (1982)(patent owner's right to prevent others from making, selling or using invention for 17 years); *see also* Great Atl. & Pac. Tea Co. v. Supermarket Equip. Corp., 340 U.S. 147, 152 (1950)(patent should not be granted if effect subtracts from, rather than adds to, sum of useful knowledge already publicly available), *reh'g denied*, 340 U.S. 918 (1951); Griffith Rubber Mills v. Hoffar, 313 F.2d 1, 3 (9th Cir. 1963)(patent owner's exclusive rights to patent is incentive to disclose knowledge which ultimately adds to store of public knowledge).

23. *See* 35 U.S.C. § 112 (1982)(patent owner must give written description); *see also, e.g.*, Todd v. Sears, Roebuck & Co., 216 F.2d 594, 596 (4th Cir. 1954)(following reasoning of Great Atl. & Pac. Tea Co. v. Supermarket Equip. Co., 340 U.S. 147, 152 (1950), *reh'g denied*, 340 U.S. 918 (1951)(patent granted in exchange for disclosure of discovery which adds to sum of useful knowledge available to skilled artisans)); International Standard Elec. Corp. v. Marzall, 184 F.2d 592, 593 (D.C. Cir. 1950)(inventor must explain how invention made so when patent expires, ordinary person skilled in that art can duplicate).

24. *See, e.g.*, United States v. Masonite Corp., 316 U.S. 265, 278 (1942)(reward to inventor is secondary and merely means to advance science and arts); Carter-Wallace, Inc. v. Riverton Laboratories, Inc., 304 F. Supp. 357, 367 (S.D.N.Y. 1969)(ultimate goal of patent to give incentive to disclose new and useful inventions to public), *aff'd*, 433 F.2d 1034 (2d Cir. 1970).

25. *See* 35 U.S.C. § 101 (1982). "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter . . . may obtain a patent . . . ." *Id.*; *see also In re* Gelnovatch, 595 F.2d 32, 36-37 (C.C.P.A. 1979)(otherwise patentable "process" within meaning of statue is unaffected by type of apparatus for effectuating process); Thomson Mach. Co. v. Larose, 197 F. Supp. 636, 641 (E.D. La. 1961)(process patent protects procedure

manufacture,[27] and compositions of matter.[28] Biotechnological innovations falling into any of these four categories have typically been protected by federal patent law.[29] To qualify as patentable, the biotechnological invention must be novel,[30] useful,[31] and nonobvious to a person with ordinary skill in the area of biotechnology to which the invention pertains.[32] Each of these criteria have posed obstacles to obtaining patents for innovations in

---

which produces physical result, not producing mechanism), *aff'd*, 320 F.2d 218 (5th. Cir. 1963). *See generally* W. BORCHARD, A TRADEMARK IS NOT A PATENT OR A COPYRIGHT 6 (United States Trademark Assoc. Executive Newsletter No. 39, 1986)(mechanical, chemical, and electrical procedures, such as for refining petroleum, are patentable processes).

26. *See, e.g.*, Rubber Co. v. Goodyear, 76 U.S. (9 Wall.) 788, 796 (1869)(new machine may be patentable although manufacture or product proceeding from it is old and nonpatentable); National Latex Prods. Co. v. Sun Rubber Co., 274 F.2d 224, 242 (6th Cir. 1959)(machine patent must independently meet requirements of patentability even though process carried out by machine is patentable), *reh'g denied*, 276 F.2d 167 (6th Cir.), *cert. denied*, 362 U.S. 989 (1960).

27. *See, e.g.*, Risdom Iron & Locomotive Works v. Medart, 158 U.S. 68, 82-83 (1895)(article of manufacture differing from prior articles only in process by which made, not patentable because served no new function); Steinfur Patents Corp. v. William Beyer, Inc., 62 F.2d 238, 240 (2d Cir. 1932)(manufacturing process on furskins resulting in fur with new quality and beneficial use held patentable article of manufacture).

28. *See e.g.*, *In re* Kunz, 181 F.2d 239, 242 (C.C.P.A. 1950)(useful and new composition of matter containing patented compound as ingredient patentable).

29. *See generally* I. COOPER, BIOTECHNOLOGY AND THE LAW § 1.03 (1987)(product patents issued for vaccines, plasmids, and antibiotics); S. OLSON, BIOTECHNOLOGY: AN INDUSTRY COMES OF AGE 95 (1986)(process patents issued for recombinant DNA techniques achieving expression of protein, gene alteration, plasmid preparation, and DNA purification).

30. *See* 35 U.S.C. § 101 (1982). The statute states that invention must be new and useful to be patentable. *Id.*; *see also* Amphenol Corp. v. General Time Corp., 397 F.2d 431, 437 (7th Cir. 1968)(to be patentable, invention must have novelty); *In re* Craige, 189 F.2d 620, 623 (C.C.P.A. 1951)(patent may not be issued for old, unchanged substance); Alco Standard Corp. v. Tennessee Valley Auth., 597 F. Supp. 133, 146 (W.D. Tenn. 1984)(patent issued on invention which lacks novelty held erroneous), *aff'd*, 808 F.2d 1490 (C.A.F.C. 1986), *cert. dismissed*, __ U.S. __, 108 S. Ct. 26, 97 L. Ed. 2d 815 (1987).

31. *See, e.g.*, Graham v. John Deere Co., 383 U.S. 1, 12 (1966)(utility one condition patentability dependent upon); Whitley v. Road Corp., 624 F.2d 698, 699 (5th Cir. 1980)(citing *Graham*, 383 U.S. at 12)(usefulness condition must be fulfilled to patent device); E.I. DuPont de Nemours & Co. v. Berkley & Co., 620 F.2d 1247, 1260 n.17 (8th Cir. 1980)(small degree of utility satisfies patent requirement); Technitrol, Inc. v. Control Data Corp., 550 F.2d 992, 997 (4th Cir.)(device must be useful to be patentable), *cert. denied*, 434 U.S. 822 (1977).

32. *See* 35 U.S.C. § 103 (1982). Patent protection is not available "if the differences between the subject matter sought to be patented and the prior art are such that the subject matter . . . 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." *Id.*; *see also* Kwik-Site Corp. v. Clear View Mfg. Co., 758 F.2d 167, 173 (6th Cir. 1985)(patent claim for obvious invention invalid); Sure Plus Mfg. Co. v. Kobrin, 719 F.2d 1114, 1116 (11th Cir. 1983)(to obtain patent invention or discovery must be nonobvious); Ashland Oil, Inc. v. Delta Resins & Refractories, Inc., 587 F. Supp. 1406, 1409 (E.D. Mich. 1984)(nonobviousness is independent legal requisite to valid patent), *rev'd on other grounds*, 776 F.2d 281 (C.A.F.C. 1985).

biotechnology.[33]

1. The Novelty Requirement

To satisfy the novelty requirement under federal patent law, an item must not be known or used by any individual in the United States before its invention is claimed.[34] The novelty requirement also prohibits the inventor from putting the invention to public use or disclosing the invention in a printed publication more than one year before the patent application is filed.[35]

Biotechnology inherently poses unique problems in satisfying the novelty requirement.[36] Courts have uniformly held that any newly-discovered law of nature or physical phenomenon lacks novelty because it was already "used" in nature prior to its discovery and, therefore, is not patentable.[37] Thus, naturally occurring substances which have been purified or synthe-

---

33. *See generally* Ihnen, *Patenting Biotechnology: A Practical Approach*, 11 RUTGERS COMPUTER & TECH. L.J. 407, 408-22 (1985)(biotechnological innovations possess problems meeting requirements for patent); Note, *Patent and Trade Secret Protection in University-Industry Research Relationships in Biotechnology*, 24 HARV. J. ON LEGIS. 191, 213-18 (1987)(biotechnological inventions encounter difficulties meeting novelty, utility, and nonobviousness requirements for obtaining patents).

34. *See* 35 U.S.C. § 102(a) (1982); *see also* Roberts v. Sears, Roebuck & Co., 723 F.2d 1324, 1332 (7th Cir. 1983)(device novel when its "essence" not disclosed in prior art or device); Armco, Inc., v. Republic Steel Corp., 707 F.2d 886, 889 (6th Cir. 1983)(device lacks novelty if all elements existed in relevant prior art doing substantially same work, same way); Brookfield Athletic Shoe Co. v. Chicago Roller Skate Co., 607 F. Supp. 241, 245 (N.D. Ill, 1984)(invention novel if not made before).

35. *See* 35 U.S.C. § 102(b) (1982). A patent will not be granted if "the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States . . . ." *Id.*; *see also In re* Yarn Processing Patent Validity Litig., 498 F.2d 271, 277 (5th Cir.)(sale or single public use one year prior to patent application invalidates patent), *cert. denied*, 419 U.S. 1057 (1974); Frantz Mfg. Co. v. Phenix Mfg. Co., 457 F.2d 314, 320 (7th Cir. 1972)(public disclosure of invention more than one year prior to filing patent application foreclosed patentability).

36. *See generally* Wassermann, *Patents and the Biotechnological Industry* 20 J. WORLD TRADE L. 705, 710 (1986). Wassermann discusses a common problem in the scientific field pertaining to substances isolated in the laboratory which do not satisfy the novelty requirement because they occur naturally. The author argues that naturally occurring substances which are not known until discovered and isolated from complex surroundings should satisfy the novelty requirement even though they are not "new" in the sense that they existed in nature for thousands of years. *Id.*

37. *See* Diamond v. Chakrabarty, 447 U.S. 303, 309 (1980)(abstract idea, law of nature, physical phenomenon, not patentable). In *Chakrabarty*, Justice Burger writing for the majority stated, "Einstein could not patent his celebrated law that E =MC2; nor could Newton have patented the law of gravity." *Id.*; *see also* O'Reilly v. Morse 56 U.S. (15 How.) 62, 112-13 (1853)(use of electromagnetism to communicate not patentable); *In re* Meyer, 688 F.2d 789, 795 (C.C.P.A. 1982)(laws of nature and scientific principles existed throughout time and, therefore, no one person should be given exclusive rights to discovery).

sized using biotechnology will not satisfy the novelty requirement[38] unless the substance does not normally occur in nature in that particular state.[39] In other words, the substance must be a "man-made product arising from nature" rather than an isolated "product of nature."[40] Only inventions created by the application of the laws and principles of nature are patentable.[41] Because rDNA is created by application of chemical and biological laws and principles of nature, there should be no problem satisfying this aspect of the novelty requirement.[42] The rDNA plasmid molecule in which a DNA fragment from a separate organism has been inserted, should satisfy the novelty requirement as a "man-made product arising from nature" since the molecule does not naturally occur in that form.[43] However, isolated plasmids which do not contain inserted DNA fragments would most likely not be considered novel because they normally occur in bacteria in that state.[44]

---

38. *See, e.g.*, Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 129-31 (1948)(non-inhibitive strain of bacteria purified from mixture of inhibitive and non-inhibitive bacteria not novel because non-inhibitive strain occurred in nature); General Elec. Co. v. De Forest Radio Co., 28 F.2d 641, 643 (3rd Cir. 1928)(natural tungsten produced in substantially pure form held not novel when pure tungsten and characteristics thereof created by nature); Merck & Co. v. Chase Chem. Co., 273 F. Supp. 68, 82 (D.N.J. 1967)(substance purified by merely extracting it from its parent material not novel).

