

Justifying Patents: A Critique of the Deontological Approach

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Abstract

This thesis assesses philosophical arguments in favour of patent systems. These come in both consequentialist and deontological forms, the latter of which are the focus of this analysis. One kind of deontological argument is based on the concept of desert. I argue that on any plausible conception of desert, the patent system fails to distribute rewards as well as viable alternative systems could. The other kind of deontological argument claims that inventors are entitled to patent rights over their inventions as an extension of their natural rights, drawing on a Lockean account of the conditions of legitimate appropriation of unowned goods. After a discussion of the metaphysics of invention, and of the nature of the commons, I argue that Locke's conditions are not in fact always trivially satisfied in the case of patents. Furthermore, entitlement-based arguments conclude that because new inventions are unowned, claiming property rights in them involves only the same moral considerations that would apply in the state of nature. I argue that because we are not in the state of nature, pre-existing property rights also need to be taken into account, which conflict with patents. The broad conclusion of this thesis is that none of the plausible deontological arguments for patent systems are sound. The implication is that any justification of them must therefore be made in consequentialist terms; this ultimately rests on strong empirical evidence rather than normative arguments alone.

1. Introduction

Patents are a kind of intellectual property right relating to inventions. They grant their owners the right to exclude others from making, using, selling, or distributing versions of the patented invention. Because of this exclusivity, they potentially prevent worthwhile ends being pursued or important needs being fulfilled. For instance, if there is a patent on a life-saving drug, those who cannot afford to pay the license fee may die unnecessarily¹. Research on genes can be stifled by patents². If patents are to be justified, strong reasons will need to be found for granting such exclusivity rights.

There has been a long history of opposition to intellectual property,³ and the question of its justification is now hotly debated by legal scholars, economists, politicians and activists.⁴ It has also gained attention from philosophers. Much of the philosophical work focuses on intellectual property in general, or on copyright in particular, drawing on political philosophy and ethics, as well as on the metaphysics of the objects of intellectual property. But intellectual property should also be of interest in the context of science and technology in society, especially where patents are concerned. Much of the subject matter of patents is developed not by amateur inventors but by scientists. It is researchers in biology, chemistry, engineering and other disciplines, whether employed by universities or the private sector, who create many of the patented inventions of today. Aside from discovering fundamental truths about the world, a primary purpose of such research is to pave the way for new technologies, which solve problems and create new opportunities.⁵ If we care about science as an institution for generating this kind of 'practical knowledge', then anything which restricts the use of that knowledge deserves scrutiny. Patents strongly determine the conditions under which the practical applications of research can be put to use, both within science and wider society. As barriers to accessing the output of research, patents ought to be an important concern for those interested in ethical and political dimensions of science and technology. Are they consistent with the universal right, as the Universal Declaration on Human Rights says, "to share in scientific advancement and its benefits?"⁶

In making the case for intellectual property reform, some authors reference an older tradition within the scientific community, according to which the output of science should be openly available to all.⁷ Sociologists of science working in the middle of the last century, such as Merton (1942), Barber (1953), and Hagstrom (1965), each provided similar characterisations of the norms of scientific research. One such norm was the promotion of a public domain of freely available scientific information. Merton (1942) is known for characterising science as 'communistic', in the sense that the findings of science are a product of social collaboration and thus owned jointly by the community. Hagstrom claimed that "scientific knowledge is [seen as] community property" (1965, p99). According to Barber, property rights in scientific inventions are often seen as immoral (1953, p153-54). In the scientific community of the 21st century, these norms may have lost some of their

1 Mercurio (2004)

2 Williams (2010)

3 Benjamin Franklin held that "as we enjoy great advantages from the inventions of others, we should be glad of an opportunity to serve others by any invention of ours; and this we should do freely and generously." Franklin (1916)

4 Prominent legal scholars include Lessig (2004) and Boyle (2008). Activists include those united under the 'Access to Knowledge' banner (Krikorian and Kapczynski [2010]), Sweden's 'Pirate Party' (Li [2009]), and the free software movement (Stallman [2011]), amongst others.

5 Intellectual property can also restrict access to the propositional knowledge generated in fundamental research, because particular expressions of such knowledge are covered by copyright; the 'open access' movement proposes an alternative (see Kaiwen [2005] for an overview)

6 Article 27 of the Universal Declaration of Human Rights (retrieved 2011).

7 See Boyle (2008), chapter 7, Lessig (2004) chapter 11 note 76.

weight, but they still hold to some extent.⁸ And as an increasing number of the practical applications of science end up covered by patents, perhaps it is now time to reconsider the case for this practice.

In the rest of this section, I will outline some of the pertinent facts about patents. I will also outline a difference between intellectual property and other kinds of property, namely that the former relates to types while the latter relates to tokens. This has important implications for the justificatory arguments in favour of patents considered later. Section 2 describes the terms in which a justification of patents can be made, and differentiates consequentialist and deontological approaches, the latter of which will be the main concern of this paper. In section 3 I develop and critique one kind of deontological argument, which is based on the concept of desert, drawing from previously unconnected literature on desert. I argue that on any plausible conception of desert, the patent system fails to distribute rewards to deserving labourers as well as alternative systems would.

Section 4 will consider what I call entitlement-based arguments, which argue that inventors are entitled to patent rights over their inventions as an extension of their natural rights. They draw on a Lockean account of the conditions of legitimate appropriation of unowned goods. Defenders of entitlement-based accounts argue that intellectual property can always trivially satisfy Locke's conditions. After a discussion of the metaphysics of invention, and of the nature of the commons, I will argue that Locke's conditions are not in fact always trivially satisfied in the case of patents. Furthermore, entitlement-based arguments falsely conclude that because new inventions are unowned, claiming property rights in them involves only the same moral considerations that would apply in the state of nature. But, I argue, because we are not in the state of nature, we must also consider pre-existing property rights, which conflict with patents. This ultimately undermines an entitlement-based justification of patents.

If neither of the plausible deontological arguments are sound, this leaves only the consequentialist approach. Ultimately, the justification of patent systems may therefore be reliant on empirical and economic analyses which fall outside the purview of philosophy.

1.1 Introduction to patents

The following are real examples of patented inventions:

a) "Synthetic Biology Vectors"

The invention provides compositions, methods and kits for generating synthetic genetic circuits in biological systems.

Inventors: Woolf et al

b) "Vegetable and fruit nutrients-enriched rice"

Separately prepared fruit and vegetable juices are used to cook rice without additional water, so that the rice grains absorb and adsorb the nutrients.

Inventor: Tse Wen Chang

c) "Anti-AIDS drug"

An agent which comprises, as the active ingredients, one or more components selected from the group consisting of [Melastoma, ... stevia].

Inventor: Michio Tani

d) "Apple tree named Silken"

⁸ See Rai (1999)

A new and distinct variety of apple tree, originating from a controlled cross of 'Honeygold' and 'Sunrise'.

Inventor: W. David Lane

Assignee: Okanagan Plant Improvement Co. Ltd.

