
Patenting DNA-Related Inventions in the European Union, United States and Japan:

A Trilateral Approach or a Study in Contrast?

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I. Introduction to the Subject-Matter

A. Patents

A patent is a contract between the government and an inventor under which, in exchange for the inventor's complete disclosure of the invention to the public, the government grants the inventor the exclusive rights to exclude others from making, using, selling or offering for sale the claimed invention for a limited period of time,¹ normally twenty years after the date that the application for the patent was filed. When this period is over, the invention can be freely used by anyone.

The first law providing these exclusive rights to an inventor dates back to 15th century Italy. In fact, the first recorded patent was issued in Florence in 1421 to Filippo Brunelleschi.² In the United States, the basis for the federal patent and copyright systems is found in the United States Constitution, which states: "Congress shall have power ... to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries." The first U.S. patent law was enacted in 1790. Since then, a variety of laws relating to patents, such as the 1930 Plant Patent Act, have been enacted by the U.S. Congress.

As clearly stated in the United States Constitution, the rationale for a patent system is to promote the progress of science and technology by encouraging and rewarding the development of new inventions. The patent system is designed to provide an effective and efficient process for the public disclosure of valuable information, which is capable of expeditiously stimulating the advancement of science and technology.

Only inventions that meet the statutory requirements of being new, useful, and non-obvious, can be patented. Inventions or discoveries, such as naturally occurring organisms, laws of nature, natural or physical phenomena and abstract ideas, cannot be patented.

Patents can be grouped into several categories, such as utility patent, design patent, and plant patent.³ In order to enjoy the benefit of a utility patent, the type of patent covering most biotechnology and DNA inventions, the claimed invention must be new, useful, and non-obvious over the prior art.⁴ In the United States, for example, these requirements are set forth in the Patent Act.⁵ Briefly, the novelty requirement is satisfied if the subject matter is new and was not disclosed or discovered by others before the inventor filed a patent application directed to the subject matter. The invention must also not be obvious from the prior work of others. In addition, the inventor must also show that the invention has a "real-world" use. It isn't enough

¹ See RONALD B. HILDRETH, PATENT LAW 1 (2d ed. 1993).

² See Owen Lippert, *Individualism, Intellectual Property and the Future of Capitalism*, FRASER FORUM, 8-10 (1999), available at <http://oldfraser.lexi.net/publications/forum/1999/03/individualism.html>.)

³ See HILDRETH, *supra* note 1, at 4-7.

⁴ See HILDRETH, *supra* note 1, at 4-6.

⁵ See 35 U.S.C. §§ 101-103 (2002).

just to find a new chemical or a new gene. The inventor must specify what the uses are, such as for example, whether the chemical or gene is useful as a drug for disease X or as a target for preventing or treating disease X or as a diagnostic marker for disease X.

In addition, the patent specification as filed must satisfy the enablement requirement of the Patent Act.⁶ That is, the specification must disclose the invention in sufficient detail to allow the public to make and use the claimed invention. The inventor must teach or “enable” other persons with ordinary skills in the related technological areas to use the invention described by the inventor. The specification must put forth the “best mode contemplated by the inventor of carrying out his invention” at the time the application was filed.

B. Understanding DNA, Genetics, and Biotechnology

Biotechnology is “the application to industry of advances made in the techniques and instruments of research in the biological sciences.”⁷ It covers many disciplines and, broadly speaking, may be defined as the synergistic union of the biological sciences and the technologically based industrial arts. In other words, biotechnology is the utilization of biological processes, as through the exploitation and manipulation of living organisms or biological systems, in the development or manufacture of a product or in the technological solution to a “real-world” problem. As such, the advancements made in the biotechnology area have broad and significant impact in pharmacology, medicine, agriculture, and many other fields.

People have been practicing biotechnology for thousands of years, including for example, the breeding and development of new crops and livestock, and the production of wine and beer through fermentation. However, it was the discovery of DNA structure in 1953 by James D. Watson and Francis H. C. Crick and the subsequent development of recombinant DNA technology in the 1970s, which facilitated the success of the biotechnology industry. Recombinant DNA technology, also called genetic engineering, has been widely used to manipulate the DNA of bacteria and other organisms to manufacture biological products such as industry materials and drugs. A common technique involved in this process is to insert a gene that produces a desired product into bacteria. Bacteria can then be grown in large quantities and processed to extract the desired substance. The same procedure can be performed using cultured plant and animal cells. Genetic engineering also has become a revolutionizing force to the “old” biotechnology industries. For example, corn, wheat, vegetables, and fruits with such desired qualities as pest, disease, and herbicide resistance have been created through genetic engineering. Today, most inventions in the biotechnology field, including the development of new plant varieties and animals, are DNA-related because of their basis in genetic engineering.

Two types of vehicles are used by living organisms to carry hereditary information; deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). With the exception of some RNA

⁶ See 35 U.S.C. § 112 (2002).

⁷ ENCYCLOPEDIA BRITANNICA, available at <http://www.britannica.com/search?query=Biotechnology&ct=&fuzzy=N> (last visited May 24, 2003).

viruses, most organisms use DNA to carry hereditary information. DNA is nucleic acid which consists of two linear, non-branching polynucleotide strands that form a double helix held together by hydrogen bonds between purine and pyrimidine bases which project inward from the two backbone chains. There are four distinct types of nucleotides in a DNA molecule: deoxyadenosine (A); deoxyguanosine (G); deoxythymidine (T); and deoxycytidine (C). It is the non-random and theoretically indefinite number of combination of these individual “bases” that result in DNA being chosen as an informational molecule by nature during hundreds of millions of years of evolution. A naturally-occurring DNA molecule generally comprises more than one gene, which is a specific sequence of nucleotides and the fundamental physical and functional unit of heredity. A genome is the complete set of an organism’s genetic material. For example, the human genome has about 3 billion nucleotides, which encodes more than 30,000 genes.⁸

II. DNA and Biotechnology Inventions as Patentable Subject-Matter

Despite the fact that Louis Pasteur, the famous French scientist, received U.S. Patent No. 141,072 in 1873, claiming “yeast, free from organic germs of disease, as an article of manufacture,” and patent offices throughout the world issue patents covering DNA and biotechnology inventions on a regular basis, the issue of whether living materials, such as plants or animals, or naturally-occurring substances, such as DNA and protein, may constitute the subject of an invention is still very controversial. Such controversy is still currently debated in almost every corner of the world today.

A. United States

The U.S. patent laws require that, to be patentable, an invention must pass the standard subject matter test.⁹ The claimed DNA and biotechnology inventions, such as living organisms or natural compounds, cannot be those that occur or exist in nature.¹⁰ One cannot obtain a patent on, for example, just any oyster, because an oyster exists in nature. If, however, an inventor creates a new type of oyster through genetic engineering that never existed before, then that type of oyster might be patented.

1. Microorganisms

Since the 1873 patenting of Louis Pasteur’s yeast, microbes have been historically considered patentable subject matter. In fact, with the phenomenal growth of genetic engineering in the late 1970s, the patentability of living microorganisms survived scrutiny, and was confirmed by the Supreme Court. A landmark case, *Diamond v. Chakrabarty*,¹¹ involved

⁸ See International Human Genome Sequencing Consortium, *Initial Sequencing and Analysis of the Human Genome*, 409 NATURE, 860-921 (2001).

⁹ See 35 U.S.C. § 101 (2002).

¹⁰ See 66 Fed. Reg. 1093 (2001).

¹¹ *Diamond v. Chakrabarty*, 447 U.S. 303 (1980).