39. *See In re* Kratz, 592 F.2d 1169, 1174-75 (C.C.P.A. 1979)(composition containing substantially pure constituent of strawberries which does not normally occur in nature in that form held novel and patentable). *See generally* Note, *Patent and Trade Secret Protection in University-Industry Research Relationships in Biotechnology*, 24 HARV. J. ON LEGIS. 191, 214 (1987)(purified forms of natural substances deemed novel if form not found in nature).

40. *See Chakrabarty*, 447 U.S. at 309-10 (nonnaturally occurring bacterium produced as result of human ingenuity not product of nature and, thus, patentable). *See generally* Maki & Brownlee, *Can Higher Life Forms be Excluded as Non-Statutory Subject Matter*? Nat'l L.J., Nov. 23, 1987, at 25-26, col. 1 (U.S. Patent and Trademark Office, April 7, 1987, announced man-made, nonnaturally occurring animal, patentable subject matter).

41. *See, e.g.*, Diamond v. Diehr, 450 U.S. 175, 187 (1981)(application of mathematical formula or law of nature to structure or process may be patentable); *In re* Sarkar, 588 F.2d 1330, 1333 (C.C.P.A. 1978)(process which involves nonmathematical and mathematical steps does not necessarily preclude patentability); Nippon Elec. Glass Co. v. Sheldon 539 F. Supp. 542, 545 (S.D.N.Y. 1982)(practical applications of laws of nature may be given patent protection); *see also* Diamond v. Chakrabarty, 447 U.S. 303, 309 (1980). In *Chakrabarty*, the Court referred to newly discovered minerals or plants, Einstein's equation for energy, and Newton's law of gravity as manifestations of nature which were free to everyone and, therefore, could not be exclusively reserved by any person as patentable subject matter. *See id.*

42. *See generally* Barkstrom, *Recombinant DNA and the Regulation of Biotechnology: Reflections on the Asilomar Conference, Ten Years After*, 19 AKRON L. REV. 81, 82-83 (1985). By inserting fragments of DNA into plasmids or phages, their natural control systems can perform "remarkable feats" in genetic engineering. *Id.*

43. *See* Wassermann, *Patents and the Biotechnology Industry*, 20 J. WORLD TRADE L. 705, 706 (1986). Recombinant DNA is a biotechnological invention in which the product of nature question does not arise because it is a creation of man. *Id.*

44. *See* Merk & Co. v. Chase Chem. Co., 273 F. Supp. 68, 82 (D.N.J. 1967)(substance

Although an rDNA plasmid may be considered novel in the sense that it does not normally occur in nature,[45] it will not comply with the novelty requirement if it has been disclosed in a printed publication more than one year before filing the patent application.[46] As early publication of rDNA research is emphatically and traditionally fostered in the scientific community, this is where the rDNA molecule is most likely to fail the novelty requirement.[47] In the scientific arena, scientists are urged to publish their research results expeditiously to maintain prominence in the field as well as attain recognition for the institution which employs them.[48] Therefore, it is likely that creation of new rDNA molecules is reported in the scientific journals long before their potential for industrial application is realized.[49] If the research results are described in a printed publication more than one year before a patent application is filed, the rDNA will not be patentable.[50]

Finally, the requirement that the invention not be publicly used more than

---

purified by separating it from its parent material not novel). *But see* Wassermann, *Patents and the Biotechnology Industry*, 20 J. WORLD TRADE L. 705, 710 (1986)(natural substances such as plasmids occurring in nature in complex surroundings should be deemed novel if one isolates and makes industrial use of the molecule).

45. *See* Wassermann, *Patents and the Biotechnology Industry*, 20 J. WORLD H. TRADE L. 705, 706 (1986)(recombinant DNA creation of man, not product which normally occurs in nature).

46. *See* 35 U.S.C. § 102(b) (1982); *see also* Medtronic, Inc. v. Cardiac Pacemakers, Inc., 555 F. Supp. 1214, 1216 (D. Minn.)(claimed invention disclosed in printed publication prior to one year application for patent filed not novel), *aff'd in part, modified in part*, 721 F.2d 1563 (C.A.F.C. 1983); Conron, Inc. v. Plasser Am. Corp., 474 F. Supp. 1010, 1012-13 (E.D. Va. 1978)(patent invalid because invention described in publication more than one year before filing patent application), *aff'd*, 609 F.2d 1075 (4th Cir. 1979), *cert. denied*, 446 U.S. 965 (1980); Maclaren v. B-I-W Group Inc., 401 F. Supp. 283, 296 (S.D.N.Y. 1975)(patent denied if invention described in publication prior to one year before filing patent application), *rev'd on other grounds*, 535 F.2d 1367 (2d Cir.), *cert. denied*, 429 U.S. 1001 (1976).

47. *See* Cooper, *The Patent System and the "New Biology"*, 8 RUTGERS J. COMPUTERS, TECH. & LAW 1, 41 (1980). Government agencies and universities often thoughtlessly demand public access to announcements and reports regarding recombinant DNA techniques and, thus, bar patent protection under section 102(b). *Id.*

48. *See* Wassermann, *Patents and the Biotechnology Industry*, 20 J. WORLD TRADE L. 705, 710 (1986)(most biotechnological inventions originate from scientists required to publish research results as soon as possible); *see also* Interview with Dr. John Groelke, Assistant Scientist, Department of Physiology and Medicine, Southwest Foundation for Biomedical Research, in San Antonio, Texas (February 7, 1988)(maintaining professional status in scientific field dependent upon one's ability to successfully research and publish results).

49. *See* Note, *Patent and Trade Secret Protection in University-Industry Research Relationships in Biotechnology*, 24 HARV. J. ON LEGIS. 191, 215 (1987)(scientists unknowingly bar patentability of invention by early journal publication or oral presentation at scientific meeting); *see also* Wassermann, *Patents and the Biotechnology Industry*, 20 J. WORLD TRADE L. 705, 710 (1986)(industrial applicability of invention often hard to determine at time research results required to be published).

50. *See* 35 U.S.C. § 102(b) (1982)(disclosure more than one year before application for

one year before the patent application is filed poses an obstacle to biotechnological innovations satisfying the novelty requirement.[51] Although experimental use by the researcher to perfect the invention is not considered public use,[52] the question arises whether such use of the researcher's invention by other scientists will be deemed public use.[53] In rDNA technology, it is common for a scientist to send samples of an rDNA molecule which he developed to other scientists for use in their own research and development.[54] If experimental use by other scientists is deemed public use, then the innovator of the rDNA molecule who subsequently wishes to patent his invention more than one year after its use by other scientists will be barred by the novelty requirement.[55]

2. *The Utility Requirement*

An invention satisfies the utility requirement for patents if it is operable and serves some useful purpose.[56] In the field of biotechnology, inventions

---

patent voids patentability); *see also* M. EPSTEIN, MODERN INTELLECTUAL PROPERTY 224 (1985).

51. *See* 35 U.S.C. § 102(b) (1982); *see also* Kinzenbaw v. Deere & Co., 741 F.2d 383, 391 (C.A.F.C. 1984)(commercial use of invention prior to one year before filing patent application barred patent), *cert. denied*, 470 U.S. 1004 (1985); T.P. Laboratories, Inc. v. Professional Positioners, Inc., 724 F.2d 965, 968 (C.A.F.C.)(person entitled to patent unless invention in public use in country prior to one year before patent application), *cert. denied*, 469 U.S. 826 (1984); Kalvar Corp. v. Xidex Corp., 556 F.2d 966, 968 (9th Cir. 1977)(patent barred because invention in public use prior to one year before filing patent application).

52. *See, e.g.*, Delong Corp. v. Raymond Int'l, Inc., 622 F.2d 1135, 1143-44 (3d Cir. 1980)(experimentation that is primary object of inventor and reasonably necessary to demonstrate invention's utility and lack of need for refinement not considered public use within meaning of section 102(b)), *overruled on other grounds*, 662 F.2d 975 (3d Cir. 1981); Red Cross Mfg. Corp. v. Toro Sales Co., 525 F.2d 1135, 1144 (7th Cir. 1975)(experimental use by inventor to perfect invention, not considered public use within meaning of statute proscribing public use); Micro-Magnetic Indus., Inc. v. Advance Automatic Sales Co., 488 F.2d 771, 773 (9th Cir. 1973)(public sale or use by inventor prior to one year before filing patent application not bar to patentability if primarily for experimental purposes).

53. *See* J. SIGALOS, INTELLECTUAL PROPERTY PROTECTION FOR BIOTECHNOLOGY INNOVATIONS 13 (1987)(biological materials often exchanged among research groups to enhance research).

54. *See id.*

55. *See id.* At the 1982 Cold Springs Harbor Symposium, scientists expressed concern regarding protection of plasmids and other biological materials exchanged among research groups. *Id.*

56. *See* 35 U.S.C. § 101 (1982)(requiring invention to be new and useful to be patentable); *see also* Moleculon Research Corp. v. CBS, Inc., 594 F. Supp. 1420, 1429 (D. Del 1984)(invention meets utility requirement if operable and capable of being used for some minimum purpose), *aff'd in part, vacated in part*, 793 F.2d 1261 (C.A.F.C. 1986), *cert. denied*, __ U.S. __, 107 S. Ct. 875, 93 L. Ed. 2d 829 (1987); Envirotech Corp. v. Al George, Inc., 730 F.2d 753, 762 (C.A.F.C. 1984)(limited utility and operability for specific applications sufficient to satisfy utility requirement).

have failed to satisfy the utility requirement in two ways.[57] First, a process which produces a biological product fails to satisfy the utility requirement if the biological product produced by the process serves no useful purpose and the process itself serves no function other than production of the nonuseful product.[58]

Likewise, a product derived from a patentable process fails to satisfy the utility requirement if the product serves no useful purpose other than being a final product of the process.[59] It is in this second category that the extracellular rDNA plasmid arguably falls because it is inoperable outside a host cell.[60] The rDNA plasmid molecule is merely a strand of circular DNA which, by itself, serves no useful purpose.[61] It is not until the molecule is inserted into a host cell that the DNA becomes operable and useful by commencing replication and synthesis of the protein for which it codes.[62] Therefore, it appears that the only rDNA plasmid that satisfies the utility requirement for patentability is the plasmid contained in a host cell.[63] If the utility of extracellular rDNA is litigated, the molecule will likely be deemed nonuseful and, therefore, nonpatentable.[64]

3. The Nonobviousness Requirement

Although an invention may satisfy the novelty requirement, it will be non-

---

57. *See* Brenner v. Manson, 383 U.S. 519, 532-35 (1966). An invented process does not satisfy the utility requirement simply because the process produces a product. *See id.*; *cf.*, Studiengesellschaft Kohle v. Eastman Kodak Co., 616 F.2d 1315, 1339 (5th Cir.), *cert. denied*, 449 U.S. 1014 (1980). Also, a product resulting from a patented process does not satisfy the utility requirement simply because it is a final product of the process. *See id.*

58. *See, e.g.*, Shurie v. Richmond, 699 F.2d 1156, 1159 (C.A.F.C. 1983)(if product of invented process has utility then process has utility); Tennessee Valley Auth. v. Monsanto Chem. Co., 383 F.2d 973, 977 (5th Cir. 1967)(process has utility if product produced has utility).