As well as showing the broad range of things that can be patented, these examples illustrate how patents can restrict access to the fruits of research, and potentially conflict with the Mertonian norms. A) is a patent on compositions, methods and kits for the emerging field of synthetic biology, which attempts to engineer biological systems from scratch – in this case, to make the biological equivalents of electrical components. The development of this new science will be strongly determined by the existence of these patents, because researchers working in this area cannot use these compositions, methods or kits to practice their science without the owner's permission. In contrast (and perhaps in opposition) to this approach, some researchers in this area have not pursued patent protection. In a move consistent with Merton's 'communism', MIT's research into synthetic biology has been made freely available to all (Arkin 2008). As well as affecting research, these examples also illustrate how patents affect access to inventions that could be directly important to wider society. B) and c) clearly both have the potential to alleviate health problems, by aiding nutrition and preventing disease. Finally, patents on plants such as d) place restrictions on what future plant breeders are allowed to do, which could affect research in plant sciences, as well as the agricultural industry, and the freedoms of farmers more generally. These examples illustrate some of the potentially negative effects of patents. MIT's decision illustrates that there is an alternative way of doing things. Good reasons in favour of patents rather than alternatives will therefore be needed to outweigh these potential negative effects.

The examples also show that the potential subject matter of patents is broad. The US patent system recognises three types of patent⁹. Utility patents are the most common, and cover “any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof”. Examples a)-c) above are utility patents, covering compositions of matter and methods. In addition there are design patents, which protect a particular ornamental design, and plant patents, which protect any new asexually reproduced plant (as in example d) above).

Patents should be distinguished from copyrights, which cover new expressive works such as literature, songs, or artworks, and last for anything up to 70 years after the author's death. I do not consider copyrights in what follows because the issues they raise may be different to patents. As copyrights cover creative works rather than inventions *per se*, they do not relate in the same way to the concerns raised above about access to the fruits of scientific research.

Upon creating a new invention, an inventor can apply to national patent offices (in multiple jurisdictions, if they can afford it) for protection. In the U.S., there are three main criteria for utility patents: novelty, usefulness, and non-obviousness. The novelty condition requires that the applicant is the first person to conceive and publicly disclose the invention. For example, had somebody already thought of using nutrient-rich vegetable juice to enrich rice, and publicly disclosed this idea, b) could not have been granted¹⁰. The usefulness condition requires that the invention serve some practical purpose, such as the detection of breast cancer, or enhancing the nutritional value of a meal. Finally, the invention must not be obvious to someone skilled in the relevant area of expertise. If the anti-AIDS drug were an obvious cure, which anyone knowledgeable about the disease and the properties of the ingredients might turn to, then it wouldn't have been eligible for patent protection.

⁹ In what follows I focus on the US system for simplicity.

¹⁰ On the other hand, if they had merely thought of the patented idea, but not disclosed it, this would not invalidate the patent – they would have to prove that they had also already disclosed the idea.

A further, more contentious criterion, embodied in legal doctrine, is that patents can only be granted over genuine inventions rather than mere 'discoveries'.¹¹ This distinction, which raises interesting metaphysical questions, has been the subject of much dispute. It has been proposed that discoveries are things which already exist in nature, whereas inventions would not exist were it not for their inventor's efforts. For instance, some claim that one shouldn't be able to patent the human genome, because this already exists in nature, but one should be allowed to patent, for instance, an invented method for isolating a gene.¹² The possibility of a precise characterisation of the distinction is not my direct concern here, suffice to say that it is widely held that however exactly they differ from inventions, discoveries are not patentable.¹³

Successful patent applicants get the legally enforceable right to exclude others from making, possessing, using, and selling copies of the invention for twenty years. This even includes the right to exclude someone from using their own version of the invention if they subsequently independently invent it themselves.¹⁴ For example, Okanagan Plant Improvement Co, the owners of the Silken apple tree patent, have the right to stop others from making, using or selling copies of the Silken tree. Anybody who crosses the Honeygold and Sunrise apple trees in such a way as to result in a Silken tree is infringing on Okanagan's patent. This is so even if they own their own Honeygold and Sunrise trees, and even if they are unaware of the prior existence of the patented Silken tree.

1.2 Intellectual goods and the type / token distinction

In this subsection I identify some important differences between intellectual and non-intellectual goods. These differences are the source of some of the asymmetries in the justifications of intellectual and non-intellectual property encountered in sections 3 and 4.

Paradigmatic examples of property include land, houses, and clothes. Intellectual property, on the other hand, covers ideas such as designs, techniques, or methods. For example, b) relates to an intangible idea; a general technique for creating a nutritious meal, rather than a particular instance of the use of that technique. A) relates not to concrete particular instances of biological matter, but rather to the idea of combining biological matter in a certain way. One might therefore think that the tangible / intangible distinction is what makes intellectual goods different from other kinds of goods. But whilst the intangibility of intellectual goods may make them metaphysically interesting, it is not what makes them problematic in the arguments I will explore in the following sections. Whilst it is true that all intellectual goods are intangible, there are also some goods, such as shares, which are intangible but not considered intellectual property. Ownership of a share is an example of a property right in an intangible, but non-intellectual good. As such, it cannot simply be the intangibility of intellectual property that makes it different from all other types of property.

Instead, what makes intellectual property different is that it always relates to *types*, while non-intellectual property, whether in physical goods (such as land and houses) or intangible goods (such

¹¹ See Foster and Shook (1989), and *Diamond v. Chakrabarty*, 447 US 303 (1980), which granted a patent over a life-form on the grounds that it was the result of human ingenuity rather than a mere discovery.

¹² See Resnik (2002)

¹³ However, I return to this issue in 35 below.

¹⁴ This is one way in which patents differ from copyrights, where there is no rule against independent creation.

However, such independent creation of copyrightable works is highly unlikely if not impossible, as is illustrated by Borges (1962) in which a fictional character attempts to write *Don Quixote* from scratch, word-for-word, without having read the original text.

as shares), always relates to *tokens*.¹⁵ ¹⁶ The object owned by Okanagan is the type 'Silken' tree.¹⁷ If they sell me a particular Silken tree, I only own a token. Even if I buy every single Silken tree, I only own tokens of the type, not the type itself. Okanagan still have the right to exclude myself and others from making, using, selling or distributing new copies of the type Silken tree. Intellectual property is different to both token property and shares, in that it covers types rather than tokens. For this reason, I shall introduce the term *token property* to denote any property which is not intellectual property.

An important difference between type goods and token goods is that the former tend to be what economists call *non-rival* while the latter tend to be *rival*.¹⁸ A rival good cannot be used by one without diminishing the ability of another to use it. My consumption of some rice and vegetables prevents you from consuming the same rice and vegetables. My use of an idea, a design or technique, on the other hand, does not diminish your ability to use that same idea (so long as in implementing the idea I do not use up the only resources available to implement that idea). Such intellectual goods are 'non-rival'. For example, my use of the technique described in the second example above, using my vegetables to cook nutrient-enriched rice, in no way limits your ability to do the same with your vegetables and rice.

This difference is not absolute, however. Some non-intellectual goods are non-rival. Traditional public goods, such as clean air, are non-rival, but they are certainly not intellectual goods.¹⁹ However, most goods that are traditionally the objects of property rights, such as land, houses and clothes, are rival. Similar qualifications apply to intellectual goods, which are rival in certain ways. We might call them non-rival in consumption; your ability to consume an intellectual good is not affected by my consuming the same intellectual good.²⁰ However, your ability to use the good in other ways may be affected by my use of it. Your ability to profit from the rice nutrient enrichment technique by using it to create a dish to sell to me, is affected by whether or not I already use the technique myself. More generally, the ability to profit from an intellectual good is compromised if others are able to consume it for free. However, with these qualifications in mind, two generalisations can be made. Intellectual goods tend to be non-rival, at least in consumption. In contrast, the kind of non-intellectual goods that are typically the objects of property rights – houses, land, vegetables – are rival.