Ananda Chakrabarty's invention of a new bacterium genetically engineered to degrade crude oil. In this case, the Supreme Court stated that new microorganisms not found in nature, such as Chakrabarty's bacterium, were "manufacture" or "composition of matter" within the meaning of § 101 of the Patent Act and were thus, patentable. The court explained as follows:

[Chakrabarty's] microorganism plainly qualifies as patentable subject matter. His claim is not to a hitherto unknown natural phenomenon, but to a nonnaturally occurring manufacture or composition of matter — a product of human ingenuity.... His discovery is not nature's handiwork, but his own; accordingly it is patentable subject matter.¹²

In *Chakrabarty*, the Supreme Court further pointed out that "anything under the sun made by man" is patentable subject matter.¹³ Therefore, if a product of nature is new, useful and nonobvious, it may be patented if it has been fashioned by humans, such as in genetic engineering.

2. Plants

Plant inventions are patentable subject matter in the United States. Newly invented plants that are either asexually or sexually reproduced are also protected under the 1930 Plant Patent Act and Plant Variety Protection Certificate (PVPC) in the 1970 Plant Variety Protection Act.¹⁴

3. Animals

The question of whether multicellular animals could be patented was examined in the 1980s. In *Ex Parte Allen*, the key issue was the patentability of polyploid pacific coast oysters that had an extra set of chromosomes.¹⁵ This new, sterile oyster was edible all year round because it did not devote body weight to reproduction during the breeding season. The applicant sought to patent a method of inducing polyploidy in oysters as well as the resulting oysters as products-by-process. Following the reasoning in *Chakrabarty*, the United States Patent and Trademark Office (USPTO) concluded that such organisms were eligible for patenting.¹⁶ It found this particular type of pacific coast oyster to be obvious, however, and thus rejected the patent application. Nonetheless, the polyploid oyster paved the way for the patenting of other non-naturally occurring animals. Shortly after the *Allen* decision, the USPTO issued a notice declaring that it would consider non-naturally occurring, non-human multicellular living organisms, including animals, to be patentable subject matter within the scope of the Patent Act.¹⁷ In 1988, for example, Philip Leder and Timothy Stewart were granted a patent on

¹² *Id.* at 309.

¹³ *Id.*

¹⁴ See MANUAL OF PATENT EXAMINING PROCEDURE § 2105 (8th ed. 2001); see also *J.E.M. AG Supply, Inc. v. Pioneer Hi-Bred Int'l, Inc.*, 534 U.S. 124 (2001).

¹⁵ 2 U.S.P.Q.2d 1425 (Bd. Pat. App. & Inter. 1987).

¹⁶ See MANUAL OF PATENT EXAMINING PROCEDURE § 2105 (8th ed. 2001).

¹⁷ *Id.*

transgenic non-human mammals (U.S. Patent No. 4,736,866) that covered the so-called “Harvard Mouse,” which was genetically engineered to be a model for the study of cancer.

4. Natural Compounds

Natural compounds, such as DNA and protein, are not themselves living, but naturally occur in nature. Under U.S. patent law, they can be patented only if they are new and purified from nature.¹⁸ Therefore, a compound that is isolated away from a fruit, or a protein that is purified away from an animal can be patented in its purified state. However, such a patent will not cover the fruit or the animal.

The ability to isolate genes and produce the proteins they encode has enormous commercial impact. The availability and scope of patent protection on genes and genome-related technologies is considered vital for the survival and success of the biotechnology industry. Patents provide the opportunity to recoup the investment required to discover and develop the patented product, to fund future research and development projects, as well as to generate financial reward for investors. For example, on March 14, 2000, \$10.4 billion was wiped out from the stock market in 10 minutes after speeches about the human genome project by Bill Clinton and Tony Blair were live-broadcasted. The speeches generated panic among investors because they misinterpreted them to mean that DNA and gene-related patenting would be prohibited. Consequently the stocks of a variety of biotech companies, such as Human Genome Science and Celera Genomics, were crushed.¹⁹

DNA sequences are considered chemical compounds by the USPTO and are patentable as compositions of matter.²⁰ Although patent claims to naturally occurring DNA sequences might be expected to trigger the “products of nature” rule, courts have upheld patent claims covering “purified and isolated” DNA sequences as new compositions of matter resulting from human intervention.²¹ In its “Utility Examination Guidelines,” the USPTO explains that an isolated and purified DNA molecule that has the same sequence as a naturally occurring gene is eligible for patent protection:

- (1) An excised gene is eligible for a patent as a composition of matter or as an article of manufacture because that DNA molecule does not occur in that isolated form in nature; or (2) Synthetic DNA preparations are eligible for patents because their purified state is different from the naturally occurring compound.²²

The USPTO guidelines heavily emphasize the patentability of DNA and DNA-related material. In rejecting a series of public comments that genes should not be patentable, the PTO

¹⁸ See 66 Fed. Reg. 1093 (2001).

¹⁹ See Christopher Evans, Intellectual Property And Wealth Creation, in RSA LECTURES 1 (March 2001).

²⁰ See 66 Fed. Reg. 1094 (2001).

²¹ See Elizabeth S. Weiswasser, *New PTO Guidelines To Affect Biotech Inventions*, NAT’L L.J., Feb. 5, 2001, at C10.

²² 66 Fed. Reg. 1093 (2001).

explained that isolated and purified DNA is patentable because this form differs from the naturally occurring compound:

An inventor's discovery of a gene can be the basis for a patent on the genetic composition isolated from its natural state and processed through purifying steps that separate the gene from other molecules naturally associated with it. If a patent application discloses only nucleic acid molecular structure for a newly discovered gene, and no utility for the claimed isolated gene, the claimed invention is not patentable. But when the inventor also discloses how to use the purified gene isolated from its natural state, the application satisfies the "utility" requirement....Like other chemical compounds, DNA molecules are eligible for patents when isolated from their natural state and purified or when synthesized in a laboratory from chemical starting materials.

A patent on a gene covers the isolated and purified gene but does not cover the gene as it occurs in nature. Thus, the concern that a person whose body "includes" a patented gene could infringe the patent is misfounded. The body does not contain the patented, isolated and purified gene because genes in the body are not in the patented, isolated and purified form. When the patent issued for purified adrenaline about one hundred years ago, people did not infringe the patent merely because their bodies naturally included unpurified adrenaline.²³

B. European Patent Office (EPO)

There are three milestones in European patent legislation history: the conclusion of the Paris Convention for the Protection of Industrial Property in 1883,²⁴ the passing of the Strasbourg Convention on the Unification of Certain Points of Substantive Law on Patents for Invention in 1963,²⁵ and the rectification of the European Patent Convention in Munich in 1973.²⁶ Appreciating that international protection for valuable intellectual property rights was requisite to growing international industrialization, the leading European countries of the time formulated the Paris Convention for the Protection of Industrial Property in 1883. The treaty required signing parties to (1) treat foreign patent owners as domestic patent holders and (2) afford international priority dates to member countries.²⁷ The Strasbourg Convention on the Unification of Certain Points of Substantive Law on Patents for Invention in 1963 was part of the effort towards the establishment of a common market in Europe, and it harmonized the terms of

²³ *Id.*

²⁴ See World Intellectual Property Organization, Paris Convention for the Protection of Industrial Property, at <http://www.wipo.org/treaties/ip/paris/index.html> (last visited May 24, 2003).

²⁵ See Council of Europe, Convention on the Unification of Certain Points of Substantive Law on Patents for Invention, at <http://conventions.coe.int/Treaty/EN/Treaties/Html/047.htm> (last visited May 24, 2003).

²⁶ See European Patent Office, Convention on the Grant of European Patents, Oct. 5, 1973, at <http://www.european-patent-office.org/legal/epc/e/ma1.html#CVN> (last modified July 2002 visited May 24, 2003).