59. *See Studiengesellschaft Kohle*, 616 F.2d at 1339 (product of patented process not useful merely because final product in series of chemical reactions).

60. *See* J. Sigalos, INTELLECTUAL PROPERTY PROTECTION FOR BIOTECHNOLOGY INNOVATIONS 7, 14 (1987)(inert extracellular rDNA may not satisfy utility requirement for patent).

61. *See* Cooper, *The Patent System and the "New Biology"*, 8 RUTGERS J. COMPUTERS, TECH. & LAW 1, 10 (1980)(plasmids inanimate aggregates of chemicals).

62. *See id.* "Plasmids in recombinant bacteria are like carburetors in engines. Properly installed, they . . . produc[e] the precious substances whose genetic information they encode." *Id.*

63. *See* J. SIGALOS, INTELLECTUAL PROPERTY PROTECTION FOR BIOTECHNOLOGY INNOVATIONS 7, 14 (1987). Sigalos suggests that although the inert extracellular recombinant DNA would fail the utility requirement, the cell containing the functional plasmid would satisfy this requirement and, thus, be patentable. *Id.*

64. *See id.* at 8. Sigalos knows of no court or Patent and Trademark Office decision on this issue, but suggests that if the issue was litigated, extracellular recombinant DNA would fail the utility requirement. *Id.*

patentable if it is considered obvious to a person with ordinary skill in the relevant art.[65] To determine if an invention is obvious, the content and scope of the prior art,[66] differences between the invention and the previous art, and the ordinary level of skill of persons in the relevant field must be considered.[67] Secondary factors which indicate nonobviousness are the invention's commercial success and a previously unresolved but long-felt need for the invention in the pertinent industry.[68] One reason many potential inventions in biotechnology fail to satisfy the nonobvious requirement is because the increase in skilled researchers has multiplied the quantity of scientific knowledge deemed prior art.[69] In addition, although rDNA technology is a relatively new area in biotechnology,[70] the number of advances and publications in the field is rapidly increasing.[71] Therefore, as new rDNAs are

---

65. *See* 35 U.S.C. § 103 (1982); *see also* Richdel, Inc. v. Sunspool Corp., 714 F.2d 1573, 1579 (C.A.F.C. 1983)(statute requires claimed subject matter be nonobvious); Lam, Inc. v. Johns-Manville Corp., 668 F.2d 462, 468 (10th Cir.)(invention not patentable if at time made, invention considered obvious to person with ordinary skill in pertinent art), *cert. denied*, 456 U.S. 1007 (1982); Kabushiki Kaisha Audio-Technica v. Atlantis Sound, Inc., 629 F.2d 978, 980 (4th Cir. 1980)(to warrant patent, invention must be nonobvious improvement over relevant prior art).

66. *See, e.g.* Beckman Instruments, Inc. v. Chemtronics, Inc., 439 F.2d 1369, 1375 (5th Cir. 1970)(prior art considered as covering every use to which invention may have been put); Foseco Int'l Ltd. v. Chemincon, Inc., 507 F. Supp. 1253, 1260 (E.D. Mich. 1981)(prior art may include prior use or knowledge, prior publications, and prior patents); Fischer & Porter Co. v. Haskett, 354 F. Supp. 464, 477 (E.D. Pa. 1973)(prior art includes prior patents, products, publications, and methods in use when invention made).

67. *See* Graham v. John Deere Co., 383 U.S. 1, 17 (1966)(content and scope of prior art, differences between claimed invention and prior art, and ordinary level of skill of persons in relevant art considered to determine if invention obvious); *see also* Atlas Powder Co. v. E.I. DuPont de Nemours & Co., 750 F.2d 1569, 1574-76 (C.A.F.C. 1984)(explosive device nonobvious where substantial difference between prior art and claimed invention); Seattle Box Co. v. Industrial Crating & Packaging, Inc., 731 F.2d 818, 823-25 (C.A.F.C. 1984)(device for packaging steel pipe containing feature unknown in prior art nonobvious).

68. *See Graham*, 383 U.S. at 17 (secondary factors considered regarding nonobviousness include commercial success and long-felt but unresolved needs for invention); *see also* Cooper v. Ford Motor Co., 748 F.2d 677, 679-80 (C.A.F.C. 1984)(feature on gas cap solving long-term mislatch problem considered in determining nonobviousness of invention); Perkin-Elmer Corp. v. Computervision Corp., 732 F.2d 888, 894-95 (C.A.F.C.)(evidence that projection printer first commercial success satisfying long felt need in industry indication invention nonobvious), *cert. denied*, 469 U.S. 857 (1984).

69. *See* Note, *Patent and Trade Secret Protection in University-Industry Research Relationship in Biotechnology*, 24 HARV. J. ON LEGIS. 191, 217 (1987)(in academic field of biotechnology, inventors imputed with constructive knowledge regarding all applicable publications).

70. *See* M. TREVAN, S. BOFFEY, K. GOULDING & P. STANBURY, BIOTECHNOLOGY: THE BIOLOGICAL PRINCIPALS 3 (1987)(techniques in molecular biology emerged in mid-1970s).

71. *See* S. OLSON, BIOTECHNOLOGY: AN INDUSTRY COMES OF AGE 93 (1986)(tremendous number of biotechnological publications concerning genetic engineering advancement).

developed, there is an increased potential for these molecules to be deemed obvious based on the prior art and, thus, nonpatentable.[72]

4. Trade Secrets

An alternative for researchers would be to resort to trade secret protection.[73] To qualify as a trade secret, the information must be novel to the extent that the information is not generally known by one in the industry to which the trade secret pertains.[74] Thus, a trade secret provides a competitive advantage as long as the information is kept secret by its possessor.[75] Once this secret information is disclosed, trade secret protection no longer exists.[76] Therefore, resorting to trade secret protection for biotechnology inventions would force scientists to refrain from the free flow of information to which they are normally accustomed.[77]

In light of the potential problems faced with patenting rDNA molecules, other alternatives for protecting intellectual property rights in this biotechnological area must be considered. One viable alternative is copyright protection.

---

72. *See* M. EPSTEIN, MODERN INTELLECTUAL PROPERTY 224 (1985). With the increased number of inventions in the biotechnology field, the prior art increases, thus, making it increasingly likely for courts to find new inventions obvious. *Id.*

73. *See* E. KINTER & J. LAHR, AN INTELLECTUAL PROPERTY LAW PRIMER 129 (2d ed. 1982)(preservation of technological information by trade secret alternative to patent and copyright protection); Note, *Patent and Trade Secret Protection in University-Industry Research Relationships in Biotechnology*, 24 HARV. J. ON LEGIS. 191, 218 (1987)(trade secret alternative protection for fruits of biotechnology research). *See generally* M. EPSTEIN, MODERN INTELLECTUAL PROPERTY 224 (1985)(trade secret information must be kept secret, used in one's business, and provide competitive advantage).

74. *See, e.g.*, Kewanee Oil Co. v. Bicron Corp. 416 U.S. 470, 475-76 (1974)(trade secret must not be generally known in trade or business); Greenberg v. Croydon Plastics Co., 378 F. Supp. 806, 812 (E.D. Pa.)(common practice and knowledge in art not granted trade secret protection), *vacated on other grounds*, 184 U.S.P.Q. 27 (1974).

75. *See* 4 RESTATEMENT OF THE LAW OF TORTS § 757, comment b (1939)(trade secret gives advantage over competitor without knowledge or use of secret); *see also* Ruckelshaus v. Monsanto Co., 467 U.S. 986, 1001 (1984)(stating that trade secret gives advantage over competitors that do not know secret); Mobay Chem. Corp. v. Costle, 447 F. Supp. 811, 824-25 (W.D. Mo. 1978)(acknowledging trade secret provides competitive advantage).

76. *See, e.g.*, Thomas v. Union Carbide Agric. Prods. Co., 473 U.S. 568, 584 (1985)(trade secret rights extinguished when company discloses information); Harrington v. National Outdoor Advertising Co., 196 S.W.2d 786, 791 (Mo. 1946)(trade secret protection extinguished if publicly disclosed).

77. *See* M. EPSTEIN, MODERN INTELLECTUAL PROPERTY 225-26 (1985)(scientists seeking trade secret protection must refrain from common practice in academia of disclosing discovery); *see also* Cooper, *The Patent System and the "New Biology"*, 8 RUTGERS J. COMPUTERS, TECH. & LAW 1, 6 (1980)(trade secret mentality already present in scientific arena restricting free flow of ideas).

II. COPYRIGHT PROTECTION FOR RECOMBINANT DNA

A. *The Copyright Act*

The current Copyright Act was revised in 1976 from the previous 1909 Copyright Act.[78] Congress' power to enact the 1976 Copyright Act, like the Patent Act, is derived from Article I, Section 8, Clause 8 of the United State Constitution.[79] This clause gives Congress the power "[t]o Promote the Progress of Science and useful Arts, by securing for limited Times to Authors . . . the exclusive Right to their respective Writings . . . "[80] The Patent Act focuses upon promoting new discoveries to aid the public[81] while the Copyright Act promotes artistic and literary creativity for the ultimate benefit of the general public.[82] To promote creativity, Congress grants the copyright holder the exclusive right to use or authorize use of the copyrighted work for

---

78. *See, e.g.*, Real Estate Data, Inc. v. Sidwell Co., 809 F.2d 366, 370-71 (7th Cir. 1987)(federal copyright statutes revised in 1976 from previous 1909 Copyright Act); Harvey Cartoons v. Columbia Pictures Indus., 645 F. Supp. 1564, 1569 (S.D.N.Y. 1986)(Copyright Act enacted in 1976 from previous 1909 Act); Silverman v. CBS Inc., 632 F. Supp. 1344, 1349 (S.D.N.Y. 1986)(1909 Copyright Act succeeded by 1976 Copyright Act); *see also* Act of March 4, 1909, ch. 320, 345 Stat. 1075 (current version at 17 U.S.C. §§ 101-810).