This distinction and its consequences will turn out to be important in sections 3 and 4. The fact that intellectual goods are types and not tokens is a key difference between them which means that while the desert-based justifications of property rights discussed in section 3 may succeed in the case of non-intellectual goods, they do succeed in the case of intellectual goods. Similarly, the fact that intellectual goods are non-rival in consumption forms the basis of the entitlement-based defence of patents which will be discussed and contested in section 4.

15 I follow Wilson (2009) in using the type-token distinction to distinguish intellectual from non-intellectual property.

16 The only apparent counter-example I can think of is that of the Queen of England's ownership of swans. She owns all and any swans which reside in the United Kingdom. She does not have a patent on swans, but she does seem to have the same kind of right over tokens of the type 'swan' that Okanagan has over tokens of the type 'Silken tree'. In this case it may make sense to think of the Queen's right as a special kind of intellectual property right similar to a patent right.

17 One might characterise this relation not as ownership of the type, but rather as a right over any new tokens of that type. I assume that nothing I argue for here turns on exactly how this relation is characterised.

18 See, for instance, Varian (1990) entries on *Rivalry* and *Public Goods*.

19 Although see Stiglitz (1999) for an argument for conceiving of knowledge as a global public good

20 However, even this is false for certain intellectual goods. For instance, stock market tips are rival in consumption; your ability to use them to stay ahead of the market is diminished by other people using them in the same way.

2. Justification

I turn now to the main concern of this dissertation; to what extent is the patent system justified? First, I'll clarify the terms in which a justification of the patent system would have to be made. Given that patents are a state-enforced monopoly, any argument for them necessarily involves making a political claim about what the state ought to do. Some arguments begin in political terms. For instance, the state has a duty to do whatever promotes national happiness; because they stimulate innovation and this makes people happy, the state ought to grant patents. Other arguments (including those discussed in sections 3 and 4 below) start by making moral claims. For instance, they may argue that inventors have certain rights over their inventions. This would then ground the political claim that the state ought to grant patent protection in order to uphold those rights. Either way, the conclusion must be framed in political terms.

It is not my concern here to defend an alternative to the patent system, but rather to assess a particular line of justification for it. But it will nevertheless be helpful to frame the justificatory question by presenting what the alternatives might be. One alternative is simply to withdraw patent protections, without replacing them with any new sources or forms of funding, incentives or rewards for invention. Under such a system, everyone would be legally free to use whatever ideas they could access. Inventors would reap whatever profits they could. The ability to protect the disclosure of one's idea, put it into practice better than others, and to be a first mover, would each be of greater importance. However, the supply of good ideas may be diminished as compared to a patent system.²¹ Alternatively, other forms of funding or reward could be put in place of patents. State support for intellectual labour, such as funding research at universities, could be expanded to make up for the lack of private funding. Prizes or rewards could be sponsored by the state, the private sector, or charitable donations. As an example of this, inspired by Pogge (2002), U.S. Senator Bernie Sanders (I-VT) has recently proposed the use of prizes to reward medical research and development, and elimination of all drug monopolies.²² These would be alternative ways to incentivise or reward innovation that would not involve patents. It is worth noting that these alternatives to the patent system – government salaries, prizes and rewards – would not involve radical experiments. They are each already in place to varying degrees, and would only need expanding to make up for any shortfall in innovation from the removal of patents.

2.1 Consequentialist Justifications

Justifications of patents can be broadly categorised into two kinds; what I will call 'consequentialist' and 'deontological'. The consequentialist approach claims that patent protection is the best way to achieve some desirable outcome. A popular defence takes the maximisation of innovation as the relevant end. This version is assumed in the economic literature and reflected in the wording of United States law on intellectual property:

"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."²³

The classic argument asks us to imagine a situation in which someone has a good idea which gives them some competitive advantage in a marketplace. Revealing the idea to others means losing that advantage. In order to encourage the inventor to disclose his secret so others can benefit, the state

21 Although the empirical evidence for this assumption is not conclusive; see Moore (1998)

22 S.1137 - *Medical Innovation Prize Fund Act (2011)*

23 Article I, section 8, clause 8 of the United States Constitution

grants him a monopoly on the use of the idea. That way, the inventor gains a profit from licensing his invention, others benefit from using the idea (for a price), and everyone is better off than they would be had the invention been kept secret. As well as encouraging disclosure, such a mechanism also provides incentives and support for research of new ideas by enabling inventors to recoup their costs and gain a profit.

This is the most common version of the consequentialist argument, made in economic terms. Of course, most people don't think innovation itself is worth maximising, but rather that innovation promotes some other goal which is worth pursuing, such as utility or social welfare. I here intend the term consequentialist to cover a broad range of arguments, namely, any view which takes a 'forward-looking' approach, justifying patents as the best means to a valuable end. For example, a view according to which patents are justified because they lead to a flourishing society (Fisher 2001) would count as consequentialist.

2.2. *Deontological Justifications*

In contrast, there is what I will call the 'deontological' approach. Rather than framing a justification of patents in terms of what would be the best way to achieve some valuable end for society, this approach focuses on individual owners of intellectual property. According to this view, inventors have certain morally important interests which ought to be respected, and patents are the best way to serve those interests. For instance, it may be claimed that we all have certain natural rights (moral rights which are independent of legal rights) including the right to own the products we create with our bodies and minds. Or that by exerting mental or physical labour, we thereby come to *deserve* the fruits of that labour. In order to protect the natural rights of labourers, or to give them what they deserve, the state must grant patent rights. This approach can be contrasted with the consequentialist approach in that it is non-instrumental – it doesn't justify patent ownership as a means to some valuable social end, but rather as an end in itself.

As I have already hinted at in mentioning both the concept of rights and of desert, a further distinction within the deontological approach can be made. There are two possible kinds of deontological arguments for patents, although they are frequently conflated. On the one hand, one could appeal primarily to claims of desert. According to this line of thinking, patents are the deserved reward for intellectual labour; call this the *desert* account. Just as some people think that those who work harder deserve more pay, the desert account holds that patents are the deserved reward for invention. On the other hand, one could appeal to claims of natural rights. Patents are what inventors are entitled to as an extension of their natural rights; call this the *entitlement* account. On this account, in the same way that I am entitled to keep the vegetables I grow, I am also entitled to own the ideas that I conceive.

One reason that these distinct kinds of deontological argument have often been run together is because many defenders of intellectual property rights have turned to the work of John Locke.²⁴ They have taken Locke (1689)'s famous account of the legitimacy of property rights in token property as a starting point for a defence of intellectual property rights. But Locke appeals to a range of different values and considerations and is actually to some extent ambiguous between desert-based and entitlement-based justifications of property rights. This ambiguity has often carried over into the work of neo-Lockean defenders of intellectual property rights. They claim on the one hand that patents are entitlements which derive from natural rights; but they also appeal to the claim that intellectual labour deserves reward, and that patents are an appropriate reward. As we

²⁴ See, for instance Moore [(1998),(2004)]; Spinello (2003); Himma (2008); Palmer (2005).

shall see later, this is problematic not just because the Desert account and the Entitlement account are distinct, but also because they may be to some extent inconsistent.

As mentioned earlier, the purpose of arguing against the deontological approach (in both its desert and entitlement-based forms) is not simply to demonstrate the flaws in one line of justification for the patent system. I intentionally leave open the possibility of a consequentialist justification. Remember that the consequentialist rationale behind the patent system is not necessarily in conflict with the Mertonian ideal mentioned in Section 1. In which case, by showing that deontological concerns do not mandate patents, I will also be showing that there is no genuine conflict between the morally important interests of inventors, and the interests of wider society.