²⁷ See World Intellectual Property Association, Paris Convention for the Protection of Industrial Property, Mar. 20, 1883, at <http://www.wipo.int/clea/docs/en/wo/wo020en.htm> (last visited May 24, 2003).

substantive patent law, including novelty and inventive step.²⁸ In 1973, the European Patent Convention (EPC) organized to establish a common system for granting patents in Europe.²⁹ EPC covers both formal and material aspects of patent law and regulates the filing and granting process of common European patents. Currently there are 20 Member States (the 15 EU countries plus Cyprus, Switzerland, Liechtenstein, Monaco and Turkey). Supervised by the Administrative Council, the European Patent Office (EPO) is the administrative body of the EPC responsible for granting European patents.

Two provisions of the EPC are relevant when considering the patentability of DNA and biotechnology inventions. Article 53(a) denies patentability to ‘inventions the publication or exploitation of which would be contrary to ‘ordre public’ or morality, provided that the exploitation shall not be deemed to be so contrary merely because it is prohibited by law or regulation in some or all of the Contracting States.’³⁰ Article 53(b) provides that patents shall not be granted for ‘plant or animal varieties or essentially biological processes for the production of plants or animals,’ however the provision does not apply to ‘microbiological processes or the products thereof.’³¹ Nevertheless, despite these provisions, the EPO started granting patents on plants and animals in the early 1990s.

In 1995, Greenpeace brought a case against a patent on plants incorporating a transgene conferring herbicide resistance granted to Plant Genetic Systems. While the EPO’s Technical Board of Appeal did not uphold any of Greenpeace’s arguments on the morality point, it did confirm in its ruling that plant varieties could not be patented.³² Consequently, patenting on animals and plants was halted.

In 1998, the EU adopted the European Directive of the European Parliament and of the Council on the Legal Protection of Biotechnological Inventions (“Directive”) requiring that its member states harmonize their laws relating to the patenting of biotechnological inventions.³³ The Directive is divided into five chapters. Chapters I and IV concern matters of patentability. Chapters II and III concern matters of scope and infringement. The last chapter, Chapter V, concerns formal issues relating to the Directive’s implementation and review of its terms. The major features of the Directive are summarized below.

²⁸ See Council of Europe, Convention on the Unification of Certain Points of Substantive Law on Patents for Invention, Nov. 27, 1963, at <http://conventions.coe.int/Treaty/EN/Treaties/Html/047.htm> (last visited May 24, 2003).

²⁹ See European Patent Office, European Patent Convention, Art. 1, Oct. 5, 1973, at <http://www.european-patent-office.org/legal/epc/e/ar1.html> (law modified May, 2003, visited May 24, 2003).

³⁰ *Id.* at Art. 53, Oct. 5, 1973, at <http://www.european-patent-office.org/legal/epc/e/ar53.html> (last modified May 2003, visited May 24, 2003).

³¹ *Id.*

³² See Decision T356/93, Plant cells/PLANT GENETIC SYSTEMS, OJ EPO 545 (1995).

³³ See Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological inventions, 1998 OFFICIAL J. EUR. COMMUNITIES O.J. (L 213) 13-21, available at http://europa.eu.int/eur-lex/pri/en/oj/dat/1998/l_213/l_21319980730en00130021.pdf.

First, inventions that meet the EPC's definition of invention are patentable "even if they concern a product consisting of or containing biological material or a process" so long as the patent is directed to the material isolated from the natural environment or the material was produced by means of a technical process."³⁵ Additionally although the EPC's prohibition on the patenting of plant and animal varieties remains intact, plants or animals inventions shall be patentable if the technical feasibility of the invention is not limited to a particular plant or animal variety.³⁶

Second, for the patentability of naturally-occurring genes, the Directive reaffirms the long-standing practice of the EPO and most national patent offices that naturally-occurring substances are considered to be patentable inventions provided they are isolated from their surroundings. In addition, "a mere DNA sequence without indication of a function does not contain any technical information and is therefore not patentable . . . The human body, at the various stages of its formation and development, and the simple discovery of one of its elements, including the sequence or partial sequence of a gene, cannot constitute patentable inventions."³⁷ However, "an element isolated from the human body or otherwise produced by means of a technical process, including the sequence or partial sequence of a gene, may constitute a patentable invention" even though its structure is identical with that of a natural element.³⁸

In addition, certain inventions are excluded from patentability on the basis that they infringe the EPC's prohibition on patents for inventions whose exploitation is contrary to *ordre public* or morality, namely:

- processes for cloning human beings;
- processes for modifying the germ line genetic identity of human beings;
- uses of human embryos for industrial or commercial purposes; and
- processes for modifying the genetic identity of animals which are likely to cause them suffering without any substantial medical benefit to man or animal, and also animals resulting from such processes.³⁹

Although the EPC is not created by the EU and as such, directives of the EU do not have any binding effect on the EPO, the Administrative Council of the EPO decided to incorporate the provisions of the EU Directive into their Implementing Regulations by adding a new Chapter VI entitled "Biotechnological Inventions" in Part II of the EPC Implementing Regulations in 1999.⁴⁰

³⁵ *Id.*

³⁵ *Id.*

³⁵ *Id.*

³⁶ *Id.*

³⁷ *Id.*

³⁸ *Id.*

³⁹ *Id.*

⁴⁰ See OFFICIAL JOURNAL OF THE EPO, Administrative Council of 16 June 1999, amending the Implementing Regulations to the EUROPEAN PATENT Convention, available at http://www.european-patent-office.org/epo/pubs/oj99/7_99/index.htm (last visited May 25, 2003).

The new provisions, Rules 23b to 23e, were enacted on September 1, 1999, and they implemented the requirements of the EU Biotechnology Directive in European patent law.⁴¹ The new rules are summarized as follows:

- For patents concerning biotechnological inventions, including DNA patents, Directive 98/44/EC shall be used as a supplementary means of interpretation for the relevant provisions of the EPC.⁴²
- The definition of biotechnological invention, according to Rule 23b, is invention that concerns “a product consisting of or containing biological material or a process by means of which biological material is produced, processed or used.” This includes DNA-related inventions, such as an isolated DNA fragment and the gene it encodes or DNA sequence analysis protocols and its software products. The definition of biological material is “any material containing genetic information and capable of reproducing itself or being reproduced in a biological system.” For example, plasmid, which is simply a piece of DNA containing a group of genes which cannot reproduce by itself, is considered biological material under this definition because it can be reproduced in a biological system, such as bacteria.⁴³
- The term “essentially biological” which appears in the prohibition of plants or animals produced by an “essentially biological process” is defined as consisting of entirely natural phenomena, such as crossing or selection. This narrow definition of “essentially biological” makes it possible for patenting genetically modified plants or animals since genetic modification is not a process consisting of “entirely natural phenomena.”⁴⁴
- Rule 23c states that inventions concerning biological materials, such as DNA, microbiological process, plants, and animals are patentable. It indicates, however, that inventions concerning plants or animals are patentable only if “the technical feasibility of the invention is not confined to a particular plant or animal variety.”⁴⁵ In the case of biological materials, such as DNA and protein, they are patentable if the materials are isolated from its natural environment or produced by means of a technical process.⁴⁶ Rule 23e further pronounces that the simple discovery of one of the elements of the human body, including the sequence or partial sequence of a

⁴¹ *Id.*

⁴² See European Patent Office, Implementing Regulations to the Convention on the Grant of European Patents, Oct. 5, 1973, Rule 23b, available at <http://www.european-patent-office.org/legal/epc/e/r23b.htm#R23b> (last visited May 25, 2003).

⁴³ *Id.*

⁴⁴ *Id.*

⁴⁵ See European Patent Office, Implementing Regulations to the Convention on the Grant of European Patents, Oct. 5, 1973, Rule 23c, available at <http://www.european-patent-office.org/legal/epc/e/r23c.htm#R23c> (last visited May 25, 2003).