79. *See* U.S. CONST. art I, § 8, cl. 8 (Congress may give authors and inventors exclusive rights to writings and discoveries for limited time); *see also* Ladd v. Law & Tech. Press, 762 F.2d 809, 812 (9th Cir. 1985)(Copyright Act enacted by Congress pursuant to art. I, § 8, cl. 8 of Constitution), *cert. denied*, 475 U.S. 1045 (1986); Schnapper v. Foley, 667 F.2d 102, 111 (D.C. Cir. 1981)(Congress' power to pass legislation regarding copyrights contained in art. I, § 8 of Constitution), *cert. denied*, 455 U.S. 948 (1982); American Int'l Pictures, Inc. v. Foreman, 400 F. Supp. 928, 932 (S.D. Ala. 1975)(Copyright Act passed by Congress pursuant to art. I, § 8, cl. 8 of Constitution), *rev'd on other grounds*, 576 F.2d 661 (5th Cir. 1978).

80. U.S. CONST. art. I, § 8, cl. 8; *see also* Sony Corp. v. Universal City Studios, Inc., 464 U.S. 417, 428 (Congress promotes science and art by securing exclusive right for author to his writing for set time period), *reh'g denied*, 465 U.S. 1112 (1984); Rubin v. Boston Magazine Co., 645 F.2d 80, 83 (1st Cir. 1981)(Constitution grants Congress power to secure exclusive right for author to writing for limited time); Rodgers v. Eighty-Four Lumber Co., 617 F. Supp. 1021, 1023 (W.D. Pa. 1985)(Constitution grants Congress power to promote science and art by securing exclusive rights to writings for author for set time).

81. *See, e.g.*, Carter-Wallace, Inc. v. Riverton Laboratories, Inc., 304 F. Supp. 357, 367 (S.D.N.Y. 1969)(purpose of patent not to reward inventor but gives incentive to publicly disclose new and useful inventions), *aff'd*, 433 F.2d 1034 (2d Cir. 1970); Lage v. Caldwell Mfg. Co., 221 F. Supp. 802, 805 (D. Neb. 1963)(reward to inventor secondary, merely means for advancement of science and arts).

82. *See, e.g.*, Hutchinson Tel. Co. v. Fronteer Directory Co., 770 F.2d 128, 130 (8th Cir. 1985)(purpose of copyright clause to promote artistic creativity and free flow of benefits to public); Pacific & S. Co. v. Duncan, 744 F.2d 1490, 1498-99 n.14 (11th Cir.)(copyright laws function to encourage creativity from which society will benefit), *reh'g denied*, 749 F.2d 733 (11th Cir. 1984), *cert. denied*, 471 U.S. 1004 (1985); Harry Fox Agency, Inc. v. Mills Music, Inc., 543 F. Supp. 844, 862 (S.D.N.Y. 1982)(fundamental purpose of copyright laws to encourage production and spread of artistic works for general public good), *rev'd on other grounds*, 720 F.2d 773 (2d Cir. 1983).

the duration of the author's life plus fifty years, in exchange for public availability of the creative work.[83] The protection afforded the author is balanced with the primary purpose of stimulating artistic creativity to benefit the general public.[84]

Copyright protection extends to works of original authorship which are fixed in a tangible medium of expression;[85] such works include literary, dramatic, musical, pictorial, sculptural, and graphic expressions.[86] Copyrightable works also include pantomimes, choreographs, motion pictures, and sound recordings.[87] Although copyright protection is granted to many forms of expression, this protection does not extend to the ideas which result

---

83. *See* 17 U.S.C. § 302 (1982). The copyrighted work endures for the author's life plus fifty years after the death of the author. *Id.*; *see also* Goldstein v. California, 412 U.S. 546, 555 (1973)(Congress grants author exclusive rights to fruits of labor to encourage intellectual and artistic creation); Sony Corp. v. Universal City Studios, Inc., 464 U.S. 417, 429 (1984). The limited grant of exclusive rights is intended to motivate creativity and, thus, allow public access to products of the author's genius upon expiration of the limited period of control. *Id.*

84. *See, e.g.*, United States v. Paramount Pictures, Inc., 334 U.S. 131, 158 (1948)(reward to author secondary to securing general benefits received by public from authors); Fox Film Corp. v. Doyal, 286 U.S. 123, 127-28 (1932)(primary purpose of copyright not to reward author but to secure general benefits derived by public from labor of author); American Int'l Pictures, Inc. v. Foreman, 400 F. Supp. 928, 932 (S.D. Ala. 1975)(benefits derived by public from work of authors, primary purpose of copyright laws), *rev'd on other grounds*, 576 F.2d 661 (5th Cir. 1978).

85. *See* 17 U.S.C. § 102(a) (1982). "Copyright protection subsists . . . in original works of authorship fixed in any tangible medium of expression . . . ." *Id.*; *see also* West Publishing Co. v. Mead Data Cent., Inc., 799 F.2d 1219, 1223, 1227 (8th Cir. 1986)(case arrangement in legal reporter copyrightable original work of authorship), *cert. denied*, __U.S. __, 107 S. Ct. 962, 93 L. Ed. 2d 1010 (1987); M. Kramer Mfg. Co. v. Andrews, 783 F.2d 421, 432-33, 441-42 (4th Cir. 1986)(copyright protection extended to computer program for audiovisual work fixed in memory device); Financial Information, Inc. v. Moody's Investors Serv., Inc., 751 F.2d 501, 502, 507 (2d Cir. 1984)(financial information compiled on index cards copyrightable work when originality present).

86. *See* 17 U.S.C. § 102(a) (1982). Works of authorship include literary works; dramatic works; musical works; choreographic works and pantomimes; sculptural, graphic, and pictorial works; audiovisual works such as motion pictures and sound recordings. *Id.*; *see also* Baltimore Orioles, Inc. v. Major League Baseball Players, 805 F.2d 663, 669 n.8 (7th Cir. 1986)(works of authorship include musical, literary, dramatic sculptural, graphic and pictorial), *cert. denied*, __ U.S. __ 107 S. Ct. 1593, 94 L. Ed. 2d 782 (1987); Norris Indus., Inc. v. International Tel. & Tel. Corp. 696 F.2d 918, 921 n.6 (11th Cir.)(Copyright Act protects literary, dramatic, musical, sculptural, graphic pictorial works), *reh'g denied*, 703 F.2d 582 (11th Cir.), *cert. denied*, 464 U.S. 818 (1983).

87. *See* 17 U.S.C. § 102(a) (1982)(copyright protection delineated); *see also* Donald Frederick Evans & Assocs., Inc. v. Continental Homes, Inc., 785 F.2d 897, 903 n.8 (11th Cir. 1986)(copyright extends to pantomimes, choreographs, sound recordings, and motion pictures); Raffoler, Ltd. v. Peabody & Wright, Ltd., 671 F. Supp. 947, 950-51 n.1 (E.D.N.Y. 1987)(works of authorship include sound recordings, motion pictures, pantomimes, and choreographs).

in the creation of an expression.[88] For example, a book disclosing a novel method for bookkeeping contains a copyrightable printed text, but the novel bookkeeping ideas expressed in the text are not copyrightable.[89] Another limitation of copyright protection pertains to the utilitarian aspects of the work.[90] Any portion of a work which does more than convey information or portray an appearance is considered utilitarian in nature and, therefore, not copyrightable.[91] Thus, any system, process, procedure, or method of operation is excluded from copyright protection.[92]

A work is protected by copyright as soon as it becomes fixed in a tangible medium.[93] Publicly distributed copyrighted works should be affixed with a copyright notice.[94] Within three months of publication with notice, two

---

88. *See, e.g.*, Mazer v. Stein, 347 U.S. 201, 217 (copyright protection given to expression of idea, not idea itself), *reh'g denied*, 347 U.S. 949 (1954); Rachel v. Banana Republic, Inc., 831 F.2d 1503, 1507 (9th Cir. 1987)(ideas themselves not protected by copyright); Worth v. Selchow & Righter Co., 827 F.2d 569, 572 (9th Cir. 1987)(ideas alone not copyrightable).

89. *See* Baker v. Selden, 101 U.S. 99, 103-04 (1879)(copyright protected book's explanatory text, not bookkeeping system itself).

90. *See, e.g.*, Apple Computer, Inc. v. Franklin Computer Corp., 714 F.2d 1240, 1250 (3d Cir. 1983)(purely utilitarian works not protected by copyright), *cert. dismissed*, 464 U.S. 1033 (1984); Gay Toys, Inc. v. Buddy L. Corp., 703 F.2d 970, 974 (6th Cir. 1983)(articles with intrinsic utilitarian function not protected by copyright); Kieselstein-Cord v. Accessories by Pearl, Inc., 632 F.2d 989, 992 (2d Cir. 1980)(1976 Copyright Act protection not extended to functional elements of articles).

91. *See, e.g.*, Brandir Int'l Inc. v. Cascade Pac. Lumber Co., 834 F.2d 1142, 1143 n.1 (2d Cir. 1987)(portion of article doing more than conveying information or portraying appearance considered, useful and not copyrightable); Carol Barnhart Inc. v. Economy Cover Corp., 773 F.2d 411, 414-15 (2d Cir. 1985). A useful article does more than portray an appearance or convey information and can only be copyrighted if it possesses an artistic or aesthetic feature separable from its utilitarian aspect. *See id.*

92. *See* 17 U.S.C. § 102(b) (1982). Copyright protection does not extend to a system, process, procedure, or method of operation. *Id.*; *see also* Toro Co. v. R. & R. Prods. Co., 787 F.2d 1208, 1211 (8th Cir. 1986)(copyright protection not granted for system, process, procedure, method of operation, regardless of how work embodied); Digital Communications Assocs., Inc. v. Softklone Distrib. Corp., 659 F. Supp. 449, 454 (N.D. Ga. 1987)(system, process, procedure, method of operation, not copyrightable).

93. *See, e.g.*, West Publishing Co. v. Mead Data Cent., Inc., 799 F.2d 1219, 1223 (8th Cir. 1986)(Copyright Act provides protection for original works fixed in tangible medium of expression), *cert. denied*, __ U.S. __, 107 S. Ct. 962, 93 L. Ed. 2d 1010 (1987); M. Kramer Mfg. Co. v. Andrews, 783 F.2d 421, 432-33 (4th Cir. 1986)(audiovisual work protected by copyright when fixed in tangible medium); Financial Information, Inc. v. Moody's Investors Serv., Inc., 751 F.2d 501, 507 (2d cir. 1984)(data copyrightable when compiled on index card medium in original manner).