3. Desert

In this section I develop and assess 'desert-for-labour' justifications of the patent system. Drawing from literature in political philosophy on desert, I outline how the basic desert claim alluded to above could be elaborated. I then argue that on any plausible interpretation of the desert-for labour claim, patents allow owners to reap profits that exceed the reward they actually deserve. This is due to the fact that the marginal cost of selling an additional license to an invention is always zero, which breaks any proportionality relation between labour and reward (which is theoretically present in the sale of physical but not intellectual goods). I then argue that the patent system necessarily precludes the rewarding of many deserving labourers.

3.1 *Developing the desert-for-labour claim*

Before discussing the case for desert-based justifications of the patent system, I must elaborate on what such a justification would involve. As mentioned above, considerations of desert are sometimes appealed to or alluded to in modern Lockean defences of intellectual property. Several authors refer to claims of desert, arguing that intellectual property rights are the deserved reward for intellectual labour. For example, Moore (2003):

"Sometimes individuals who voluntarily do or fail to do certain things *deserve* some outcome or other. Thus, students may deserve high honour grades and criminals may deserve punishment... These claims and obligations are generated by what individuals do or fail to do... if desert can properly attach to labour or creation, then claims may be generated in these cases as well."(p121)

A similar appeal to the desert claim is made by Spinello (2003):

"We argue for a secure regime of protection based on the Lockean vision that property rights are *justly deserved as a reward for labour that creates value*" (p1, emphasis mine)

While the 'desert-for-labour' claim is rarely elaborated upon, the basic idea is simple. Generally, claims of desert are grounded in certain features of individuals, such as things that have happened to them or acts they have performed. These are the 'bases' of desert (Feinberg 1970). According to desert-for-labour arguments, labour is one such base for desert. When we labour, we generate *prima facie* moral claims to certain rewards. A desert-based defence of intellectual property, then, will claim that labourers who produce ideas deserve reward, and that property rights in their ideas are the appropriate reward for that labour. For instance, the fact that Tse Wen Chang (the inventor of example b)) spent his time and effort thinking about and experimenting with rice and vegetable juice, eventually hitting upon the idea of boiling the one with the other, constitutes a basis for

desert. This desert basis generates a moral claim to a certain reward, namely, a patent over the invention.

Strangely, while this appeal to desert appears to be a crucial step in their arguments, these writers rarely elaborate upon it. Instead, they go on to focus on Locke's theory of the conditions of just appropriation of goods, and arguing that intellectual property can meet these conditions. This application of Locke is an interesting line of argument and will be dealt with in the next section. However, it is not relevant to present purposes. What is relevant and what they fail to elaborate on and defend is the claim that patent rights constitute a deserved reward for intellectual labour. Perhaps this is because the desert-for-labour claim is not intended as a substantive premise of the argument. These writers may believe that Locke's conditions, if met, are sufficient to establish the legitimacy of intellectual property. Whether or not inventors also in some important sense deserve to own their inventions may not be seen as an important issue.

However, the appeal to desert does seem to be playing a role in the arguments quoted above, even though it is not elaborated on. If it is *not* intended to play an important role, then its inclusion is at best misleading, and at worst, adds spurious weight to the overall argument. I do not attempt to decide between interpretations here. Rather, I will assume for the sake of argument that an appeal to substantive desert is being made, and assess the potential for arguments which make such appeals. Even if none of the writers identified above actually intends to mount a desert-based justification, it nevertheless appears to be a natural and promising strategy to take, consistent with desert-based justification of profits more generally, which can be found elsewhere in political philosophy on desert.²⁵ Appeals to desert-for-labour arguments in the context of intellectual property have not yet been connected to this literature. This is surprising, given the volume of literature on the topic. It is also unfortunate, because it makes such appeals harder to assess, due to the fact that several important features of the claim of desert are left ambiguous. In what follows I will connect these two areas. I grant for the sake of argument that intellectual labour could generate desert claims, but deny that these claims are best met by granting patents. I first lay out some of the ways the desert claim could be interpreted, drawing from the literature. I then argue that on any plausible interpretation, patents are not the appropriate reward for intellectual labour. Other systems of reward would work better at meeting the demands of the desert claims.

First, however, I should note that no one could plausibly argue that the current patent system perfectly allocates rewards to all those who deserve them, in exact proportion to degrees of desert. For one thing the current system takes a one-size-fits-all approach with its 20 years protection period. If the level of reward deserved for an invention is based on the amount of labour involved, then clearly different lengths of patent protection would be necessary to reflect this. Despite this, it might be argued that the current system is the best reflection of desert that is practically possible. To attempt to calculate exactly the correct amount of reward deserved and adjust the length of protection accordingly would be impossible, so an arbitrary period of 20 years for all may be a reasonable compromise. While it does not deliver rewards entirely accurately according to desert, it may be claimed, the patent system nevertheless leads to a distribution of rewards which approximates what inventors deserve to the most practical degree possible. In what follows I argue against this claim; alternative systems would more closely approximate what inventors deserve.

Before continuing with my main objections to this claim, I should first note an important distinction between two kinds of desert. Olsaretti (2004) distinguishes between institutional and pre-institutional desert. Desert is an institutional principle if its demands are wholly reducible to or determined by the rules and purposes of institutions within which desert claims arise. By contrast,

²⁵ See for instance Feinburg (1970), Miller (1976) and Sher (1987)

desert is a pre-institutional (or natural) notion if its demands are not so determined or reducible. An example of an institutional desert claim is that 'the runner who comes first deserves the prize'. An example of a pre-institutional desert claim is that 'someone who has had a particularly hard life deserves some respite in their old age'. If the demands that the desert-claim generates are determined by the rules and purposes of the patent system, then the desert argument has no independent force. So if the institution of patents is to be justified by appeal to desert, this desert must be pre-institutional or else based on other, justified institutions. For example, return to b), the vegetable nutrient-enriched rice invention. The claim that Chang deserves reward for his labour must be interpreted as a case of pre-institutional rather than institutional desert. That is, it cannot simply be that Chang deserves the patent because the purpose of the patent system is to reward inventors with patents. Rather, it must be that Chang deserves the patent independently of the patent institution, and the patent institution is justified because it responds to these pre-institutional claims. Interestingly, one of Moore's paradigm examples of desert in the quote above, that high-achieving students deserve high grades, appears to refer to institutional rather than pre-institutional desert. However, it's clear that if desert-claims are to ground a substantive argument for the patent system, they must be pre-institutional.

As I interpret them here, and as is standard in the literature, claims of desert involve a three-place relation between a deserving subject, a deserved object, and a basis for the desert. For example, take the claim that I deserve to be paid five pounds because I mowed your lawn. This claim involves a deserving subject (me), a deserved object (five pounds), and a desert basis (mowing your lawn). In the case of the desert-for-labour argument for patents then, we must identify the relevant subject, object and basis for desert. The obvious candidates would be as follows; the relevant subject is the inventor, the relevant object is patent protection over the invention, and the relevant desert base is labour.

There are different ways to elaborate on the claim that labour is the base for desert. Exactly which aspect of labour is generating claims of desert here? Lamont and Favor (2008) survey contemporary proposals and identify three possibilities.

