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Scientific Realism and the Patent System

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Abstract

The patent system appears to make three metaphysical assumptions often associated with scientific realism: there is a natural (i.e. external) world that is independent of human knowledge and technology; unobservable entities (such as some types of inventions) exist; and objects can have causal powers. Although a straightforward reading of patent laws implies these metaphysical commitments, it is not at all clear that what the patent system has to say about the world has any bearing on issues of scientific realism. While realists might embrace the patent system's apparent metaphysics as providing additional support for their view, anti-realists could propose an alternative interpretation of patent law that does not involve realist metaphysical commitments. Thus, questions about the patent system's metaphysics depend on whether one takes patent law at face value or defends an interpretation of patent law motivated by philosophical theory. Nevertheless, philosophers of science should pay attention to the practice of patenting, even if they ultimately reject the patent system's apparent metaphysics and offer an alternative interpretation.

Keywords

patents; inventions; realism; anti-realism; nature; causation

1. Introduction

Philosophical questions loomed large in the recent 9–0 U.S. Supreme Court decision in *Association for Molecular Pathology v. Myriad Genetics* (2013). The legal issue before the Court was whether Myriad's patents on isolated and purified BRCA1 and BRCA2 genes associated with breast and ovarian are valid. The Court ruled that Myriad's patents on isolated and purified endogenous deoxyribonucleic acid (DNA) sequences are invalid, because they are patents on naturally occurring compositions of matter, not human inventions. The central legal—and philosophical—issue in this case was where to draw the line between naturally occurring phenomena (also known as products of nature) and inventions (also known as products of human ingenuity). The Court drew line by distinguishing between DNA sequences that occur in nature and those that have been modified in some way by human beings. Although the court rejected Myriad's DNA patents, it held that patents on complementary DNA (cDNA), i.e. DNA in which non-protein coding regions have been removed, are valid because cDNA is not naturally occurring. One of the philosophical assumptions lurking behind the product of nature vs. product of human

ingenuity distinction is the idea that the natural world is independent of human concepts, beliefs, interests, and technologies (Radder 2013).

The idea that the natural world is independent of human beings is one of the key tenets of most versions of scientific realism, but not the only one. Most realists also hold that unobservable entities (e.g. electrons, DNA, black holes, etc.) described by well-confirmed scientific theories exist, and that the world has a causal structure (Chakravartty 2007).¹ As I shall argue below, a straightforward reading of patent law appears to imply metaphysical commitments typically associated with scientific realism. However, it is not clear what bearing this reading of patent laws has for the philosophy of science, since anti-realists would favor an alternative interpretation of patent law that does not involve realist commitments.²

2. The Patent System

A patent is an ownership right granted by or for government to inventors. A patent gives the inventor the right to exclude others from making, using or commercializing his or her invention for a limited period of time, usually twenty years from the date of the patent application. Inventors may transfer or license their inventions to other parties. Someone who violates a patent holder's rights can be held liable for infringement. Once a patent expires, anyone may make, use or commercialize the invention without obtaining permission from the patent holder. The first patents were awarded by the British monarchy to inventors in the 1300s. The city of Venice adopted the first patent statute in 1474. Article 1, Section 8 of the U.S. Constitution grants Congress the right to award patents to promote science and the useful arts. The U.S. adopted its first patent statute and established its patent office in 1790 (Miller and Davis 2007).

Under U.S. law, to receive a patent an inventor must submit an application to the U.S. Patent and Trademark Office (USPTO) in which he or she describes the invention and its potential uses.³ The patent application must contain enough information to allow someone knowledgeable in the relevant practical art to make and use the invention (Miller and Davis 2007). If the patent office examiners determine that the invention cannot work, the patent office will refuse to grant a patent. In the U.S., the patent application becomes part of the public record once the patent is awarded, so that others may learn from the invention. Placing the application in the public record in return for awarding patent rights is often referred to as the "patent bargain," because the inventor gives up his right to practice his invention in secret in exchange for exclusive control over the invention for a limited time. Unlike patents, trade secrets can be kept indefinitely (Miller and Davis 2007).

The U.S. awards patents on invented products (i.e. articles of manufacture, compositions of matter, machines, and plant varieties), methods, and ornamental designs. An invention must meet the following criteria for the inventor to receive a U.S. patent (Miller and Davis 2007):

¹By 'unobservable entity' I mean something that we cannot observe with our unaided senses. See van Fraassen (1980).

²The patent system also raises many interesting ethical, political, and policy issues that will not be examined here. See Heller and Eisenberg (1998), Resnik (2003a,b), Sterckx (2006), Biddle (2012).