⁴⁶ *Id.*

protein or a gene, cannot constitute patentable inventions.⁴⁷ In any case, the industrial application, i.e. utility, of the claimed gene or protein sequences or a partial sequence must be disclosed in the patent application.⁴⁸

Since the Implementing Regulations parallel the EU Directive concerning patents on living organisms, they also now stand in conflict with the text of the EPC concerning the patenting of plant varieties and animals. There is a clear provision in the EPC that says that the treaty language of the EPC takes precedence over the Implementing Provisions.⁴⁹ In addition, the Administrative Council has no legal authority to adopt substantive changes to the patent law. Despite this, however, the EPO has again started to grant patents on living organisms as of September 1, 2000.

In November 2000, the EPC Diplomatic Conference of the Governments met in Munich, Germany. It is the highest legislative body of the EPC and it has the authority to overrule the decision of the Administrative Council. Nevertheless, the Conference did not address the patentability of living organisms. Instead, it “urge[d] the EPO to give priority to preparing for another Diplomatic Conference which might deal with consideration of how provisions on subjects such as biotechnological inventions should be most appropriately included in the EPC.”⁵⁰

C. Japan

The patenting of plants in Japan started in 1978 after the Seeding Law was enacted in conformity with the UPOV Convention.⁵¹ Following the U.S. Supreme Court indecision in *Chakrabarty*, the Japanese Patent Office (JPO) started granting patent protection for microorganisms in 1981.⁵² Animals became patentable subject matter in Japan after 1988 when the so-called “Harvard Mouse” patent was issued by the USPTO.⁵³ By the end of 1998, seven plant variety patents, nineteen animal patents, and a large number of microorganism patents were issued by the JPO. The majority of them were the products of genetic engineering.⁵⁴

⁴⁷ See European Patent Office, Implementing Regulations to the Convention on the Grant of European Patents, Oct. 5, 1973, Rule 23e, at <http://www.european-patent-office.org/legal/epc/e/r23e.htm#R23e> (last visited May 25, 2003).

⁴⁸ *Id.*

⁴⁹ See European Patent Office, European Patent Convention Art. 162, <http://www.european-patent-office.org/legal/epc/e/ar162.html> (last visited May 25, 2003).

⁵⁰ See The United Kingdom Patent Office, Diplomatic Conference for the Revision of the European Patent Convention, <http://www.patent.gov.uk/about/notices/europatconf.htm> (last visited May 25, 2003).

⁵¹ See Japan Patent Office, *Bio Patent*, 46, available at <http://www.apic.jiii.or.jp/facility/text/6-03.pdf> (last visited May 25, 2003).

⁵² *Id.*

⁵³ *Id.*

⁵⁴ *Id.*

In Japan, Article 32 of the Patent Law provides that “inventions liable to contravene public order, morality or public health shall not be patented . . .”⁵⁵ In contrast to the situation in Europe where inventions such as DNA, genes, or transgenic animals/plants, have become very problematic in this respect, there are very few cases, if any, where problems regarding public order or morality or public health have been raised in Japan.

In 1997, the JPO published its Implementing Guidelines for Inventions in Specific Fields (“Guidelines”).⁵⁶ Chapter 2 of the Guidelines is entitled “Biological Inventions.”⁵⁷ According to the Guidelines, inventions in the DNA and biotechnology field can be divided into four categories: genetic engineering, microorganisms, plants and animals.⁵⁸ “Inventions relating to genetic engineering include those of a gene, a vector, a recombinant vector, a transformant, a fused cell, a protein which [is] obtained by transformation (hereinafter, referred to as “a recombinant protein”), [and] a monoclonal antibody, etc.”⁵⁹ Inventions related to microorganisms include “microorganisms *per se* as well as those related to the use of microorganisms, etc.”⁶⁰ Inventions related to plants include “inventions of plants *per se*, those relating to parts of plants (*e.g.*, a fruit), those of a process for creating plants, those relating to use of plants, etc.”⁶¹ Inventions related to animals include “inventions of animals *per se*, those relating to parts of animals, those of a process for creating animals, those relating to use of animals, etc.”⁶²

The JPO also points out that since “the aim of the patent law is to develop industries, only inventions that are useful or having industrial applicability are patentable.”⁶³ Although it is uncommon for an ordinary invention to face questions about its industrial utility, quite frequently, DNA-related inventions encounter these sorts of concerns. This is regularly an issue involving the patentability of inventions of the express sequence tags (ESTs) and single nucleotide polymorphisms (SNPs), since their specific functions are often unclear or unknown, except that they can be utilized as a probe. However, the JPO has clearly stated that any EST invention is not patentable for lacking industrial utility if their functions are indefinite.⁶⁴ Issues related to DNA fragments and ESTs are further discussed *infra*.

III. Basic Requirement for Patentability

⁵⁵ See JAPAN PATENT LAW, Law No. 220 of 1999, ch. II, no. 32, available at <http://www.jpo.go.jp/shoukaie/patent.htm#32> (last visited May 25, 2003).

⁵⁶ See Japan Patent Office, Implementing Guidelines for Inventions in Specific Fields, available at <http://www.jpo.go.jp/index.htm> (last visited May 25, 2003).

⁵⁷ See Japan Patent Office, Implementing Guidelines for Inventions in Specific Fields, Ch. 2 Biological Inventions, available at http://www.jpo.go.jp/tetuzuki_e/t_tokkyo_e/sisine.htm (last visited May 25, 2003).

⁵⁸ *Id.*

⁵⁹ *Id.*

⁶⁰ *Id.*

⁶¹ *Id.*

⁶² *Id.*

⁶³ See Japan Patent Office, *Bio Patent*, 67, available at <http://www.apic.jiii.or.jp/facility/text/6-03.pdf> (last visited May 25, 2003).

⁶⁴ *Id.* at 73.

A. The Utility of DNA and Biotechnology Inventions

1. The Utility Examination Guidelines of the USPTO

i. Case Study: ESTs

An EST is part of a sequence from a cDNA molecule, therefore, it can be used to identify and locate an expressed gene. The patenting of ESTs proved to be controversial since NIH first filed patent applications on a large number of ESTs in 1991 and 1992.⁶⁵ According to the 1995 version of the Utility Examination Guidelines,⁶⁶ the USPTO used a two-prong test to determine utility of invention:

- (1) Is the described utility specific to a particular purpose?
- (2) Is the described utility credible?⁶⁷

In 1997, the Clinton Administration announced that the PTO would begin allowing patents on ESTs based on their utility as probes. On October 6, 1998, the first 'EST patent', 'Human Kinase Homologs' (U.S. Patent No. 5,817,479), was issued to Incyte Pharmaceuticals, Inc., that as of late 1998, had alone filed patent claims encompassing over 1.2 million DNA sequences, many of human origin.⁶⁸ In fact, by the end of 2000, the USPTO had received patent applications on millions of gene fragments; one application alone covering more than 20,000.⁶⁹ Though the content of these applications isn't public, their sheer numbers suggest that every human gene, at least in part, might already be subject to a patent application.

The patentability of ESTs has been challenged by a variety of societies like The Human Genome Organization (HUGO), which advocates three view points. First, ESTs are obvious and the creation of ESTs does not involve any inventive step. The current strategy of large-scale EST sequencing represents a useful but straightforward extension of a technique that has been in use on a smaller scale for years. The scientific work involved in generating ESTs is straightforward and based on automated sequencing technology that has been well understood since the mid-1980s. Indeed, the sequencing of any gene involves the sequencing of individual, small fragments. Moreover, the sequencing of fragments of genes has long been used as a rapid

⁶⁵ See AIPPI Report, *Question Q 150: Patentability Requirements and Scope of Protection of Expressed Sequence Tags (ESTs), single Nucleotide Polymorphisms (SNPs) and Entire Genomes*, available at <http://www.aippi.org/reports/q150/gr-q150-e-questions.htm> (last visited May 25, 2003).