94. *See* 17 U.S.C. § 401(a) (1982). A published copyrighted work should contain a notice of copyright on publicly distributed copies. *Id.*; *see also* Midway Mfg. Co. v. Artic Int'l, Inc., 547 F. Supp. 999, 1008 (N.D. Ill. 1982)(copyrighted work published and publicly distributed should contain notice of copyright), *aff'd*, 704 F.2d 1009 (7th Cir.), *cert. denied*, 464 U.S. 823 (1983); O'Neill Devs., Inc. v. Galen Kilburn, Inc., 524 F. Supp. 710, 713 (N.D. Ga. 1981)(publication of work requires notice of copyright).

copies of the work should be deposited at the Copyright Office for use or disposition by the Library of Congress.[95] Published and unpublished works must be registered during the term of the copyright as a prerequisite for instituting a copyright infringement action.[96]

B. *Copyright Protection for Computer Programs*

Copyright appears to be a viable alternative for the protection of intellectual property rights to rDNA molecules.[97] This is demonstrated by the similarities between the rDNA molecule and a computer program,[98] deemed copyrightable by Congress through the 1980 revision of Sections 101 and 117 of the 1976 Copyright Act.[99] Recent cases have interpreted the statutory language of the revised sections as extending copyright protection to computer programs, regardless of the type of medium in which the program is fixed, whether it be a written document, magnetic disk, or computer chip.[100] Understanding the similarity between computer programs and

---

95. *See* 17 U.S.C. §§ 407(a), (b), (d) (1982). Copyright holder may be subject to penalties if two copies of the work are not deposited at the Copyright Office for use by the Library of Congress within three months of publication with notice of copyright. *Id.* § 407(d); *see also* Ladd v. Law & Tech. Press, 762 F.2d 809, 809-11, 815 (9th Cir. 1985)(defendant subject to fines for failure to deposit two complete copies of work at Copyright Office for use by Library of Congress pursuant to 17 U.S.C. § 407 (1982)), *cert. denied*, 475 U.S. 1045 (1986).

96. *See* 17 U.S.C. § 411(a) (1982). This section states that no copyright infringement action may be brought unless the copyright has been registered with the Copyright Office. *Id.*; *see also* Midway Mfg. Co. v. Dirkschneider, 543 F. Supp. 466, 481 (D. Neb. 1981)(copyright registration prerequisite to institution of infringement action); Co-opportunities, Inc. v. National Broadcasting Co., 510 F. Supp. 43, 48 (N.D. Cal. 1981)(registration of copyright condition precedent to instituting infringement action).

97. *See* J. SIGALOS, INTELLECTUAL PROPERTY PROTECTION FOR BIOTECHNOLOGY INNOVATIONS 8 (1987)(suggesting copyright protection for recombinant DNA); *see also* Davidson, *Common Law, Uncommon Software*, 47 U. PITT. L. REV. 1037, 1104-05 (1986)(copyright protection viable alternative for intellectual property rights to DNA). *See generally* Kayton, *Copyright in Living Genetically Engineered Works*, 50 GEO. WASH. L. REV. 191, 191-205 (1982)(suggesting copyright protection for works genetically engineered by rDNA technology).

98. *See* J. SIGALOS, INTELLECTUAL PROPERTY PROTECTION FOR BIOTECHNOLOGY INNOVATIONS 12-13 (1987). An rDNA plasmid, like computer software, is a set of informational instructions. Both plasmid and software lack utility until inserted into the cell or computer, respectively. *Id. See generally* Kayton, *Copyright in Living Genetically Engineered Works*, 50 GEO. WASH. L. REV. 191, 199-201 (1982)(pointing out similarity between genetically engineered works using rDNA technique and computer programs). *Id.*

99. *See* 17 U.S.C. §§ 101, 117 (1982). Section 101 added a definition for "computer program," and section 117 was replaced by a new section which allowed an owner of a computer program copy to modify or make a new copy as a necessary step in utilizing the program with a computer. *See id.*; *see also* M. Kramer Mfg. Co. v. Andrews, 783 F.2d 421, 432 (4th Cir. 1986)(1980 amendment of Copyright Act expressly included computer programs as copyrightable subject matter).

100. *See, e.g.*, Apple Computer, Inc. v. Formula Int'l, Inc., 594 F. Supp. 617, 619-23

rDNA and, thus, the copyrightability of recombinant DNA, requires an examination of the nature and function of both works.

A programmable computer contains hardware which is the computer component capable of performing various functions such as adding two numbers together.[101] A computer program specifies the exact order in which these functions are to be performed by the hardware.[102] The hardware "reads" the program instructions by sensing a series of electrical impulses which have been encoded into a fixed medium such as a computer chip.[103] Thus, by "reading" these electrical impulses which code for specific functions, the hardware can execute a particular task as dictated by the computer program.[104]

There are three main categories of computer programs which, by working with the hardware, are capable as a unit of completing a given task.[105] These are the microcode, which is a substitute for certain parts of the hardware circuitry;[106] the application program, called software, which dictates the desired task to be performed by the hardware;[107] and the operating system, which attends the interaction between the application program to be executed and the hardware.[108]

Computer programs exist in two basic forms: source code, which is the

---

(C.D. Cal. 1984)(copyright protection for computer program extends to program on diskette and read only memory computer chip); Micro-Sparc, Inc. v. Amtype Corp., 592 F. Supp. 33, 34-36 (D. Mass, 1984)(copyright protection extends to written form of computer program and same program on diskette).

101. *See generally* T. PRATT, PROGRAMMING LANGUAGES: DESIGN AND IMPLEMENTATION 15-16 (2d ed. 1983)(giving list of functions performed by computer hardware).

102. *See* R. CONWAY & D. GRIES, AN INTRODUCTION TO PROGRAMMING 4 (3d ed. 1979)(program specifies exact sequence in which hardware to execute primitive functions).

103. *See* B. ARDEN, WHAT CAN BE AUTOMATED? 12 (1980)(hardware of programmable computer "reads" instructions in program which directs primitive functions to be performed). *See generally* C. SIPPL, DATA COMMUNICATIONS DICTIONARY (1976)(defining "read": "to sense the presence of information on a recording medium").

104. *See* Samuelson, *CONTU Revisited: The Case Against Copyright Protection for Computer Programs in Machine-Readable Form*, 1984 DUKE L.J. 663, 676 (hardware performs steps necessary to accomplish task directed by program).

105. *See id.* at 676, 680 (programs and hardware interacting to perform given task known as the "virtual machine").

106. *See* Patterson, *Microprogramming*, SCI. AM. 50, 52 (March 1983)(path electrical impulses must follow stored in microcode instead of hardware circuitry).

107. *See* B. ARDEN, WHAT CAN BE AUTOMATED? 13-15 (1980)(program which brings about desired result considered application program for that particular task).

108. *See* Toong & Gupta, *Personal Computers*, SCI. AM 87, 88 (Dec. 1982)(operating system mediates between machine and human operator and between machine and application program which enables computer to perform specific task). *See generally* Note, *Defining the Scope of Copyright Protection for Computer Software*, 38 STAN. L. REV. 497, 502 (1986)(operating system enables computer hardware to execute application program).

written text of the program in human readable form,[109] and machine code (often called object code), which is the electrical impulses corresponding to the source code that are readable by the computer.[110] The source code is transformed into machine code by the computer's operating system program called a compiler.[111]

Prior to enactment of the 1976 Copyright Act, Congress appointed the National Commission on New Technological Uses of Copyrighted Works (CONTU) to determine the need for copyright protection of computer programs.[112] Based on CONTU's recommendation that computer programs be granted copyright protection, Congress amended the Copyright Act in 1980.[113] Although the 1980 amendment deemed computer programs copyrightable, the amendment's scope of protection for computer programs was

---

109. *See* Note, *Copyright Protection of Computer Program Object Code*, 96 HARV. L. REV. 1723, 1725 (1983). Programs in human readable form exist in two levels of language. *Id.* The first level, called assembly language, is written in alphanumeric form. For example halt processing would be expressed in assembly language as HLT, e.g., "HLT" means "halt processing." The next level, called high-level language, uses English words and syntax and, thus, is easier to understand and use. Both high level and assembly languages are termed "source code" or "source programs." *Id.*

110. *See* Plains Cotton Co-op. Assoc. v. Goodpasture Computer Serv., 807 F.2d 1256, 1258 (5th Cir.)(programs in computer-readable langauge called object code), *cert. denied*, __ U.S. __, 108 S. Ct. 80, 98 L. Ed. 2d 42 (1987); *see also* Note, *Copyright Protection for Computer Programs in Read Only Memory Chips*, 11 HOFSTRA L. REV. 329, 340-42 (1982). Machine readable language is evidenced by a binary representation consisting of electrical pulses which are either off (0) or on (1). This program form, referred to as object code, corresponds to the source code, and can be read only by the computer. *Id.*

111. *See* Apple Computer, Inc. v. Franklin Computer Corp., 714 F.2d 1240, 1243 (3d Cir. 1983), *cert. denied*, 464 U.S. 1033 (1984). "Programs written in source code can be converted or translated by a 'compiler' program into object code for use by the computer." *Id. See generally* Samuelson, *CONTU Revisited: The Case Against Copyright Protection for Computer Programs in Machine-Readable Form*, 1984 DUKE L.J. 663, 686 (source code transformed to machine code by compiler).

112. *See, e.g.*, Whelan Assocs., Inc. v. Jaslow Dental Laboratory, Inc., 797 F.2d 1222, 1240 (3d Cir. 1986)(Congress appointed CONTU in 1974 to study problems and issues concerning computer technology and copyright protection), *cert. denied*, __ U.S. __, 107 S. Ct. 877, 93 L. Ed. 2d 831 (1987); Apple Computer, Inc. v. Formula Int'l Inc., 725 F.2d 521, 524 (9th Cir. 1984)(CONTU appointed in 1974 by Congress to establish extent computer programs protected by copyright).

113. *See* 17 U.S.C. §§ 101, 117 (1982)(section 101 defining computer program and section 117 allowing owner of computer program copy to make additional copy if such copy essential step in utilization of program with computer). *See generally* Note, *Software Piracy and the Personal Computer: Is the 1980 Software Copyright Act Effective?*, 4 COMPUTER L.J. 171, 181-83 (1983)(Congress enacted without modification CONTU's recommendations as Computer Software Copyright Act of 1980); Note, *Copyright Infringement of Computer Programs: A Modification of the Substantial Similarity Test*, 68 MINN. L. REV. 1264, 1270-71 (1984)(Congress enacted CONTU's recommendation verbatim, extending copyright protection to all types of computer programs).

not defined until subsequent cases interpreted the statutory language.[114]

Through judicial interpretation, several issues pertaining to the scope of copyright protection for computer programs were resolved.[115] The first issue was whether copyright protection extended to computer programs in machine readable form (machine code or object code) in addition to human readable form (source code).[116] Lower federal courts have reasoned that the statutory language encompassed copyright protection for machine readable programs because the statute included any work which could be perceived, reproduced, or communicated directly or with the help of a machine.[117] Furthermore, the statutory definition of a computer program included any statements or instructions used indirectly or directly in a computer to bring about a result.[118] Because only programs in machine code can be *directly*

---

114. *See* Note, *Copyright Protection for Computer Programs in Read Only Memory Chips*, 11 HOFSTRA L. REV. 329, 349 (1982)(Congress' mandate that computer programs copyrightable left scope of copyright protection to courts); *see also* Note, *Copyright — Copyright Act of 1976 — Operating System Computer Programs Expressed in Object Code and Stored on ROM Are Copyrightable*, 29 VILL. L. REV. 894, 917 (1984)(computer programs copyrightable by 1980 amendment, yet, scope of protection undefined).