³Other countries have similar laws.

- **Originality.** An invention must be original or novel. It cannot have been previously used or disclosed in the scientific and technical literature.
- **Non-obviousness.** An invention must not be obvious to someone knowledgeable in the relevant practical art.
- **Utility.** An invention must have a well-defined, lawful use. The usefulness of the invention cannot be purely speculative or hypothetical.

In addition to meeting these criteria, the invention must belong to a patent-eligible subject matter. Since the U.S. patent statute does not define patent-eligible subject matter, the courts have interpreted this concept. In so doing, they have construed the statute broadly under the assumption that Congress intended it to have wide application (*Association for Molecular Pathology v. Myriad Genetics* (2013)). However, the courts have decided that some things are not patent-eligible, including natural phenomena (such as electricity or newly discovered species), laws of nature (such as $E = mc^2$), and abstract ideas (such as the Pythagorean Theorem). Natural phenomena are not patent-eligible, according to the courts, because they are products of nature, not human inventions. An inventor must create or conceive of something new that did not exist previously in nature. For example, newly discovered species of bacteria are not patent-eligible but genetically modified bacteria are (*Diamond v. Chakrabarty* 1980). Laws of nature and abstract ideas (or mental constructions) are not patent-eligible because they do constitute applied knowledge (*Mayo Collaborative Services v. Prometheus Laboratories, Inc.* 2012).⁴ Though one cannot patent a mathematical equation, one can patent a computer program that uses the equation to control manufacturing processes (*Diamond v. Diehr* 1981).

In attempting to draw the line between what is and is not patent-eligible, the courts have sought to balance two competing values: protection of intellectual property and free and open exchange of scientific information. The ethical and political rationale for the patent system is that it can stimulate the progress of science and technology by providing incentives and rewards for inventors and private companies (Resnik 2003a,b). Though some intellectual property protection has a beneficial impact on science and technology, too much can be detrimental. In delineating the realm of patent-eligibility, the courts have sought to make fundamental knowledge available to all scientists while offering protection for practical applications of scientific knowledge. Although the courts use the product of nature versus product of human ingenuity distinction in their legal opinions, they are undoubtedly guided by the practical implications of their decisions for science and technology. Thus, value judgments play a key role in determining patent-eligibility (Resnik 2003a,b, Sterckx 2006).

3. Apparent Metaphysical Commitments of the Patent System

In this section, I will argue that the patent system appears to make metaphysical commitments associated with scientific realism. To defend this claim, it is necessary to first say what I mean by apparent metaphysical commitments. An apparent metaphysical

⁴By “laws of nature” the courts generally include any type of empirical generalization.

commitment is one that is implied by a straightforward reading of a text, without any reinterpretation (or paraphrasing) of the text (Horgan 1986). For example, someone who believes the sentence “Tom’s cells contain DNA” is apparently committed to the existence of Tom, cells, and DNA, because the variables, ‘Tom,’ ‘cell,’ and ‘DNA’ used in this sentence are bound by existential quantifiers (Quine 1948, 1960). An apparent metaphysical commitment is not the same as an actual or genuine metaphysical commitment, because one might attempt to eliminate an apparent commitment by reinterpreting (or paraphrasing) a text (Macdonald 2005). For example, the sentence “The New York Yankees have won 27 World Series” appears to commit one to the existence of an abstract entity, the New York Yankees. However, one might try to avoid this ontological commitment by equating the New York Yankees with individual players that have played on the team. Apparent metaphysical commitments may include ontological claims (e.g. “electrons exist”) as well as a variety of other assertions concerning our relationship to the world, such as statements about causality.

The first apparent metaphysical commitment made by the patent system is to the existence of a world that is independent of human beings, i.e. nature. Under a straightforward reading of the products of nature vs. products of human ingenuity distinction as it occurs on patent law, the distinction implies that there are things that exist in nature, independent of human beings as well as things (i.e. inventions) that depend on human beings for their existence. The bicycle, for example, would not have existed unless it had been invented by human beings, but the sun would still exist even if human beings had never existed. Thus, the patent system *appears* to be committed to the idea of a natural world independent of human knowledge, technology, and so on (Radder 2013).

The patent system also appears to be committed to the existence of unobservable entities, because patent law recognizes patents on many things that we cannot observe with our unaided senses. For over a century, government agencies have awarded patents on unobservable entities, such as molecules used in industry and medicine, isolated and cultured cell lines, microscopic organisms, and microscopic parts. In 1911, a U.S. federal court recognized the validity of a patent on isolated and purified adrenalin (Parke-Davis & Co. v. H.K. Mulford Co. 1911). In 1958, the Supreme Court recognized the validity of a patent on isolated and purified Vitamin-B12 (Merck & Co. v. Olin Mathieson Chemical Corp. 1958). As noted earlier, in 1980 the Court recognized patents on genetically engineered microorganisms (Diamond v. Chakrabarty 1980). The USPTO recently awarded a patent on a nanowire, a device with a diameter of 1 nanometer or 10^{-9} meters (Colli 2012).