1. *Compensation*: People should be rewarded according to the costs they incur in their work activity. (Dick 1975, Lamont 1997)
2. *Effort*: People should be rewarded according to the effort they expend in their work activity. (Sadurski 1985a,b, Milne 1986)
3. *Contribution*: People should be rewarded for their work activity according to the value of their contribution to the social product. (Miller 1976, Miller 1989, Riley 1989)

Note that as well as being the basis for desert, these various features are also taken to determine the level of reward that is due. For instance, according to 1), the fact that I have incurred costs in my work means that I deserve a reward; i.e. cost is a base for desert. But exactly how much cost I incurred also determines exactly how much of a reward I deserve; i.e. cost determines the level of reward. So (1-3) are not just bases for desert, but also determinants of deserved reward.

In what follows I do not aim to decide between these desert bases. My strategy is instead to argue that on any of these interpretations, or any mixture thereof, patents are a poor method of distributing deserved rewards to inventors. The arguments that follow are not intended to be arguments against desert-based justifications of the way the market allocates profits to labourers (for such arguments see Olsaretti [2004]). Indeed, I'm willing to concede for the sake of argument that the market distributes rewards roughly according to desert. For instance, I am willing to grant that the profits a farmer gains from selling fruit are a decent approximation of level of reward she deserves for her

labour (whether measured in terms of cost, effort or contribution). My criticisms are specific to the way that the patent system rewards inventors. My first argument is based on the fact that unlike selling token physical goods, the marginal cost of selling another license to a patented invention type is zero. My second argument is based on the fact that unlike the creation of physical goods, invention is always cumulative and borrows from the ideas of the past. Each argument will take into account the three different possible bases for desert. When it comes to the profits that inventors gain from selling licenses to their patents on the free market, there are special reasons why these are unlikely to reflect deserved rewards. Alternative systems would better reflect deserved rewards.

3.2 Profits from patents are not proportional to deserved reward.

As explained in section 2, patents cover types rather than tokens. If I own a patent on an anti-AIDS drug, I do not just own particular token doses of the drug. Instead, I have the right to exclude others from making, using, selling and distributing any new tokens of the drug. Of course, most patent owners exercise this right not by actually completely excluding others, but rather by selling them a license to make, use, sell and/or distribute tokens of the invention. Rather than produce the drug themselves, the owner of an anti-AIDS drug will usually simply gain royalties from tokens of the drug type.

Note that because patents cover types, the cost of selling another license to your patent is zero.²⁶ Of course, the development and testing of a new invention typically does involve costs. But once the invention exists, it costs nothing to license it (save the administrative fees). The owner of the anti-AIDS drug may have spent a significant amount on the development and testing of the drug.²⁷ The cost of selling a license for the production of the first dose of the drug will equal the entire production cost. But once the first license has been sold, the cost of selling subsequent licenses for the production of the second and third doses will be nothing. In economist's terms, the 'marginal cost' of a license is zero. This is not the case when it comes to the profits that can be derived from selling token property or other kinds of labour. The marginal cost of selling token property is never zero (even if the marginal cost often declines somewhat due to economies of scale). If a farmer sells apples, she will always need to plant, pick and package each apple she sells. The marginal cost of selling another hour of one's labour is never zero. If a teacher is to get rewarded for her intellectual labour, she must continue to put in the hours at school to obtain her monthly wage.

This fact has important implications for desert-for-labour justifications of patents. The desert-based justification for token property works because there is a link between the degree to which the relevant desert basis is present and the level of reward received. In order to gain a profit from the sale of a token good, one must exert some effort, incur some cost, and/or make some contribution to the social product. Not so for intellectual goods. The fact that the marginal cost of selling a license is zero breaks the link between the reward received and the reward deserved.

This is most clearly the case for cost-based desert claims. The marginal cost of selling a license to a token is always going to be zero, while the marginal cost of creating another token will be more than zero. There will always be costs involved in producing another token pill, but the owner of a patent on that pill incurs virtually no cost in collecting her royalty on that pill. Similar remarks apply to selling one's intellectual labour. Every month a teacher must spend her weekdays in the classroom to earn her wage. But a teacher who owns a patent on a teaching method can collect

²⁶ Or, at least, near enough zero. There may be some small transaction costs involved in the collection of royalties

²⁷ DiMasi et al (2003) estimate that new drugs cost on average \$800 million to bring to market, while critic Angell (2004) puts the figure at just \$100m.

royalties without lifting a finger.²⁸ This dynamic also applies if we take effort as the basis for desert claims. Unlike in the case of the sale of regular property or labour, the sale of a license to a token of an invention involves next to no effort. While the farmer toils to sell another apple, the owners of the Silken apple tree patent can sit back and collect royalties from the licensing of their invention. In the case of token property, there is a certain amount of effort behind every sale. In the case of intellectual property, there is none or next to none.

I must here make an important qualification. Of course, I am not claiming that the *development* of new ideas costs nothing, or that it takes no effort. Of course, all good ideas initially take effort and money to produce. And indeed, proponents of patents, for instance in the pharmaceutical industry, note that the profits they gain from patents allow them to recoup this cost and effort.²⁹ I do not dispute this. My claim is instead that the correlation between the level of reward gained from patents and the level of reward that is actually deserved will be weak. In the sale of token property, such as apples, or in wage-labour, such as apple-picking or teaching, the revenue from the sale of the good or the labour will always bear some correlation to the amount of cost or effort involved (even if market forces do not ensure perfect proportionality in this regard). But in the case of patents, this correlation is absent.

Because a patent owner can always sell another license for the use of her invention, without having to exert further effort or incur further costs, they have the potential to gain more than their level of deserved reward. Note also that patents have the potential to give their owners *less* than their deserved reward.³⁰ Just because an inventor has put in lots of effort and incurred high costs, there is no guarantee that anyone will buy enough tokens of her invention for her to recoup that cost via licensing. In such cases inventors can get much less than they deserve. This danger is typically less prevalent in the sale of token goods, where the initial outlay is typically smaller and supply can be more easily calibrated to meet demand. Similarly, because wage-labourers get paid for the days they work, no more and no less, they are typically rewarded according to some fixed function of their labour. So in the case of token rather than type goods, there is less of a danger of labourers not getting their deserved return for efforts or costs incurred.

Having outlined the marginal cost problem for effort and cost-based desert claims, I now turn to contribution-based desert claims. They claim the level of reward deserved depends on the degree to which the labour is a valuable contribution to the social product. It is not so clear here that there will be a poor correlation between deserved rewards and actual rewards derived from patents. This is because, one might think, there is a correlation between how socially valuable an invention is, and the profits gained from licensing it. In other words, if the royalties from the anti-AIDS drug patent are higher than those from the Silken apple tree patent, this may be an indication that the former is more socially valuable than the latter. The total number of token anti-AIDS drug sold over the lifetime of the patent is a reflection of the social value of the invention; the profit derived from royalties on these tokens is therefore approximately equivalent to deserved reward.

My objection to this line of argument is that the patent system actually punishes rather than rewards optimal social contribution. To see why, note that there is a difference between the actual and potential social value of an invention. The *potential* social value of, say, an invented anti-AIDS drug is the value of all the lives it *could* save. The *actual* social value of the drug is the value of all the lives it actually does save. Because patent owners rely on charging for access to their inventions in

28 Such patents do exist; see Greenbowe et al (1998) Patent # 5813865 "Methods and apparatus for teaching science and engineering"

29 See 26 [^]ibid

30 And as we shall see in 3.4, the patent system also leaves some deserving labours with no reward at all.

order to obtain their rewards, they must exclude some people who would benefit but cannot or will not pay.³¹ This means that when inventions are patented they realise less than their potential social value. If, on the other hand, it is not patented but freely distributed, it can realise its full potential value. For example, if an anti-AIDS drug is patented, those who need it but cannot afford it will not get it. But if it is freely distributed, everyone who needs it can have it; the potential social value can be realised.