⁶⁶ See 60 Fed. Reg. 36263-265 (1995).

⁶⁷ See Thomas T. Aquilla, *Meeting Reports: Biotechnology Patent Practice in the New Millennium*, 19 (1) BIOTECHNOLOGY LAW REPORT 22(1), available at <http://www.liebertpub.com/blr/default1.asp> (last visited May 25, 2003).

⁶⁸ See Robin Teskin, *Human Gene Patenting - An Overview of Legal and Ethical Considerations*, FOOD AND DRUG LAW INSTITUTE UPDATE Issue 3 May/June, 2001, available at <http://www.fdpi.org/pubs/Update/toc/2001/issue3.html> (last visited May 25, 2003).

⁶⁹ See Douglas Steinberg, *Whither gene patenting after the human genome project?* 11 INTELLECTUAL PROPERTY TODAY (Nov. 2000).

tool for the characterization of genes encountered in a variety of settings, including library screening.⁷⁰

In addition, HUGO also believes that ESTs lack both substantial and credible utility. The process from EST to full-length cDNA or genomic sequence is not straightforward. The full-length cDNA represents the entire sequence of the mRNA and the genomic sequence of the gene also includes introns and other flanking regions. Though using partial gene sequences, such as ESTs, to find full-length cDNA and genomic sequences is an important research activity which is routinely performed in many laboratories, it still remains a task that is troubled with uncertainty. HUGO has been quoted as follows:

In some cases known techniques such as specific primer extensions may be successful; in others extraordinary skill will be required to overcome obstacles such as secondary structure. Foreseeable obstacles include the difficulty or impossibility of cloning mRNAs that are large or that encode poorly clonable sequences; the problems posed by immature, or incorrectly or alternatively spliced messages; the difficulties posed by cross-hybridization among members of gene families; [and the rare but extremely challenging problems posed by post-transcriptional alterations of RNA sequence.] Having an EST in hand does not guarantee insight into a practical or feasible strategy for overcoming these obstacles. The effort involved may range from a matter of weeks (in case of an extremely short, easily cloned gene) to more than a year.⁷¹

Finally, HUGO asserts it is easy to give a list of potential uses without knowledge of their true biological functions, such uses including:

- categorizing genes according to their expression profile;
- developing markers for mapping, tissue typing, individual/forensic identification;
- producing antibodies;
- generating antisense DNA; and
- locating chromosomal regions associated with genetic disease.⁷²

The “real world” application is hard to achieve without the investment of considerable further effort and creativity, far more than that invested in finding the initial fragment. For example, in order to use DNA fragments for individual identification, one must first find sites of polymorphic variation and identify the distribution of such polymorphisms in appropriate populations. Similarly, to use DNA fragments for tissue typing, one must first establish that a particular fragment or set of fragments provides a sufficiently discriminating signature of a particular tissue type or state. Mapping a sequence may sometimes be routine, but in other cases

⁷⁰ See C. Thomas Caskey, Rebecca S. Eisenberg, Eric S. Lander, and Joseph Straus, *HUGO Statement on the Patenting of DNA Sequences*, at <http://www.hugo-international.org/hugo/patent.htm> (last visited May 25, 2003).

⁷¹ *Id.*

⁷² *Id.*

it may involve overcoming problems posed by gene families, pseudogenes, and repetitive elements which lead to mapping ambiguities due to signals from multiple locations. Moreover, with antisense applications, it is easy to postulate such uses, but scientists would not pursue them without specific and detailed knowledge of biological function. Each of these asserted uses may not be carried out without considerable further effort and additional biological information not apparent from the information inherent in the sequence alone.⁷³

Many other commentators agreed with HUGO, stating that sufficient patentable utility is not shown when the sole disclosed use of an EST is to identify other nucleic acids whose utility was not known, and the function of the corresponding gene is not known. Some commentators suggested that PTO examination procedures would result in granting patents based on non-specific and nonsubstantial utilities, contrary to established case law.⁷⁴

In early 2001, the USPTO published its new ‘Utility Examination Guidelines.’⁷⁵ The Utility Guidelines are applicable to all areas of technology, however, they are particularly relevant in areas of gene-related technologies. While the utility requirement is not frequently a focus in many technology areas, it has been for DNA and biotechnology inventions, as the utility of a specific gene or DNA sequence often remains unknown until the gene’s function has been characterized and the activity of its product determined. Under the new utility guidelines, the USPTO moves to a four-prong test for utility:

- (1) Does an invention have a well-established utility?
- (2) Does an invention have a specific utility?
- (3) Does an invention have a substantial utility?
- (4) Does an invention have a credible utility?⁷⁶

Under the new Guidelines, the USPTO re-affirmed that ESTs are patentable subject matter.⁷⁷ If an EST meets the statutory requirement on utility, novelty, unobviousness and enablement, it is patentable. Nevertheless, a mere assertion of the utility of an EST as a probe without further disclosure of its specific function is considered not enough by USPTO to satisfy the utility and enablement requirements.⁷⁸ The patentability of ESTs and DNA fragments has been further studied by the Trilateral Patent Offices (USPTO, EPO, JPO). The conclusions of Trilateral Project B3b, Comparative Study on Biotechnology Patent Practices (Theme: Patentability of DNA Fragments) can be summarized as follows:

- (1) A mere DNA fragment without indication of a function or specific asserted utility is not a patentable invention[;]
- (2) A DNA fragment, of which specific

⁷³ *Id.*

⁷⁴ See Xiao D. Zhang, *The Patentability of Biotechnological Inventions and Practices in China*, at http://pharmalicensing.com/features/disp/997365145_3b72959963a57 (last visited May 25, 2003).

⁷⁵ See 66 Fed. Reg. 1092-99 (2001).

⁷⁶ *Id.*

⁷⁷ See *id.* at 1094.

⁷⁸ *Id.*

utility, *e.g.* use as a probe to diagnose a specific disease, is disclosed, is a patentable invention as long as there [are] no other reasons for rejection[;] (3) A DNA fragment showing no unexpected effect, obtained by conventional method, which is assumed to be part of a certain structural gene based on its high homology with a known DNA encoding protein with a known function, is not a patentable invention (EPO, JPO). The above-mentioned DNA fragment is unpatentable if the specification fails to indicate an asserted utility (USPTO)[; and] (4) The mere fact that DNA fragments are derived from the same source is not sufficient to meet the requirement for unity of invention.⁷⁹

As a result of the Trilateral Technical Meeting in June, 2000, the following conclusions were added to the final report of the project:

(1) All nucleic acid molecule-related inventions, including full-length cDNAs and SNPs, without indication of function or specific, substantial and credible utility, do not satisfy industrial applicability, enablement or written description requirements[; and] (2) Isolated and purified nucleic acid molecule-related inventions, including full-length cDNAs and SNPs, of which function or specific, substantial and credible utility is disclosed, which satisfy industrial applicability, enablement, definiteness and written description requirements would be patentable as long as there is no prior art (novelty and inventive step) or other reasons for rejection (such as, where appropriate, best mode [US] or ethical grounds [EPC/JP]).⁸⁰

ii. The utility requirement

An invention has a well-established utility if a person of ordinary skill in the art would immediately appreciate why the invention is useful based on the characteristics of the invention. Well-established utility does not encompass any ‘throw away’ utility that one can dream up for an invention or a non-specific utility that would apply to virtually every member of a general class of materials, such as proteins or DNA. The utility requirement is met when a DNA-related invention has well-established utility.⁸¹ Well-established utility is satisfied where the utility is specific, substantial and credible.⁸²

Specific utility means a utility that is *specific* to the subject matter claimed. This contrasts with a *general* utility that would be applicable to the broad class of the invention.⁸³ For example, a claim to a DNA fragment whose use is disclosed simply as a ‘gene probe’ or

⁷⁹ See TRILATERAL PROJECT B3B: COMPARATIVE STUDY ON BIOTECHNOLOGY PATENT PRACTICES (THEME: PATENTABILITY OF DNA FRAGMENTS), at <http://www.european-patent-office.org/tws/sr-3-b3b-ad.htm> (last visited May 25, 2003).