The patent system also appears to be committed to the existence of causal relationships, because patent applications and legal cases discuss the causal powers of inventions. Chin (2012) argues that processes, articles of manufacture, and compositions of matter have been viewed by the courts as having causal powers. A light bulb produces light, and a mousetrap catches mice. At the microscopic level, patented inventions with causal powers include drugs, such as molecules known as selective serotonin reuptake inhibitors, which increase levels of serotonin in the brain and can thereby be used to treat depression and other mental illnesses (Harper et al 1999), as well as bacteria that metabolize crude oil (Diamond v. Chakrabarty 1980). The requirement that the invention is useful also implies that the invention has causal powers in many cases, because often things are useful because they can

do something. A light bulb is useful because it produces light, and a nanowire is useful because it carries electricity (Chin 2012). Chin (2012) also notes that one reason why abstract ideas cannot be patented is that the courts regard them as lacking causal powers.

Thus, a straightforward reading of patent law appears to commit the patent system to at least three metaphysical assumptions often associated with scientific realism:

1. There is a natural world independent of human beings;
2. Unobservable things (such as some types of invented products) exist;
3. Physical objects (such as some types of inventions) can have causal powers.

The patent system's realist orientation should come as no surprise, since patent law deals with inherently practical matters concerning describing, making, using, and controlling inventions. Inventions are things that can do something in the world (Chin 2012).

4. Philosophy of Science and the Patent System

4.1 Scientific Realism and the Patent System

What bearing—if any—does the patent system's apparent metaphysics have for traditional questions concerning scientific realism? Let's consider the patent system's apparent commitment to a natural world that is independent of human beings, i.e. nature. This claim would seem to offer support for scientific realism, since most scientific realists are committed to the existence of an external world (Chakravartty 2007). While the commitment to an external world distinguishes scientific realism from idealism, it does not distinguish scientific realism from empiricism. Constructive empiricists, such as van Fraassen (1980) also accept the existence of an external world, even though they remain agnostic about the existence of unobservable things described by scientific theories. Constructive empiricists are willing to accept scientific claims concerning observable physical objects, such as voltmeters, planets, trees, and so on, but they remain agnostic about the existence of electrons, DNA, and other theoretical entities. So, scientific realism involves more than a commitment to an external world.

The second aspect of the patent system's apparent metaphysics distinguishes scientific realism from constructive empiricism because it involves a commitment to unobservable objects, processes, and properties. Scientific realists could argue that the patent system's apparent metaphysical commitments provide supporting evidence for their view. One of the most influential arguments for scientific realism is the success of science argument. According to one version of this argument, the best explanation of the predictive success of a theory (or hypothesis) is that the theory is true (or approximately true) and the entities described by the theory, including unobservable ones, exist (Boyd 1983, Chakravartty 2007). For example, a scientific realist would hold that the best explanation of our ability to accurately predict the products of chemical reactions is that our chemical theories are true (or approximately true) and the entities described by these theories, such as various elements and types of chemical bonds, exist.

Some scientific realists, such as Ian Hacking (1983), make no pronouncements about the truth of theories and limit realism to claims about entities. According to Hacking (1983), successful experimental manipulation of an object (or process or property) constitutes good evidence that the object exists. Our ability to insert DNA into an organism to produce desired effects, such as giving the organism the ability to metabolize crude oil, would be evidence that DNA exists. Our theories about DNA might still be mistaken, according to Hacking, but we can infer that DNA is real, even if we cannot observe it with our unaided senses (Resnik 1994).

The patent system seems to be a natural fit for Hacking's approach to scientific realism. Patent applications rarely mention scientific theories but they do describe ways of making and using invented products. To get a patent on a light bulb, you must show that the light bulb can do something useful (i.e. generates light) and that it works as designed. The patent application must contain enough information to allow someone trained in the relevant practical art to make and use the light bulb. The same requirements hold for any invention, whether it is cDNA, a method for splicing genes, or a nanowire. Sometimes inventions do not work as described, but when this happens the inventions will not be commercially successful, since people will not license or purchase technologies that do not work.