My objection, then, is as follows. Inventors should be rewarded, rather than punished, for securing the full potential social value of their invention. The patent system *punishes* those who allow the social value of their invention to be fully realised, because by allowing free use of their idea inventors prevent themselves from getting a reward from royalties. The patent system *perversely rewards* inventors who limit the social value of their invention by excluding those who cannot or will not pay. This seems in direct contradiction with the spirit of the contribution-based conception of desert. If labourers should be rewarded according to their contribution to the social product, then surely those who ensure that their goods contribute more to the social product ought to be rewarded *more*, not less. Alternative systems in which inventors would be rewarded according their contribution to the social product would be better. Unlike the patent system, such alternatives would reward inventors for fully realising the potential social value of their invention, not punish them.

3.3 Unrewarded labour.

The last section explored the ways in which patents can over or under-reward inventors. This section expands on the latter case, arguing that a great number of deserving labourers go unrewarded under a patent system.

According to any of the three plausible grounds for desert, the current patent system fails to reward the majority of intellectual labour. This is because most intellectual labour does not result in intellectual goods which pass the conditions of patentability. A great number of people engage in some kind of intellectual labour which involves effort, cost, and / or contributes in some way to social product. But the vast majority of this work clearly does not get rewarded with intellectual property rights in the ideas generated therein. The existence of stringent criteria for patentability prevents this. Most ideas, even if they involve effort, cost, and / or contribution to the social product, would not be granted with patent rights because they do not meet the all of the conditions (non-obvious, useful, novel, etc.). Even if an idea is obvious, it may also be highly valuable to the social product; for instance, the idea of cutting down on our carbon emissions to reduce global warming. Discoveries about laws of nature are not patentable, because they are not genuine inventions; but they clearly require a lot of effort. An idea might not be novel, but that doesn't mean it doesn't cost anything to produce. In each case, the relevant desert base is present, but patents cannot be granted.

From the perspective of the desert-for-labour argument, this appears to be an injustice. If patents are the appropriate reward for intellectual labour, then all labourers who possess the relevant desert basis should be given exclusive rights over their ideas, whether or not they meet the conditions on patentability. A defender of the desert account might here argue that the conditions on patentability roughly map on to the relevant desert base, such that labourers generally deserve a reward only when they create something patentable. In other words, perhaps the conditions on patentability (non-obviousness, novelty, usefulness, invention rather than discovery) are features of all and only inventions for which inventors deserve reward. Even if such a conception of desert can be

³¹ This is because patent owners face differential pricing problems. For instance, if a pharmaceutical company licenses a patented drug to one party at \$1, it is difficult to license it to another at \$2. See Damstedt (2003).

formulated, the examples given above indicate how implausible it would be. Because whichever one of the plausible desert bases we take - effort, cost, or contribution – they each appear capable of grounding desert claims in cases where the relevant invention would not meet the conditions on patentability. In such cases, the patent system fails to reward deserving labourers.

In order to reward these deserving labourers, defenders of the desert account might propose neglecting the conditions on patentability. But these conditions are in place for good practical reasons. Granting patent rights over the fruits of all intellectual labour, regardless of whether it meets the conditions, would be impractical if not impossible. We would end up in a situation where the use of any given item of practical knowledge would be subject to the permission of its owner. For instance, if we relaxed the obviousness condition, obvious solutions to practical problems could become patented. Relaxing the novelty condition would mean that multiple independent inventors would also have to be granted patent rights over the same invention. If we both independently come up with a new method for sorting fruit-flies, we would both have to be granted patent rights over this invention. This would increase the number of people whose permission a user would need to seek before making use of the owned invention, exacerbating the problem. Patents would also then no longer be exclusive, making them meaningless, and a rather poor form of reward. For example, if I own exclusive patent rights over a method for sorting fruit-flies, I can gain royalties from those who use the method. But if anyone who thinks of this method is also granted patent rights over it, this threatens my ability to get my reward.

So defenders of the Desert account must concede that any practical version of the patent system must necessarily prevent many inventors from getting what they deserve. This is not a knock-down objection however. It might be claimed that despite failing to reward some intellectual labour, the patent system, or something like it, is nevertheless the best compromise. It affords the highest possible number of deserving labourers with the reward they deserve. It might also be claimed that the patentability conditions are in place to help ensure that this optimal compromise is secured. To see why even this response fails to justify the patent system, we must consider how alternative systems can lead to a better distribution of rewards according to desert.

As mentioned above, existing alternative systems such as rewards, prizes, and / or government support of research, could be extended as an alternative way to reward intellectual labour. This could be done according to whatever metric is favoured as a desert basis (i.e. effort, cost, or contribution). If we take *costs incurred* as the basis for desert, then a reward system based on an inventor's estimated costs could be put in place. For example, the inventors of the anti-AIDS drug could be compensated according to the research and development costs. *Effort* is difficult to precisely measure, but the amount of time spent inventing may be a reasonable indicator of the effort an inventor expends. As such, a wage paid for time spent inventing may be an appropriate reward for effort. For example, MIT's synthetic biology researchers get paid a yearly wage, and this may be in rough proportion to the amount of effort they put in. Finally, consider *contribution to social product* as a desert basis. This may be the hardest to measure, partly because it is so hard to define. However, a variety of metrics already exist which could be used to measure contribution to the social product. Governments and third sector organisations use such metrics on a daily basis to measure the impact of different programmes and inform their decisions. 'Social Impact Assessments' (SIA's) are used to inform public policy decisions and international development projects.³² Even if they are imperfect, they presumably do bear some correlation to the actual value they attempt to measure. They could be used to measure the contribution of an individual's labour to the social product, and used as a basis for the distribution of rewards to inventors.³³

32 See Barrow (2000).

33 See for instance Pogge (2002)'s idea for a "Health Impact Fund".

I do not claim that in each of these cases, alternative systems would distribute rewards exactly in proportion to desert. However, I do argue that alternative systems would be more effective than the patent system in this regard. Under an alternative system, where the reward for intellectual labour is a prize rather than a right to exclude others from the fruits of one's labour, there would be no reason why rewards could not be granted to deserving labourers whose intellectual goods do not meet the conditions of patentability. As well as rewarding those inventors who would otherwise go unrewarded under a patent system, these alternative systems would not over or under-reward inventors in the way that the patent system does (as explained in 3.3 above).

In this section, I have argued against a desert-based justification of the patent system. Drawing from literature in political philosophy on desert, I have outlined how the basic desert claim alluded to in the arguments of Moore and others could be elaborated (3.1). I then argued that on any plausible interpretation of the desert-for labour claim, patents allow owners to reap profits that exceed the reward they actually deserve (3.2). This is due to the fact that the marginal cost of selling a license to an invention is always zero. This breaks the proportionality between labour and reward (which is generally present in the sale of token goods). I then argued that the patent system necessarily precludes the rewarding of many deserving labourers, while alternative systems do not (3.3). In conclusion, on any plausible account of desert, appeals to desert do not support the patent system. Alternative systems would be better at distributing rewards to inventors on a desert-for-labour basis.