⁸⁰ *Id.*

⁸¹ *Id.*

⁸² See MANUAL OF PATENT EXAMINING PROCEDURE § 2107 (8th ed. 2001).

⁸³ *Id.*

“chromosome marker” would not be considered specific in the absence of a disclosure of a specific DNA target.⁸⁴

Substantial utility is a utility that relates to a “real world” use. Utilities that require carrying out further research to identify or reasonably confirm a practical application or use are not substantial utilities.⁸⁵ For example, both a therapeutic method of treating a known or newly discovered disease and an assay method for identifying compounds that themselves have a substantial utility define a “real world” use. The Guidelines illustrate that substantial utility is not present in any of the following examples: basic research such as studying the properties of a claimed product or the mechanisms in which the material is involved; a method of treating an unspecified disease or condition; a method of assaying or identifying a material that itself has no specific, substantial and credible utility; a method of making a material that itself has no specific, substantial and credible utility; or a claim to an intermediate product for use in making a final product that has no specific, substantial and credible utility.⁸⁶

Finally, an assertion of utility is credible, or in other words believable to a person of ordinary skill in the art based on the totality of evidence, unless the logic underlying the assertion is seriously flawed, or the facts on which the assertion is based are inconsistent with the logic underlying the assertion. Credible utility is assessed from the standpoint of a person of ordinary skill in the art, that is, whether they would accept that the invention is currently available for such use according to the disclosure of the application.⁸⁷

2. EPO

According to the EPO, utility is defined as industrial applicability, which includes any kind of industry, such as agriculture.⁸⁸ In the case of DNA patents, EPO requires that the specific industrial application of a DNA sequence or a partial DNA sequence of a gene must be disclosed in the patent application. Inventions which merely display nucleic acid sequences without clear indication of a function are not considered patentable inventions.⁸⁹ For example, in cases where a DNA sequence of or partial sequence of a gene is used to produce a protein or part of a protein, it is necessary to specify which protein or part of a protein is produced and what is the function this protein or part of a protein performs.⁹⁰ If the identity and function of the protein is based on the homology search but not direct experimental data, then the function of the

⁸⁴ *Id.*

⁸⁵ *Id.*

⁸⁶ *Id.*

⁸⁷ *Id.*

⁸⁸ See European Patent Office, European Patent Convention, Part II, Chapter 1: Patentability, Art. 57 – Industrial Application, at <http://www.european-patent-office.org/legal/epc/e/ar57.html> (last visited May 25, 2003).

⁸⁹ See European Patent Office, Guidelines for Examination in the EPO, Part C, Chapter IV: Patentability, Article 52(4), at http://www.european-patent-office.org/legal/gui_lines/e/c_iv_4.htm (last visited May 25, 2003).

⁹⁰ See *Id.*

claimed nucleotide sequence and the protein it encodes should be certain to the degree that a specific utility for the claimed sequence becomes apparent beyond speculation.⁹¹

3. JPO

In Japan, utility means industrial applicability as prescribed in the main paragraph of Article 29(1) of the Japanese Patent Law,⁹² which states, “Any person who has made an invention which is industrially applicable may obtain a patent therefor.”⁹³ Any invention lacking this requirement is deemed unpatentable.

DNA fragments, genes, and recombinant proteins are considered to be chemicals by the JPO.⁹⁴ Examination practice regarding the requirement for industrial applicability of conventional-type chemicals requires that at least one use be described in the specification as filed. However, clear demonstration of the use is not necessary. Where there is disclosure from which a specific use of a DNA-related invention can be expected or predicted, the industrial applicability requirement is satisfied. With regard to transgenic animals and plants, the requirement for industrial applicability, as well as the how-to-use requirement will rarely become problematic, because their use is more often obvious.

B. The Novelty of DNA and Biotechnological Inventions

1. Novelty Issues Particular to Biotechnology Invention

In the field of biotechnology invention, the issue of novelty often is combined with the issue of patentable subject matter. The “Product of Nature” doctrine creates an important restriction particularly in biotechnology, because biotechnology products and processes may be derived from the duplication of compounds found in living organisms or produced by naturally occurring animals or plants.⁹⁵ If it is accepted that transgenic plants and animals, modified microorganisms and isolated and purified DNA sequences are the results of human intervention and that they are patentable subject matter, naturally, one might advocate the view that they are “new” in the sense of having no previous existence in the state of the art.

⁹¹ See TRILATERAL PROJECT B3B: COMPARATIVE STUDY ON BIOTECHNOLOGY PATENT PRACTICES (THEME: NUCLEIC ACID MOLECULE-RELATED INVENTIONS WHOSE FUNCTIONS ARE INFERRED BASED ON HOMOLOGY SEARCH), at http://www.european-patent-office.org/tws/sr-3-b3b_bio_search.htm (last visited May 25, 2003).

⁹² See *Industrial Applicability/Utility and Enablement Requirement in Japan*, at <http://listbox.wipo.int/wilma/scp-forum/2001/msg00005.html> (last visited May 25, 2003).

⁹³ See Japanese Legislative Affairs, Japan Patent Office General Affairs Division, JAPAN PATENT LAW, Chapter 1, art. 29(1), at <http://www.jpo.go.jp/shoukaie/patent.htm> (last modified July 27, 2001).

⁹⁴ See TRILATERAL PROJECT B3B: COMPARATIVE STUDY ON BIOTECHNOLOGY PATENT PRACTICES (THEME: NUCLEIC ACID MOLECULE-RELATED INVENTIONS WHOSE FUNCTIONS ARE INFERRED BASED ON HOMOLOGY SEARCH), *supra* note 91, at http://www.european-patent-office.org/tws/sr-3-b3b_bio_search.htm (last visited May 25, 2003).

⁹⁵ See Courtney J. Miller, *Patent Law and Human Genomics*, 26 CAP. U. L. REV. 893, 911 (1997).

2. Novelty and DNA Fragments

ESTs, SNPs and partial gene sequences, once isolated, characterized and made available to the public, form a part of the state of the art, in the same way as any other chemical. Just as one chemical may not destroy the novelty of a different chemical; ESTs, SNPs, or partial gene sequences will not destroy the novelty of full-length gene sequences. Similarly a full-length gene sequence forming a part of the state of the art is not ‘novelty destroying’ to a section of the full length DNA.⁹⁶

For instance, in the ‘Biotechnology Comparative Study on Biotechnology Patent Practices Comparative Study Report,’ authored by the USPTO, EPO and JPO, the following case is presented.⁹⁷ The prior art (Y) is a structural gene encoding a functional polypeptide, the whole sequence of which is disclosed. The claimed invention (Y') is a partial DNA fragment of Y. Does the claimed invention (Y') have novelty over the prior art (Y)? The three Offices present a generally similar result, which is that inventions that relate to a partial sequence will fall within the scope of novelty when the invention ‘has not been disclosed in concrete terms in publicly known literature.’⁹⁸ The DNA fragment is an isolated compound that is different from the full-length gene compound. Because the DNA fragment and the full-length gene are different compounds, the full-length gene sequence forming part of the state of the art is not novelty destroying to the DNA fragment. However, the USPTO, for example, further states, ‘the claimed fragment could lack novelty if the fragment were claimed using open ended language such as ‘comprising.’”⁹⁹

C. The Inventive Step of DNA and Biotechnology Inventions

Instead of focusing on the obviousness issue of the sequence itself, early DNA patent cases in the United States, for example, focused on the obviousness of the method used to isolate the DNA sequence.¹⁰⁰ However, in the case of *In Re Bell*,¹⁰¹ the Court of Appeals for the Federal Circuit (‘Federal Circuit’) focused on the structure of a DNA sequence rather than on the method used to obtain the sequence.¹⁰² The USPTO argued that, once a portion of the amino

⁹⁶ See The British Group of AIPPI, *Patentability Requirements and Scope of Protection of Expressed Sequence Tags(ESTs), Single Nucleotide Polymorphisms (SNPs) and Entire Genomes*, 1 EUR. INTELL. PROP. REV. 39-42 (2000).