Scientific realists could also argue that the patent system's apparent metaphysical commitments also provide supporting evidence for their approaches to causation. In addition to Hacking (1983) many other scientific realists posit the existence of causal properties and relationships to explain the success of science (Salmon 1984, Chakravartty 2007). For example, James Woodward (2003) argues that the notion of causation used in scientific explanation is based on the idea of experimental manipulation. To demonstrate a causal relationship between two variables one must perform experiments showing that manipulation of one variable produces corresponding changes in the other variable. For example, to show that fire causes smoke, one could perform experiments showing that changing the amount of fire affects the amount of smoke produced, or that starting a fire produce smokes or extinguishing it stops the smoke. This notion of causation as a form of manipulation complements Hacking's experimental realism, and fits in well with the patent system's ontology, which emphasizes practical utility.

It is important to note, however, that there are many different approaches to causation in the philosophical literature, ranging from counterfactual approaches to probabilistic ones, and it is not clear which one the patent system supports. As discussed below, some approaches to causality do not involve commitments to the existence of unobservable entities. So, a scientific realist who wants to use the patent system to support a particular approach to causation would need to develop this argument more fully and explain why the patent system supports this approach as opposed to some other one.

4.2 Anti-realism and the Patent System

While realists might welcome a straightforward reading of the patent law as providing additional support for their view, anti-realists could offer an alternative interpretation of patent law that does not involve such metaphysical commitments. This would not be a

straightforward interpretation of patent law, but an interpretation motivated by philosophical theory.

Social constructivists might argue that the distinction between products of nature and products of human ingenuity does not involve a commitment to a natural world independent of human beings (Rader 2013). Social constructivism is a modern form of idealism that rejects the idea that there is a natural world independent of human concepts, beliefs, and technologies (Woolgar 1988, Collins and Pinch 1993).⁵ Social constructivists argue that all aspects of science—from observation and experimentation to data analysis and theory choice—are strongly influenced by social factors, and that the natural world is itself a social construct. All perceptual objects are fashioned from concepts, beliefs, and technologies. There is no “DNA” in the world independently of us; “DNA” is a merely concept that we use to organize our perceptions. Social constructivists might admit that there are some objects that we recognize as part of nature and others that we view as human inventions, but they would maintain that such a distinction is a linguistic convention and that both are ultimately socially constructs.

Likewise, Kantians could also maintain the distinction between products of nature and products of human ingenuity involves no commitments to a natural world independent of human knowledge or technology. Kant (1781) held that we construct our perceptions of the world (i.e. the phenomena) from our categories (causality, substance, etc.) and intuitions (space, time). Products of nature and products of human ingenuity would both belong to the world that we perceive, not to any mind-independent reality. Kant held that we must posit a mind-independent reality (the *noumena*) for the purposes of morality and religion, but that we can never know anything about it. Our knowledge is limited to the world of the phenomena. Since the practice of patenting involves epistemic claims about how inventions work, it is limited to the phenomenal realm.

Constructive empiricists, such as Bas van Fraassen (1980), would reinterpret the patent system’s apparent commitment to the existence of unobservable entities. Van Fraassen is not an idealist because he believes in the existence of a natural world independent of human beings. Van Fraassen argues, however, that scientific knowledge and ontological commitments concerning the world should be limited to the realm of what is observable by means of our unaided senses (i.e. observables). Though he does not deny that unobservable entities can exist, he says that we cannot know that they exist and should therefore remain agnostic about them (van Fraassen 1980). Evidence for a scientific theory (or hypothesis) can only show that the theory is empirically adequate, i.e. that the theory is consistent with the observations we make with our unaided senses. Evidence cannot prove that what the theory says about unobservable entities is true. Thus, van Fraassen (1980) would say that we cannot know whether unobservable inventions, such as cDNA, nanowires, or genetically modified bacteria, exist. Patenting unobservable entities, such as nanowires, does not prove that they exist anymore than patenting a design for Santa’s sleigh proves that Santa Claus

⁵My aim in this paper is not to critique specific philosophical positions on scientific ontology but to explore how different approaches (such as social constructivism, realism, etc.) might respond to the patent system’s apparent ontology. For further discussion of these positions see Salmon (1984), Kitcher (1995), and Chakravartty (2007).

exists. Any claims we make about patents on unobservable entities have to be understood as really making complex claims about things that we can observe. For example, a patent on a nanowire would be understood in terms of claims concerning observable operations or activities, such as observations we make concerning how we control or use an observable device (such as a computer).