4. Entitlement

In this section I argue against an Entitlement-based justification of the patent system. According to this approach, patents are grounded in certain natural rights that people have. I first introduce the basic idea, outlining Locke's 'provisos' – conditions under which it is legitimate to claim ownership rights over a good. I then reproduce a popular argument according to which the claiming of property rights in intellectual goods, unlike for token goods, always trivially satisfies the provisos. After a discussion of the metaphysics of invention, and of the nature of the commons, I will argue that Locke's conditions are not trivially satisfied in the case of patents. I then argue that they are also problematic because they fail to take into account pre-existing property rights. Entitlement-based arguments infer that because new inventions are unowned, claiming property rights in them involves only the same moral considerations that would apply in the state of nature. But, I argue, because we are not in the state of nature, we must also consider pre-existing property rights, which conflict with patents. This ultimately undermines an entitlement-based justification of patents. Combined with the arguments of the last section, this will show that the only tenable approach to defending the patent system is a consequentialist one.

4.1. Introducing the Entitlement account and its application to intellectual goods

As mentioned in the introduction, while neo-Lockean defenders of patents sometimes appear to be appealing to the kind of desert-for-labour argument discussed in section 3, they do not elaborate on such appeals. Rather, they turn to a certain strand of Locke's thinking. This approach is taken by Moore [(1998), (2003)] who states that his arguments are a development of Nozick (1976). Locke was concerned with the question of how property rights in token goods could be originally justified. If you legitimately own some property, then sell it to me, then under normal conditions I legitimately own that property. But how did anyone come to legitimately own property in the first place? To answer this question, Locke imagined a 'state of nature', a period prior to civilisation, in

which nobody owned anything other than their own bodies and minds. How, in such a situation, did anybody come to own anything? According to Locke, ownership of one's own body and mind extends to ownership of the products of one's body and mind. In this way, then, individuals in the state of nature can come to own the things they create.

But creating things with one's labour inevitably involves taking resources. I cannot build a shelter without claiming some land and cutting down a tree, nor make a meal without taking some berries or killing an animal. According to Locke, all of the unowned resources in the state of nature form part of a 'commons'. He proposed that the taking of resources from the commons is only legitimate if two provisos are met. One must a) leave 'enough and as good' for others, and b) not waste the property one appropriates. If these conditions are met, then one can claim property rights in what one creates with the resources of the commons. Of course, state of nature theorising about the conditions under which it is legitimate to appropriate unowned resources is not relevant to the majority of property claims today. Most valuable physical matter on earth is now owned, and if I want a house, or to eat a meal, I purchase them. I don't go looking for unowned land or hunting wildlife. Locke was concerned with how our system of property rights could ever have legitimately got started in the first place. The provisos are therefore less relevant to the question of how property can be legitimately acquired now. In most cases, property is now acquired through exchanging goods on a marketplace, rather than taking something unowned from the commons.

Except, perhaps, in the case of intellectual property, whose defenders have frequently turned to Locke. The question seems to be the same as that which Locke grappled with in imagining the state of nature. How could it be that inventors come to legitimately have property rights over inventions that they previously did not own? It is as if we are permanently in state of nature when it comes to new ideas. This is the reason that entitlement-based defenders of intellectual property resurrect the Lockean provisos.³⁴ If they can show that Locke's conditions of just appropriation can be met in the case of intellectual property, then patents may be justified in just the same way that token property is justified. They argue that intellectual property not only *can* meet the provisos, but that there are good reasons to think that it always *does* meet them. For this reason, intellectual property is on especially strong justificatory grounds. In what follows I outline these arguments, taking each proviso in turn.

Take the 'enough and as good' proviso. In the case of token property, one can fail to satisfy this condition by taking so much from the commons that other people will not have enough. But in the case of intellectual property, can one ever fail to satisfy this condition? One reason we might think one cannot is that in inventing a new idea, one does not need to appropriate anything from the unowned commons. This is unlike the creation of a new physical good, which would require taking physical materials from the commons. So because the creation of intellectual goods does not require taking anything from the commons, there can be no equivalent problem. Two important clarifications of this point are worth bearing in mind.

First, it is true that to come up with a new idea one inevitably must draw on already known ideas and use them as inspiration. We can conceptualise the domain of already known (and unpatented) ideas as a kind of 'information commons' (Himma 2007). But ideas, unlike the physical goods of the commons, are non-rival in consumption. The information commons can be drawn from without depriving anyone else of the ability to use the ideas contained within it to come up with their own inventions. When Tse Wen Chang invented his method for enriching rice with fruit and vegetable nutrients, he did not need to appropriate the idea of boiling rice, or of juicing vegetables. He freely used these ideas, but without taking them from the intellectual commons of which they are part. The

34 See 26 [^]ibid

'ingredients' that must be appropriated to produce physical goods tend to be rival, but the equivalent ingredients of new ideas are not rival, and hence no problem of appropriation exists.

Second, this point does not imply that invention involves no physical materials. The resources used to create intellectual property are not solely intellectual. When Tse Wen Chang invented the method for enriching rice with fruit and vegetable nutrients, he did not only draw on ideas such as boiling rice and juicing vegetables. He also used up tangible physical resources – experimenting with actual rice and vegetables, water, cooking equipment. Just as with the creation of physical goods, the creation of intellectual goods also requires physical resources. But this does not affect the argument if we assume that these physical resources used were legitimately owned by the inventor. If Chang had taken the physical resources (rice, cooking equipment) from the commons, without leaving enough for others, then there would be a problem.

The conclusion drawn is that in inventing intellectual goods, one need not claim the exclusive use of any resources from the commons. One can use physical resources (which one already owns), and ideas from the intellectual commons (which one does not need to appropriate in order to use), in order to come up with a new invention. In which case, the first proviso will be trivially fulfilled; nothing will have been taken from the commons. The question of leaving enough and as good is therefore irrelevant.

Locke's second proviso, according to which property rights are only legitimate if the owner does not let the good go to waste, also seems to be trivially fulfilled in the case of intellectual property. With token property like land, it's clear that it will go to waste - become dry, or overrun with weeds, or unproductive due to overuse - unless I maintain it carefully. But ideas cannot get overused in the way that farmland can. They do not require maintaining. The wheel is as good an idea now as it ever was, and nobody had to maintain it or limit its use for the idea to remain useful. So, a defender of patents might argue, it looks like the non-waste proviso is also trivially fulfilled in the case of intellectual property.

4.2 'Enough and as good'; two models of invention

However, I think the basic intuitions behind both the provisos actually do apply to the claiming of patent rights, in a somewhat modified form. In this section I deal with the first proviso which stipulates that 'enough and as good' of the resources used must be left for others. This proviso is a recognition that everybody has an equal right to a share of an unowned resource. It prohibits the taking of unowned goods where this would deprive others of their share of such goods. This is what makes it relevant to intellectual property. To explain this further, I must first make a distinction between two ways to conceive of the metaphysics of invention, and some practical realities about the use of new ideas.

There are, I believe, two different possible models of the metaphysics of invention. They are not distinguished in the literature, but they have implications for the validity of the arguments put forward. They are:

Genesis:

There are old ideas, which are held in common. Intellectual labour involves using these old ideas as intellectual resources (in addition to physical resources) to come up with entirely new ideas. For example, Chang used the idea of juicing vegetables, and the idea of boiling rice, etc, as intellectual resources (in addition to some physical resources, such as actual rice,

vegetables, and cooking equipment) to come up with an entirely new idea for a method to enrich rice with vegetable nutrients.

Platonic Discovery:

There are ideas, some of which are known, the rest of which are (as yet) unknown. Intellectual labour involves using the known ideas as intellectual resources (in addition to physical resources) to arrive at previously unknown ideas. For example, before Chang came along, the idea of boiling rice with vegetable juice to increase its nutritional value was an unknown idea. But when Chang used certain intellectual resources (the idea of juicing vegetables; the idea of boiling rice; etc.), as well as some physical resources, he arrived at the previously unknown idea.