115. *See, e.g.*, Apple Computer, Inc. v. Formula Int'l Inc., 725 F.2d 521, 523-25 (9th Cir. 1984)(computer operating system program copyrightable); Apple Computer, Inc v. Franklin Computer Corp., 714 F.2d 1240, 1249 (3d Cir. 1983)(computer program in source code or object code copyrightable), *cert. dismissed*, 464 U.S. 1033 (1984); Midway Mfg. Co. v. Artic Int'l, Inc., 704 F.2d 1009, 1012 (7th Cir.)(distinctive set of sounds and images stored in circuit board of computer copyrightable while physical design of circuit board patentable), *cert. denied*, 464 U.S. 823 (1983). *See generally* Note, *Copyright Infringement of Computer Programs: A Modification of the Substantial Similarity Test*, 68 MINN. L. REV. 1264, 1271 (1984)(discussing courts, difficulty determining whether programs in object code, programs stored in silicon chips, and operating system programs, were copyrightable after 1980 amendment). *Id.*

116. *See Franklin Computer Corp.*, 714 F.2d at 1248-49 (computer program, whether source code or object code, protected by copyright law); *see also* Williams Elecs., Inc. v. Artic Int'l, Inc., 685 F.2d 870, 876-77 (3d Cir. 1982)(Congress intended copyright protection for source code and object code computer programs); Midway Mfg. Co. v. Strohon, 564 F. Supp. 741, 750 (N.D. Ill. 1983)(human readable source code and machine readable object code protected by copyright legislation); G.C.A. Corp. v. Chance, 217 U.S.P.Q. 718, 720 (N.D. Cal. 1982)(copyrighted source code protects object code since object code encryption of copyrighted source code).

117. *See Franklin Computer Corp.*, 714 F.2d at 1248 (quoting section 102(a) as including object code as copyrightable subject matter); *Strohon*, 564 F. Supp. at 750 (machine readable object code protectible by copyright under section 102(a)). The statute provides that, "copyright protection subsists . . . in original works of authorship fixed in any tangible medium of expression . . . from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device." 17 U.S.C. § 102(a) (1982).

118. *See* 17 U.S.C. § 101 (1982). "A computer program' is a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result." *Id.*; *see also Franklin Computer Corp.*, 714 F.2d at 1248 (only object code used directly by computer); *Strohon*, 564 F. Supp. at 750 (object code encompassed by section 101 definition of computer program because object code, alone, used directly by computer).

used by a computer, the courts have reasoned the statute must have been intended to cover machine readable programs such as application and operating system programs.[119] The Third Circuit addressed whether machine readable programs could be considered literary works within the meaning of the Copyright Act.[120] The statutory language described literary works as including words, numbers, numerical symbols, or indicia embodied in material objects such as film, tape, and disks.[121] Because this language would include machine readable programs embodied in material objects such as disks or computer chips, the court held that machine readable programs were literary works within the meaning of the Copyright Act.[122]

A second issue regarding the extent of computer program copyright protection concerned the tangible medium in which the program was fixed.[123] It was argued in both the United States District Court for the Northern District of Illinois and the Third Circuit that silicon chips such as Read Only Memory (ROM),[124] which could embody a computer program, were machine parts or utilitarian objects and, therefore, not copyrightable.[125]

---

119. *See, e.g.*, Apple Computer, Inc. v. Franklin Computer Corp., 714 F.2d 1240, 1248 (3d Cir. 1983)(Copyright Act protects machine readable code because only code used directly by computer), *cert. dismissed*, 464 U.S. 1033 (1984); Midway Mfg. Co. v. Strohon, 564 F. Supp. 741, 750 (N.D. Ill. 1983)(Copyright legislation protects object code used directly by computer).

120. *See Franklin Computer Corp.*, 714 F.2d at 1249 (computer program in source code or object code classified as literary work), *cert. dismissed*, 464 U.S. 1033 (1984).

121. *See* 17 U.S.C. § 101 (1982). " 'Literary works' are works . . . expressed in words, numbers, or other verbal or numerical symbols or indicia, regardless of the nature of the material objects, such as books, . . . phonorecords, film, tapes, disks, or cards, in which they are embodied." *Id.*

122. *See Franklin Computer Corp.*, 714 F.2d at 1249 (Copyright Act definition of "literary works" expanded to include object code embedded in computer chip).

123. *See, e.g.*, Williams Elecs., Inc. v. Artic Int'l, Inc., 685 F.2d 870, 874-77 (3d Cir. 1982)(computer program embedded in Read Only Memory (ROM) chip protected by copyright); Stern Elecs., Inc. v. Kaufman, 669 F.2d 852, 854-57 (2d Cir. 1982)(computer program for audiovisual work fixed in Programmable Read Only Memory (PROM) device protected by copyright); Midway Mfg. Co. v. Artic Int'l, Inc., 547 F. Supp. 999, 1007-09 (N.D. Ill. 1982)(computer program for audiovisual work embedded in Read Only Memory (ROM) protected by copyright), *aff'd*, 704 F.2d 1009 (7th Cir.), *cert. denied*, 464 U.S. 823 (1983); Tandy Corp. v. Personal Micro Computers, Inc., 524 F. Supp. 171, 173 (N.D. Cal. 1981)(imprinted computer program on silicon chip subject to copyright laws).

124. *See, e.g.*, Apple Computer, Inc. v. Franklin Computer Corp., 714 F.2d 1240, 1243 (3d Cir. 1983)(Read Only Memory internal permanent memory device of computer on which computer program stored and read but not erased or rewritten), *cert. dismissed*, 464 U.S. 1033 (1984); Stern Elecs. Inc. v. Kaufman, 669 F.2d 852, 854 n.1 (2d Cir. 1982)(Read Only Memory is memory device of computer on which information permanently stored). *See generally* Note, *Copyright Protection of Computer Program Object Code*, 96 HARV. L. REV. 1723, 1725 n.21 (ROM is memory device on which information permanently fixed by manufacturer and can be read only, not rewritten or erased).

125. *See, e.g.*, *Williams Elecs., Inc.*, 685 F.2d at 874 (defendant claimed copyright protec-

This argument failed because the copyright sought only to protect the artistic expression embodied in the tangible medium, the silicon chip, and did not purport to protect the use of the silicon chip itself.[126]

A final issue raised pertaining to copyright protection for computer programs was whether an operating system program, attending the interactions between the software application program and the hardware, was copyrightable.[127] It was asserted in the United States Courts of Appeals for the Ninth and Third Circuits that this type program was a process, method of operation, or system and, therefore, not copyrightable.[128] Both courts held, however, that the copyright sought to protect the instructions of the operating system program, not the method by which the program instructed the computer to perform.[129] Therefore, despite the copyrighted work performing a useful function, which was not protected by the copyright, this fact failed to bar the issuance of a copyright for the operating system program itself.[130]

C. *Similarities Between Computer Programs and Recombinant DNA*

The structure and function of rDNA is analogous to that of a computer program. Because all proteins are composed of the same primary components, amino acids, it is the order—the code—in which these components

---

tion not extended to program fixed in ROM chip because ROM machine part or utilitarian object); *Midway Mfg. Co.*, 547 F. Supp. at 1008-09 (defendant argued ROM utilitarian object and, thus, program embodied in ROM not subject to copyright).

126. *See, e.g.*, *Williams Elecs., Inc.*, 685 F.2d at 874-75 (artistic expression fixed in ROM copyrightable regardless of utilitarian nature of chip); *Midway Mfg. Co.*, 547 F. Supp. at 1008-09 (copyright protection extends to program recorded in ROM, not ROM itself).

127. *See, e.g.*, Apple Computer, Inc. v. Formula Int'l Inc., 725 F.2d 521, 523-25 (9th Cir. 1984)(operating systems program interacting with computer system, not computer user, copyrightable); Apple Computer, Inc. v. Franklin Computer Corp., 714 F.2d 1240, 1249-52 (3d Cir. 1983)(operating system program not per se barred from copyright), *cert. dismissed*, 464 U.S. 1033 (1984); *see also* G.C.A. Corp. v. Chance, 217 U.S.P.Q. 718, 719-20 (N.D. Cal. 1982)(object code version of copyrighted source code of operating program considered same work and protected by copyright); Tandy Corp. v. Personal Micro Computers, Inc., 524 F. Supp. 171, 173 (N.D. Cal. 1981)(operating program embedded in ROM protected by copyright).

128. *See, e.g.*, *Formula Int'l Inc.*, 725 F. 2d at 523 (defendant alleged program controls internal operation of computer, process or method and, therefore, not copyrightable); *Franklin Computer Corp.*, 714 F.2d at 1250 (defendant claimed computer operating system program noncopyrightable system, process or method of operation).

129. *See, e.g.*, *Formula Int'l Inc.*, 725 F.2d at 525 (copyright sought for instructions themselves, not for method which instructs computer to perform operating functions); *Franklin Computer Corp.*, 714 F.2d at 1251 (copyright not for method which instructs computer to perform functions, but for instructions only).

130. *See, e.g.*, *Formula Int'l Inc.*, 725 F.2d at 524 (copyright protection extends to works of authorship regardless of uses to which works may be put); *Franklin Computer Corp.*, 714 F.2d at 1251-52 (useful function of article eligible for copyright does not bar or invalidate copyrightability).

are arranged which results in a particular protein.[131] The rDNA, which contains the coded genetic information for the synthesis of a particular protein, is similar to the application program of a computer, which dictates the desired task to be performed by the computer hardware.[132] The rDNA plasmid is inserted into the cell, the "computer," where the ultimate task of protein synthesis occurs.[133] Inside the cell, messenger RNA (mRNA), which "reads" the genetic information of the rDNA, functions as the operating system program of a computer.[134] Just as a computer's operating system tells the hardware the particular task the application program is directing it to perform, the mRNA instructs the ribosome, the "hardware," to execute the code provided within the rDNA to synthesize the particular protein.[135] The "hardware" ribosome carries out the function of directing protein synthesis by allowing transfer RNA (tRNA), which carries amino acids that form protein, to "read" the information contained in the mRNA and thus form the protein for which the rDNA codes.[136]

---

131. *See* J. WATSON, N. HOPKINS, J. ROBERTS, J. STEITZ & A. WEINER, MOLECULAR BIOLOGY OF THE GENE 92 (4th ed. 1987)(genetic information in cell dictates order of amino acids forming specific protein); *see also* H. CURTIS, INVITATION TO BIOLOGY 75 (1972)(order in which amino acids arranged determines biological character of protein); R. DYSON, CELL BIOLOGY, A MOLECULAR APPROACH 91 (2d ed. 1978)(sequence of amino acids determines shape, biological function, and physical and chemical properties of protein).