⁹⁷ See JAPAN PATENT OFFICE, TRILATERAL PROJECT 24.1 – BIOTECHNOLOGY, COMPARATIVE STUDY ON BIOTECHNOLOGY PATENT PRACTICES COMPARATIVE STUDY REPORT, art. 2.1, at http://www.jpo.go.jp/torikumi_e/kokusai_e/tws/sr-3-bio.htm (last visited May 25, 2003).

⁹⁸ *Id.*

⁹⁹ *Id.* at art. 2.2.

¹⁰⁰ See Xiao D. Zhang, *The Patentability of Biotechnological Inventions and Practices in China*, BIO-SCI. L. REV. Aug. 10, 2001, available at http://pharmalicensing.com/features/disp/997365145_3b72959963a57 (last visited Sept. 24, 2002). See Xiao D. Zhang, *The Patentability of Biotechnological Inventions and Practices in China*, *supra* note 73. http://pharmalicensing.com/features/disp/997365145_3b72959963a57 24, 2002).

¹⁰¹ See *In re Bell*, 991 F.2d 781, 785 (Fed. Cir. 1993).

¹⁰² *Id.*

acid sequence is known, the method for isolating DNA sequences that encode a given protein is obvious; simply prepare and utilize nucleotide probes based on the amino acid sequence to isolate the full-length DNA. Thus, the entire nucleotide sequence of the gene would be *prima facie* obvious when the amino acid sequence for that gene could be found in the prior art.

The Federal Circuit disagreed, commenting that the established relationship in the genetic code between a nucleic acid and the protein it encodes does not necessarily cause a gene to be *prima facie* obvious over its corresponding protein, because there are an enormous number of nucleotide sequences that might encode for a specific protein as a result of degeneracy in the genetic code.¹⁰³ The court further pointed out that the USPTO's focus on Bell's method is flawed. Instead, the USPTO should focus on the obviousness issue of the claimed nucleic acid.¹⁰⁴ In the case of *In Re Deuel*,¹⁰⁵ the Federal Circuit underwent detailed analysis, reasoning that a prior art disclosing the amino acid sequence of a protein does not automatically make the particular DNA molecules encoding the protein obvious. As in *In re Bell*, the Federal Circuit stated that the USPTO's rejection on the basis of *prima facie* obviousness is clearly misplaced because a vast number of DNA sequences could be deduced from the known protein sequence as a consequence of the redundancy of the genetic code.¹⁰⁶ The existence of a general method of gene cloning in the prior art is not sufficient, without more, to render obvious a particular cDNA molecule either.¹⁰⁷

In the JPO, DNA fragments, genes, recombinant proteins, and the like, are considered chemicals.¹⁰⁸ The JPO examines the obviousness of gene-related inventions based on its "obvious-to-try" test. The JPO's practice of applying the obvious-to-try test is substantially the same as the EPO's practice. This is in complete contrast, however, to the US practice of applying the test of structural obviousness to genes and gene fragments as in *In re Deuel*. The JPO, however, has not officially made clear any reasonable ground for assessing obviousness of gene-related substances on the basis of the obvious-to-try test. Also, there is also a lack of Japanese judicial precedent that supports this method of assessment.

The sources of naturally occurring DNA are often restricted to known or readily expected sources (or screening sources), such as specific human organ cells and genes encoding specific proteins. Generally, the processes for obtaining the subjects are completely standardized, for example, isolation of a subject by a probe and sequencing by a sequencer. Thus, with respect to naturally occurring DNA, a "presumption of obvious-to-try with reasonable expectation of success" is applicable. This presumption is often applied to recombinant proteins encoded by the above-described naturally occurring DNA. Consider the following example:

¹⁰³ *Id.* at 784.

¹⁰⁴ *Id.* at 785.

¹⁰⁵ See 51 F.3d 1552, 34 U.S.P.Q.2d 1210 (Fed. Cir. 1995).

¹⁰⁶ *Id.* at 1557.

¹⁰⁷ See MANUAL OF PATENT EXAMINING PROCEDURE § 21002144.0900-148 (8th ed. 2001).

¹⁰⁸ *Trilateral Project B3b: Comparative study on biotechnology patent practices (Theme: Nucleic acid molecule-related inventions whose functions are inferred based on homology search)*, at http://www.european-patent-office.org/tws/sr-3-b3b_bio_search.htm (last visited May 29, 2003).

(1) Where protein A is publicly known but its amino acid sequence is not publicly known, an invention of a gene encoding Protein A does not have an inventive step, provided that a person skilled in the art could determine the amino acid sequence easily at the time of filing. However, when it is considered that the gene is specified by a specific base sequence and has advantageous effects that person skilled in the art cannot foresee in comparison with other genes having a different base sequence encoding the Protein A, the invention of the said gene has an inventive step.

(2) When an amino acid sequence of Protein A is publicly known, an invention of a gene encoding the Protein A does not have an inventive step. However, when it is considered that the gene is specified by a specific base sequence and has advantageous effects that a person skilled in the art cannot foresee in comparison with other genes having a different base sequence encoding the Protein A, the invention of the said gene has an inventive step.

(3) When a structural gene is publicly known, an invention related to a structural gene of naturally obtainable mutant (allelic mutant, *etc.*) of the said publicly known structural gene and which is derived from the same species as the said structural gene and has the same properties and functions as the said structural gene does not have an inventive step. However, if the claimed structural gene has advantageous effects that a person skilled in the art cannot foresee in comparison with the said publicly known structural gene, the claimed invention of the structural gene has an inventive step.¹⁰⁹

The denial of inventive step is based on the concept that if the amino acid sequence of protein A is known, it would be easy to try to isolate and sequence of a specific gene coding protein A by means of standard cloning procedures. The main reason for the JPO's adoption of this standard might likely be ascribed to the fact that under the present technical standard, once the amino acid sequence of protein A is known, it would reasonably be expected to find out the target gene.¹¹⁰ Notably, the EPO has a similar policy to the JPO where, under the premise of a reasonable expectation of success, the denial of inventive step is based on the "obvious-to-try" standard.¹¹¹

D. The Written Description Requirement

In the United States, for example, the Patent Act embodies a written-description requirement to ensure that an applicant has actually invented what is claimed and that the public will be in possession of the claimed invention after the expiration of the patent.¹¹² The new

¹⁰⁹ See Japan Patent Office, *Bio Patent*, 74-75.

¹¹⁰ *Id.* at 75.

¹¹¹ *Id.* at 75-76.