Philosophers influenced by the writings of David Hume (1711–1776) would challenge the patent system's apparent commitments to causation. Hume argued that when we observe events that we call causes and effects, such as fire and smoke, we cannot infer any causal connection between these events (Hume 1739/40). We can only infer that two events, A & B, regularly occur sequentially. We come to expect that when we observe A we will then observe B, but this psychological association is not proof of causation. To prove causation, we would need to be able to observe a necessary connection between events, but we cannot do this, according to Hume. We observe event A and event B but no causal connection between A and B. Although a number of philosophers have proposed theories of how we can have knowledge of causal relationships, Hume's skepticism concerning causation remains an influential position in the philosophy of science (Salmon 1984, Baumgartner 2008), and a follower of Hume would not be convinced by the patent system's claims concerning causation. Humeans would attempt to reinterpret patent law's causal claims as involving nothing more than claims about associations between observable events, not as claims about causal powers per se. For example, the claim that a light bulb produces light could be understood as a claim that electrical activation of a light bulb is associated with emission of light.

4.3 Descriptive vs. Normative Philosophy of Science

As we have just seen, the response to the patent system's apparent metaphysical commitments depends on one's philosophical views. While scientific realists would welcome an interpretation of the patent law that supports their view, anti-realists would seek alternative interpretations which do not involve metaphysical commitments that they reject. This difference between realists and anti-realists raises the issue of whether one should accept a straightforward reading of patent law or an alternative interpretation. One reason why one might seek an alternative interpretation of patent law is that one views a straightforward reading as irrational, implausible, or otherwise unjustified. For example, the sentence "The average American family has 2.1 children" makes an apparent commitment to the existence of 2.1 children. One might reject this commitment on grounds that 2.1 children is a biological impossibility. Moving beyond this simple example, philosophers have debunked many different ontological commitments made by scientists, such as beliefs in vital forces, the ego, the id, so on, on the grounds that these commitments were inconsistent with scientific or epistemological principles (Popper 1963).

Criticizing the metaphysical commitments made by scientists raises an important issue in the philosophy of science: should philosophy of science be normative or descriptive (Wylie 1986, Screrri 2005)? If the philosophy of science is a purely descriptive discipline, then philosophers should accept scientists' metaphysical commitments at face

value. If philosophy of science is normative, the philosophers may criticize scientists' apparent metaphysical commitments.

For many years, philosophy of science was regarded as a normative discipline that analyzes and explores the logical and epistemological foundations of science. The practice of science was regarded as largely irrelevant to the philosophy of science, since philosophical questions concerning scientific knowledge could be answered without appealing to what scientists actually do or believe. In his landmark book, *The Structure of Scientific Revolutions*, Thomas Kuhn (1962) argued that the history, sociology, psychology, and economics of science have an important bearing on the philosophy of science, and that philosophers of science must come to terms with scientific practice. As a result of the work of Kuhn and other scholars working in his tradition, such as Laudan (1977) and Lakatos (1980), most philosophers now recognize that the philosophy of science is not a purely normative discipline but that it must also take into consideration insights from the practice of science (Hull 1990, Kitcher 1995).

Recognizing that philosophy of science should be normative and descriptive implies that philosophers should not ignore the patent system's apparent metaphysical commitments, especially since the patent system is a key part of scientific practice that helps to stimulate the progress of science and technology. However, it is far from clear whether the metaphysical commitments made by patent attorneys, judges, patent examiners, and scientists have any implications for the philosophy of science. Since the philosophy of science retains its normative orientation, anti-realists could challenge the apparent metaphysical commitments of the patent system by reinterpreting patent law. Anti-realists could argue that patent attorneys, judges, patent examiners, and scientists are philosophically confused or misguided when it comes to the patent system's metaphysics. Realists could argue, however, that a straightforward reading of patent law provides a better explanation of patenting practice than an anti-realist interpretation. Thus, an examination of the patent system's apparent metaphysics probably does not settle any questions in the realism vs. anti-realism debate, but it reveals how different sides of this dispute would interpret legal texts.

5. Conclusion

Under a straightforward reading of patent law, the patent system appears to make three metaphysical claims often associated with most types of scientific realism: there is a natural (i.e. external) world independent of human beings; unobservable entities (such as some types of inventions) exist; and objects can have causal powers. The implications of the patent system's apparent metaphysics for the philosophy of science are far from clear. While scientific realists might view the patent system's commitments as providing additional support for their approach to the philosophy of science, anti-realists could offer an alternative interpretation of patent law consistent with their philosophy. Thus, an examination of the patent system's apparent metaphysics probably does not settle any questions concerning the realism vs. anti-realism debate, but it reveals how different sides in this dispute would interpret legal texts. Nevertheless, philosophers of science should pay attention to the practice of patenting, even if they ultimately reject the patent system's apparent metaphysics and offer a different interpretation of patent law.

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