132. *Compare* 9 J. SETLOW, GENETIC ENGINEERING: PRINCIPLES AND METHODS 155 (1987)(recombinant DNA plasmid in host bacterial cell directs synthesis and secretion of protein for which DNA codes) *with* Samuelson, *CONTU Revisited: The Case Against Copyright Protection for Computer Programs in Machine-Readable Form*, 1984 DUKE L.J. 663, 680 (application program directs task to be performed by computer).

133. *See* J. SIGALOS, INTELLECTUAL PROPERTY PROTECTION FOR BIOTECHNOLOGY INNOVATIONS 12 (1987)(plasmids are "software" causing microorganisms to synthesize products); *see also* Davidson, *Common Law, Uncommon Software*, 47 U. PITT. L. REV. 1037, 1104 (1986)(DNA, like software, contains information and accomplishes task of directing protein synthesis in living organism).

134. *Compare* 1 J. WATSON, N. HOPKINS, J. ROBERTS, J. STEITZ & A. WEINER, MOLECULAR BIOLOGY OF THE GENE 84, 298-300 (4th ed. 1987)(messenger RNA replicates information contained in DNA and carries to site of protein synthesis) *with* Samuelson, *CONTU Revisited: The Case Against Copyright Protection for Computer Programs in Machine-Readable Form*, 1984 DUKE L.J. 678 n.54 (operating systems program manages flow of information between application program, directing specific task for computer to perform, and computer).

135. *Compare* Note, *Defining the Scope of Copyright Protection for Computer Software*, 38 STAN. L. REV. 497, 502 (1986)(operating system program enables computer hardware to execute application program task) *with* Cooper, *The Patent System and the "New Biology"*, 8 RUTGERS J. COMPUTERS, TECH. & LAW 1, 2 (1980)(messenger RNA encodes information of DNA and instructs ribosome, protein-manufacturing unit of cell, to execute synthesis of protein for which DNA codes).

136. *See* B. ALBERTS, D. BRAY, J. LEWIS, M. RAFF, K. ROBERTS & J. WATSON, MOLECULAR BIOLOGY OF THE CELL 109 (1983). The ribosome serves as a biochemical machine on which the tRNA molecules position themselves to read the genetic information encoded in the mRNA. The ribosome moves along the strand-like mRNA molecule, allowing tRNA mol-

The issues surrounding the scope of protection of a copyrighted computer program are also pertinent to copyrighted rDNA. For example, although the rDNA nucleotide sequence that codes for a particular protein can be written on paper in human readable form and, therefore, should be copyrightable,[137] does the copyright extend to the actual rDNA molecule that can only be "read" inside the cell?[138] Applying the reasoning pertaining to machine readable and human readable computer programs, the rDNA molecule could be viewed as "machine readable" and, therefore, copyrightable, because it can be "read" by the cell, the "machine."[139] Furthermore, the "machine readable" rDNA molecule should be considered a literary work because the information conveyed by the nucleotide sequence,[140] the indicia, is embodied in the rDNA molecule, a material object, and thus fits the statutory definition of a literary work.[141]

---

ecules to join amino acids forming the protein for which the mRNA and rDNA coded. *Id.*; *see also* Barkstrom, *Recombinant DNA and the Regulation of Biotechnology: Reflections on the Asilomar Conference, Ten Years After*, 19 AKRON L. REV. 81, 82 (1985)(ribosome moves down mRNA attracting and connecting molecules forming protein).

137. *Compare* Midway Mfg. Co. v. Strohon, 564 F. Supp. 741, 750 (N.D. Ill. 1983)(computer program in human readable source code protected by copyright) *with* J. SIGALOS, INTELLECTUAL PROPERTY PROTECTION FOR BIOTECHNOLOGY INNOVATIONS 12 (1987) (plasmids, like computer programs, identified by sequence of informational instructions which are depictable and diagrammable on paper).

138. *See generally* Cooper, *The Patent System and the "New Biology"*, 8 RUTGERS J. COMPUTERS, TECH. & LAW 1, 10 (1980)(plasmid inanimate chemical until inserted into cell).

139. *Compare* Apple Computer, Inc. v. Franklin Computer Corp., 714 F.2d 1240, 1248-49 (3d Cir. 1983)(computer program, whether source code or machine readable object code, protected by copyright law), *cert. dismissed*, 464 U.S. 1033 (1984) *and* Midway Mfg. Co. v. Strohon, 564 F. Supp. 741, 750, 752 (N.D. Ill. 1983)(machine readable object code which is copy of human readable source code, protected by copyright) *and* G.C.A. Corp. v. Chance, 217 U.S.P.Q 718, 720 (N.D. Cal. 1982)(copyright protection extended to object code encryption of copyrighted source code) *with* 9 J. SETLOW, GENETIC ENGINEERING: PRINCIPLES AND METHODS 155 (1987)(insertion of recombinant DNA plasmids into host bacterial cell results in "reading" of DNA by cell and synthesis and secretion of protein for which rDNA codes).

140. *See* R. DYSON, CELL BIOLOGY, A MOLECULAR APPROACH, 88, 187 (2d ed. 1974)(order of nucleotides in DNA records genetic information of cell). The order of nucleotides in a DNA molecule determines which amino acids are incorporated into a chain thus forming a specific protein. *Id.* For a general discussion of nucleotide sequence see B. ALBERTS, D. BRAY, J. LEWIS, M. RAFF, K. ROBERTS & J. WATSON, MOLECULAR BIOLOGY OF THE CELL 106-11 (1983).

141. *Compare* 1 J. WATSON, N. HOPKINS, J. ROBERTS, J. STEITZ & A. WEINER, MOLECULAR BIOLOGY OF THE GENE 74, 78 (4th ed. 1987)(DNA real molecular object consisting of four nucleotide building blocks analogous to long sentence made with four-letter alphabet) *with* 17 U.S.C. § 101 (1982) (" 'Literary works' are works . . . expressed in words, numbers, or other verbal or numerical symbols or indicia, regardless of the nature of the material objects . . . in which they are embodied.") *See generally* Kayton, *Copyright in Living Genetically Engineered Works*, 50 GEO. WASH. L. REV. 191, 200 (1982)(scientist authors literary work

In addition, the rDNA molecule should not be barred from copyright protection because of its utilitarian nature once it is inserted into the cell.[142] The issue is analogous to the question of whether computer programs embodied in silicon chips are machine parts or utilitarian objects and, therefore, not copyrightable.[143] As pointed out in prior case law, the copyright seeks to protect the information embodied in the tangible medium, such as the silicon chip or an rDNA molecule, and does not purport to protect any utilitarian aspect of the object itself.[144] Therefore, any useful function the rDNA molecule may perform inside the cell should not bar copyrightability of the informational expression embodied in the rDNA molecule.[145]

Copyright protection for rDNA may also be contested as to whether a copyright on an rDNA molecule should extend to the mRNA which copies the rDNA information and relays it to the ribosomes.[146] As seen in cases

---

composed of nucleotides, "indicia," in genetically engineered work). Kayton also states that the genetically engineered "literary work" is original because it involves joining DNA fragments from separate organisms, thus, forming an original DNA sequence compilation. *Id.* at 201; *see also* 17 U.S.C. § 102 (1982)(requiring work of authorship to be original); 17 U.S.C. § 101 (1982)(compilation assembly of pre-existing materials in such way that work as whole is original).

142. *Compare* B. ALBERTS, D. BRAY, J. LEWIS, M. RAFF, K. ROBERTS & J. WATSON, MOLECULAR BIOLOGY OF THE CELL 188 (1983)(recombinant DNA within cell can direct synthesis of large quantities of useful proteins) *with* Apple Computer, Inc. v. Franklin Computer Corp., 714 F.2d 1240, 1250 (3d Cir. 1983)(purely utilitarian works not protected by copyright), *cert. dismissed*, 464 U.S. 1033 (1984) *and* Gay Toys, Inc. v. Buddy L. Corp., 703 F.2d 970, 974 (6th Cir. 1983)(article with intrinsic utilitarian function not protected by copyright).

143. *Cf.* Williams Elecs., Inc. v. Artic Int'l, Inc., 685 F.2d 870, 874-75 (3d Cir. 1982)(defendant alleged copyright protection not extended to program fixed in ROM chip because ROM machine part or utilitarian object); Midway Mfg. Co. v. Artic Int'l, Inc., 547 F. Supp. 999, 1008-09 (N.D. Ill. 1982)(defendant claimed ROM chip embodying computer program utilitarian object and not subject to copyright), *aff'd*, 704 F.2d 1009 (7th Cir.), *cert. denied*, 464 U.S. 823 (1983).

144. *Cf. Williams Elecs., Inc.*, 685 F.2d at 874-75 (artistic expression fixed in ROM chip copyrightable regardless of utilitarian nature of chip); *Midway Mfg. Co.*, 547 F. Supp. at 1007-09 (copyright protection extended to program for audiovisual work recorded in ROM, not ROM itself).

145. It is the nonutilitarian aspect of the rDNA molecule outside the cell which may bar patent protection for information expressed in the rDNA molecule tangible medium. *See* J. SIGALOS, INTELLECTUAL PROPERTY PROTECTION FOR BIOTECHNOLOGY INNOVATIONS 7-8 (1987). Outside the cell, the informational instructions contained in the rDNA molecule cannot be executed. Therefore, rDNA could be found nonpatentable for lack of utility if this issue is litigated. *Id.*

146. *See* B. ALBERTS, D. BRAY, J. LEWIS, M. RAFF, K. ROBERTS, J. WATSON, MOLECULAR BIOLOGY OF THE CELL 107-09 (1983). Messenger RNA copies the information contained in the DNA sequence and transfers it from the cell nucleus to ribosomes in the cell cytoplasm where protein synthesis occurs. *Id.*; *see also* Barkstrom, *Recombinant DNA and the Regulation of Biotechnology: Reflections on the Asilomar Conference, Ten Years After*, 19 AK-

regarding operating system programs, although the mRNA is part of a "method of operation," the mRNA copy of the rDNA molecule should be protected by the copyright because only the information contained in the mRNA is sought to be protected, and not the method by which the mRNA relays the information to the ribosomes, thus, triggering protein synthesis.[147]

III. CONCLUSION

Although patent protection has been extended to the rDNA product and process, it is likely that future rDNA development may have difficulty meeting patent requirements. Because of the increase in scientific publications, advances, and the number of skilled researchers, the prior art is rapidly increasing, making it more difficult for new rDNAs to satisfy the nonobviousness requirement for patentability. Furthermore, it is likely that rDNA will fail the utility requirement for patentability because the extracellular rDNA is nonoperable and serves no useful purpose. Also, scientists must make an immediate determination of potential industrial application of the new rDNA to ascertain whether to apply for patent protection. Thus, scientists are placed in the disadvantageous position of choosing between rapid publication and public use of their invention, which destroys the novelty requirement of patents if either occurs more than one year before filing a patent application, and ignoring their academic duty to publish expeditiously to obtain patent protection.