¹¹² 35 U.S.C. § 112 (2001).

guidelines issued by the USPTO, the Guidelines for Examination of Patent Applications Under the 35 U.S.C. § 112, ¶1 “Written Description” Requirement, set forth the methodology for determining the adequacy of a written description.¹¹³

For each claim, the examiner should first determine what the claim as a whole covers and give the claim its broadest reasonable interpretation.¹¹⁴ The entire patent application is then reviewed to understand how the applicant provides support for each element of the claimed invention and determine whether the applicant has demonstrated possession of the claimed invention. Such a review is conducted from the standpoint of one of skill in the art at the time the application was filed. Information that is well known in the art need not be described in detail in the specification.¹¹⁵

The Examiner should determine whether there is sufficient written description to inform one reasonably skilled in the art that the applicant was in possession of the claimed invention as a whole at the time the application was filed.¹¹⁶ This may be shown in a number of ways, including describing an actual reduction to practice of the claimed invention; that is, by showing that the inventor produced an embodiment or performed a process that met all the limitations of the claim and that the invention worked for its intended purpose. Sufficient written description can also be shown by disclosing drawings or structural chemical formulas, so long as they enable one skilled in the art to practice the invention.¹¹⁷ To this end, the Written Description Guidelines state that “[d]escribing the complete chemical structure, i.e., the DNA sequence, of a claimed DNA is one method of satisfying the written description requirement, but it is not the only method[;]...there is no basis for a *per se* rule requiring disclosure of complete DNA sequences or limiting DNA claims to only the sequence disclosed (emphasis added).”¹¹⁸

IV. Strategic Utilization of DNA-Related Patents

The utilization of DNA and DNA-related patents is quite a complicated issue. The global marketplace is more and more an information economy. Traditionally, companies were valued primarily on the basis of their physical assets, including tangibles such as cash, manufacturing plants, inventory, land holdings, and mineral rights. However, it is increasingly common to find that the primary asset of a contemporary company is its intellectual property. This is especially true for the biotech start-ups, such as functional genomics and bioinformatics firms. The relevant question becomes how can an owner of DNA patents, such as a small bioinformatics company, a pharmaceutical giant, or a public institute, create, protect, and extract value from these intellectual assets?

¹¹³ Guidelines for Examination of Patent Applications Under the 35 U.S.C. 112, P1, "Written Description" Requirement, 66 Fed. Reg. 1099 (Jan. 5, 2001) (bb p. 98).

¹¹⁴ *Id.* at 1105.

¹¹⁵ *Id.*

¹¹⁶ *Id.*

¹¹⁷ *Id.* at 1106.

¹¹⁸ *Id.* at 1101.

For high-tech companies like functional genomics firms, successful business depends on strategic intellectual property management (“SIPM”). SIPM can be defined as a system consisting of the following three interdependent functions: (1) planning and acquiring; (2) organizing and protecting; and (3) extracting value.¹¹⁹ Product development in the biotech industry is often a lengthy process, thereby affording potential competitors abundant opportunities to enter the market and compete. A well-managed DNA patent portfolio can create barriers to entry that discourage competitors and greatly slow or even halt competition, providing time for further research and development.¹²⁰ Another advantage of SIPM is that a strategically constructed DNA patent portfolio will place a company in a better position to attract investment or acquisition, since investors are generally more willing to invest in a company with a strategic technological edge over its rivals.

Strategic planning should start even before the patent application itself. Since a patent application is lengthy and expensive, usually taking approximately 3 years and costing upwards of \$15,000 (for a U.S. patent, for example), a biotech company may want to assess its current state of research and development to identify the key technologies it intends to protect. This planning should include an analysis of its current intellectual property inventory in the context of well-defined business objectives. The main questions a company should ask itself at this stage include whether it should focus on expanding new products or protecting existing ones and whether specific patent applications would create market barriers to competition.¹²¹ In fact, a common strategy in the field of genomics is to acquire substantial patent portfolios, even if the patents are not strong in the traditional sense, so that competitors are discouraged from taking similar products to market.¹²² Furthermore, in deciding which core intellectual property to protect, decision-makers should also take into account market demand. An intellectual property strategist should let the market control the direction of the planning and construction of the patent portfolio. In addition, third-party patent positions must be identified and thoroughly reviewed to determine the potential for blocking patents and “licensing -in” opportunities.

A well-planned DNA patent portfolio cannot function well without diligent organization and protection. The stakeholder should perform diligent record-keeping practices and routine, vigilant surveillance of the activities of competitors and other third parties for potential patent infringement. Thorough due diligence should be conducted before patents are licensed, including a close evaluation of patent claims.¹²³ Patents holders must also maintain and archive all invention records related to the DNA patents, such as laboratory notebooks, because these constitute critical evidence of invention. The information of all inventors and other employees involved in the research and development processes should be updated regularly because they

¹¹⁹ John P. Isacson, *Maximizing profits Profits through Through intelligent Intelligent planning Planning and Implementation*, 18 NATURE BIOTECHNOLOGY 565 (2000).

¹²⁰ Reid Adler, *Corporate Patent Strategies in the Genomics Industry*, Presentation to Yale Law and Technology Society (March 23, 2000) in 3 YALE SYMP. L. & TECH. 1 (2000).

¹²¹ See Isacson, *supra* note 118, at 565.

¹²² See Adler, *supra* note 119, at 566.

¹²³ See Isacson, *supra* note 118, at 565.

are potential witnesses in any potential litigation. Furthermore, there are sometimes disastrous consequences of omitting an inventor in a patent application.¹²⁴

Patent infringement, in the U.S. for example, results from using, making or selling a patented invention without authorization, from contributing to another's infringement, or from inducing a third party to infringe. It is not uncommon to unknowingly infringe upon another's patent, as knowledge of the patent is not a prerequisite to infringement. To reduce this risk, companies should conduct an extensive search of all issued patents. Alternatively, if an extensive search is cost prohibitive, then a search should be conducted of competitors' patents before exploiting a new technology or making a new product. For example, a fictional company, Miracle Antibodies, develops humanized antibodies for treating breast cancer patients. Before spending tens, maybe hundreds, of millions of dollars and years on laboratory and clinical research, the company should know whether its future product, Breast Cancer Miracle Antibody, would infringe another's patent. In this hypothetical, the result of a patent search would provide invaluable guidance to the company's decision makers.

The ultimate goal of SIPM is to extract value out of the DNA patent portfolios. Besides the utilization of DNA patents as a barrier to discourage potential competitors, DNA patents can also be utilized to generate value for the patent holders through a number of methods:

- licensing patents that do not match the firm's business objectives and are unlikely to be utilized;¹²⁵
- cross-licensing with competitor to gain critical market access;¹²⁶
- using DNA patents as "bargaining chips" for better position when forming strategic alliances;¹²⁷
- obtaining monetary compensation and stronger market position through infringement litigation against competitors,¹²⁸ or for companies with substantial patent portfolios of their own, protecting the company from competitor's infringement accusations by establishing counterclaims of infringement by the accuser or offering part of their portfolios for a cross-licensing settlement;¹²⁹
- donating non-utilized DNA patents to public institutions or other nonprofit institutions for corporate tax deduction benefits and to gain access to the research and talents in those organizations.¹³⁰

In summary, effective management of a proprietary DNA portfolio is vital to the success of biotech companies. The DNA patent portfolio is now a key strategic element and the decisions

¹²⁴ See, e.g., *Ethicon, Inc. v. US Surgical Corp, Inc.*, 135 F.3d 1456 (Fed. Cir. 1998).

¹²⁵ See Isacson, *supra* note 118, at 565.

¹²⁶ See Adler, *supra* note 119, at 566.

¹²⁷ See Isacson, *supra* note 118, at 565.

¹²⁸ *Id.*

¹²⁹ See Adler *supra* note 119, at 566.

¹³⁰ See Isacson, *supra* note 118, at 565.

surrounding it must be adeptly and dynamically managed to maximize firm profits. The DNA patent is no longer mere property, but is now the core of modern biotech companies.