Copyright appears to be a viable alternative for the protection of intellectual property rights to rDNA. A comparison of the nature and function of computer programs to that of rDNA leads to the conclusion that rDNA is a literary work fixed in a tangible medium of expression and is, therefore, copyrightable. Copyright protection encompasses the written version of the rDNA sequence, the rDNA molecule itself, and the mRNA copy of the rDNA molecule.

Copyright protection is advantageous to the scientist because it is available as soon as the work is fixed in a tangible medium. Furthermore, there are no restrictions on printed publications, public use, or obviousness. If the rDNA is publicly distributed, the scientist need only send a notice of copyright with the rDNA and deposit two copies of the rDNA molecule at the

---

RON L. REV. 81, 82 (1985)(mRNA copies DNA and travels to ribosome where attached ribosome attracts and connects molecules to form protein).

147. *Cf.* Apple Computer, Inc v. Formula Int'l Inc., 725 F.2d 521, 523-25 (9th Cir. 1984)(operating systems program copyrightable where copyright sought for instructions themselves, not method of instructing computer to perform operating functions); Apple Computer, Inc. v. Franklin Computer Corp., 714 F.2d 1240, 1249-52 (3d Cir. 1983)(operating systems program copyrightable where copyright protects instructions not method which instructs computer to perform operating functions), *cert. dismissed*, 464 U.S. 1033 (1984).

Copyright Office within three months of distribution. The Copyright Office has already stated that a drawing of the rDNA molecule showing the nucleotide sequence and bearing a notice of copyright would satisfy this requirement.[148] Finally, copyrighting is advantageous for the holder because the copyright lasts for the life of the author plus fifty years, rather than the seventeen year protection by patent law.

In conclusion, copyright is a viable alternative for protecting intellectual property rights to rDNA. In addition, it is more advantageous and could possibly become the only means available for protecting intellectual property rights in future rDNA development.

Donna Smith

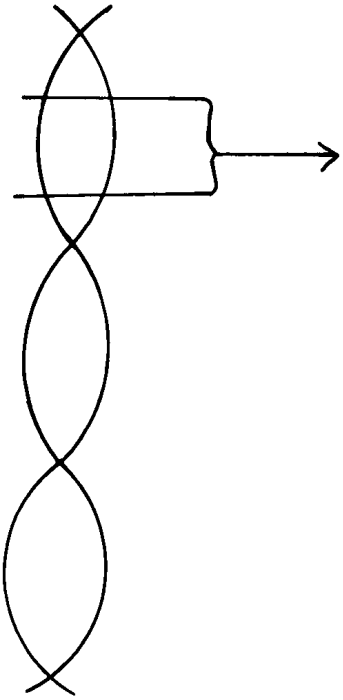
148. *See* J. SIGALOS, INTELLECTUAL PROPERTY PROTECTION FOR BIOTECHNOLOGY INNOVATIONS 13 (1987)(Copyright Office advises drawing of DNA nucleotide sequence bearing copyright notice sufficient for copyright).

IV. APPENDIX

The following discussion and diagrams are based on the text from B. ALBERTS, D. BRAY, J. LEWIS, M. RAFF, K. ROBERTS & J. WATSON, MOLECULAR BIOLOGY OF THE CELL ch. 3 (1983).

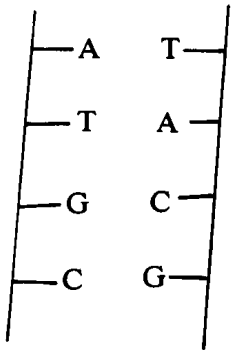
DNA consists of two strands of genetic information intertwined forming a double helix. Each strand consists of four building blocks, called nucleotides, which vary in number and order. It is the variation in number and order of these four nucleotides in a strand of DNA that makes different genes which code for various proteins. The four nucleotides which make up a strand of DNA are adenine (A), thymine (T), guanine (G), and cytosine (C). When two strands of DNA intertwine forming a DNA double helix, (A) nucleotides of one DNA strand are paired with (T) nucleotides on the opposite strand. Likewise, (G) nucleotides always pair with (C) nucleotides.

1)



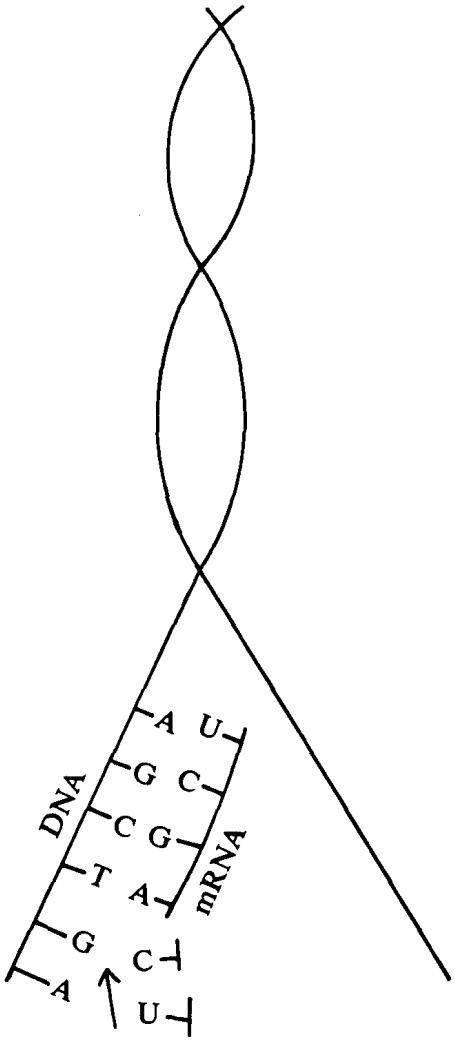
DNA Double Helix

2)

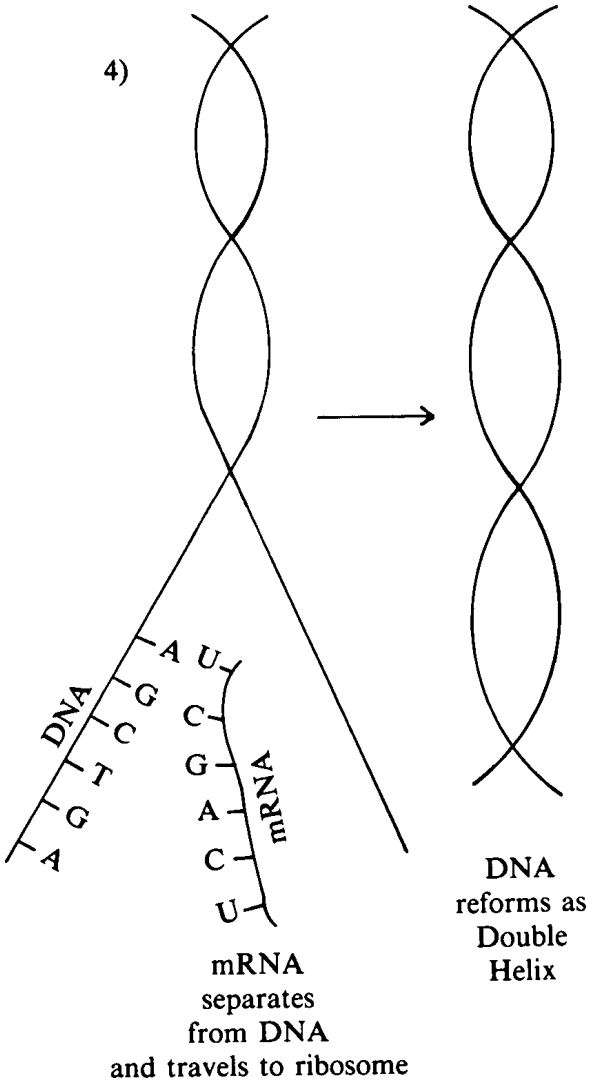


pairing of
DNA nucleotides

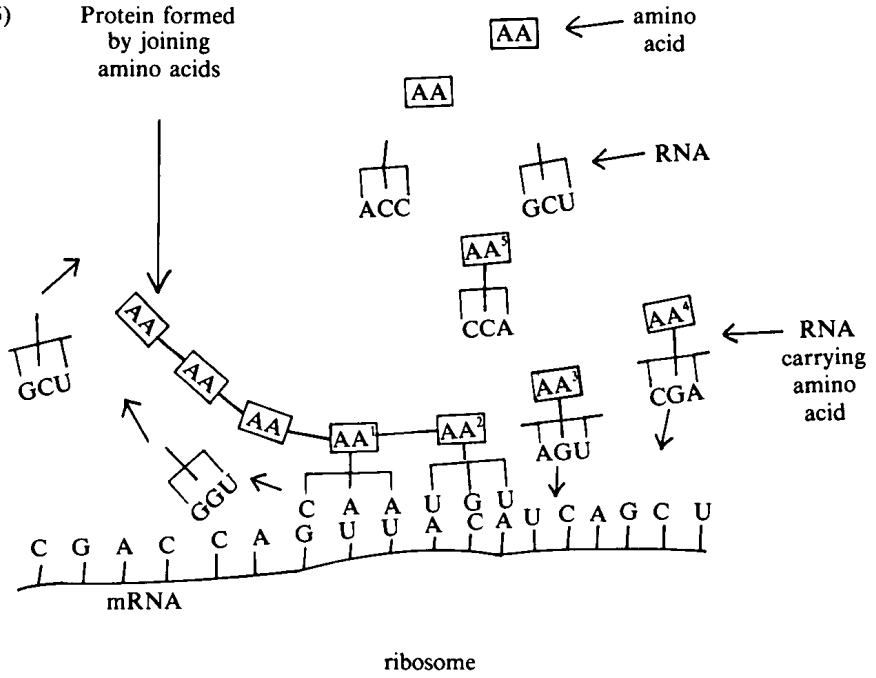
3)



The reading of the DNA genetic code, which ultimately leads to the synthesis of protein, is performed by a molecule called messenger ribonucleic acid (mRNA). Messenger RNA consists of the nucleotides adenine (A), uracil (U), guanine (G) and cytosine (C) which pair in the same manner as the DNA nucleotides, substituting (U) for (T). The reading process begins with the partial separation of the double-stranded DNA helix into two single strands. Messenger RNA nucleotides pair with the nucleotides of one DNA strand to form an mRNA molecule which is a direct complement of the DNA strand.



The mRNA molecule then separates from the DNA strand carrying the DNA genetic information from the cell nucleus to spherical particles in called ribosomes, found in the cell cytoplasm. This is where protein synthesis occurs.



The ribosome attaches to the mRNA strand and moves down the molecule, allowing another molecule called transfer ribonucleic acid (tRNA) to pair with the mRNA nucleotides. Transfer RNA consists of the same nucleotides as mRNA and pairs in the same manner. However, unlike mRNA the tRNA carries amino acids, the building blocks of protein. Each amino acid pairs with a specific tRNA "nucleotide sequence" composed of three tRNA nucleotides. As tRNA nucleotides pair with the mRNA, the tRNA brings amino acids which bind together in the particular order designated by the mRNA, thus forming the protein for which the original DNA molecule coded.