According to the Genesis model, Locke's first proviso seems irrelevant to the appropriation of intellectual property. It is trivially met in every case because no resources from the commons are used up in the process of invention. The resources used are non-rival; their use does not involve a loss to the commons. The question of whether intellectual labourers are taking more than their fair share is irrelevant; they are not really 'taking' anything, because everything they used is still available for everyone else to use. What they do is create an entirely new intellectual good. Their appropriation of this good is not akin to taking something from the commons because the new invention was never part of the commons to begin with. So the first proviso is trivially fulfilled because no appropriation from the commons has taken place.

According to the Platonic Discovery model, it is not so obvious whether the first Lockean proviso will always be trivially met. Unowned ideas belong to no one, and thus are part of the commons, in the same way that unowned land is part of the commons. Because all unknown ideas are unowned, they are part of the commons. In which case, if an inventor appropriates a previously unknown idea that she has arrived at through intellectual labour, she is taking something away from the commons.

In which case, we must check that the first Lockean proviso is met. If the inventor appropriates the idea, will there be enough and as good *other* ideas left for everyone else to appropriate? Possibly not. Thus the argument made by Himma above may not work if we are assuming a Platonic Discovery rather than Genesis model of invention. However, Rosenberg (2004) presents a different argument to the effect that appropriation of intellectual goods trivially fulfils the first Lockean proviso, and his argument explicitly appeals to a platonic discovery model of invention. Rosenberg claims that unlike the earth's scarce physical resources, there are countless unknown ideas out there waiting to be found. If I discover and appropriate one of them, there are still enough others out there for everyone else to discover and appropriate. Thus the Lockean proviso will always be unproblematically fulfilled for intellectual property. Even if appropriation of new ideas does deplete the commons, the commons of ideas is so large that no matter how much one person appropriates, there will always be enough and as good for everyone else.³⁵

So the claim that intellectual property rights automatically meet the Lockean provisos will need to be defended in different ways depending on which model of invention is assumed. Rather than attempt to decide between these two models, I shall argue that on either model the relevant argument is not sound. Consider first the argument which assumes the Genesis model. According to this argument, because claiming property rights in a new idea does not deplete the commons, such

35 Interestingly, note that this model collapses the invention / discovery distinction, just as Plato's account of knowledge collapses the learning / remembering distinction (*Meno*, 86b). On this model, all so-called invention of new ideas is actually discovery of previously unknown ones. This would make the invention / discovery distinction upheld in patent law appear unprincipled, and might therefore ground a rejection of that principle. I leave this issue to one side for now.

claims always trivially meet the proviso.

It is in one sense true that the appropriation of a new idea does not deplete the commons, because the idea appropriated was never itself part of the commons. And it is also true that even if old ideas from the commons were drawn upon in coming up with the new idea, these old ideas are strictly speaking still part of the commons. But there is a sense in which the commons has been depleted. Prior to the appropriation, individuals other than the actual inventor were free to use the old ideas to come up with the new idea, i.e. to invent it themselves. For example, prior to Juizup Corporation's appropriation of the nutrient-enriched-rice process, individuals were free to draw on the ideas of boiling rice and juicing vegetables, and to combine these ideas to create nutrient-enriched rice. After the patent is granted, individuals lose the opportunity to do this freely; they now must attempt to negotiate with the patent owner. The opportunity to use certain ideas from the commons in certain ways has been lost.

When a patent is granted on an invention which draws from the commons, the value of the commons is diminished. Even if the number of ideas in the commons remains the same, the value of the commons with respect to non-owners decreases. Non-owners are no longer able to freely use them in the ways they were before. Even if I was not ever actually going to combine the ideas of juicing vegetables and boiling rice, the patenting of Chang's invention still reduces the value of those ideas for me, because I am no longer free to use them in that way. In which case, the first Lockean proviso is not always trivially fulfilled. We must ask, in each case of appropriation, whether there is still enough and as good left in the commons for others. And if the opportunities to use ideas from the commons in certain ways are reduced, this may constitute a failure to leave enough and as good for others.

Next, consider Rosenberg's argument which assumes the Platonic Discovery model of invention. To see what is wrong with this argument, note that the proviso does not merely state that one must leave *enough* but also *as good*. If I appropriate more than my share of the land, I could not justify this on the grounds that there are plenty of other resources for you to appropriate under the earth's surface, or on the moon. And not all land is equally fertile. The portion of the commons which I must leave for others must be of some practical use to them. It must be 'as good' as that which I have taken.

It may be true that there is a near-unlimited supply of ideas out there waiting to be discovered. But the number of ideas that can be put to good use at any given time is constrained by several factors. There are only so many human wants and needs, so that demand for new ideas is limited. There are only so many people with so much time and money to spend on new inventions. Only so many ideas are relevant and useful at a particular time and at a particular stage of scientific and technological progress. Technologies are usually only valuable for a short period of time. Particular industries have standard techniques, parts, and ways of doing things, and functionally equivalent alternatives are just not as valuable once an industry standard is in place. The idea of an electron microscope may be highly useful at one stage of scientific progress, but less so later. Because of these constraints, only so many ideas are actually valuable at a given time. Even if there is a near limitless stock of ideas to be discovered, there will always be a limit to the number of those new ideas which are actually useful and valuable at the time.

Locke's paradigm case of appropriation of the commons was the vast and (in Locke's eyes) 'unowned' commons of America. There is no modern equivalent in land; almost everywhere is now owned by someone. But one might say that the domain of as yet unknown or un-invented ideas is like Locke's America. One might even draw a parallel between the appropriation of ideas and the

enclosure of common land (Boyle 2004). Given this, the appropriation of ideas, like the appropriation of land, is actually problematic and subject to the first proviso. Those who appropriate good, useful and timely new ideas may in fact deprive others of their share of such ideas. As well as offending the Mertonian ideal of universal access to the fruits of science, patents may also fail to meet Locke's first proviso on legitimate appropriation.

4.3 Waste

As for the second proviso - one must not waste what one appropriates - a version of it may also apply in the case of ideas. Of course, ideas cannot rot or wither due to over-use. So there is no problem of literal spoilage. But the basic rationale behind the second proviso does apply to ideas. The idea is that one can only take something from the commons if one puts it to good use. When one has taken some resource from the commons (thus depriving others of it), one is under a duty to use the resource. Failure to do so constitutes waste.

It is not only physical resources that can be wasted in this way. Imagine a scientist who discovers a cure for cancer, obtains a patent, and then refuses to sell the cure. This is the equivalent scenario to a case where I appropriate some land and let it go dry or get overrun with weeds. The resource appropriated from the commons has been wasted; it would have been better in the hands of someone else who would have put it to some use.

Many less extreme cases of wastage of an appropriated idea can be found. Large players in an industry will file for patents that they never intend to use. This is so that they can prevent others from entering the market. Cases of so-called 'patent trolls' also abound. Patent trolls file patents not in order to manufacture inventions, or sell the patents to manufacturers, but for the explicit purpose of extracting damages from those who unwittingly infringe on the patent. Both of these cases involve appropriating an idea and excluding everyone from its use; a clear example of wastage.

Even if it seems clear that in these cases patent owners are guilty of wastage, it is unclear exactly how we should assess whether some appropriated idea has been wasted. Waste cannot simply be sub-optimal use of the idea. This would be too demanding, as any situation in which less than the total number of people who want to use the idea get to use it, would count as waste. This would effectively prevent the inventor from making any profit as she would have to license it to anyone who had the slightest desire for it, even if they did not want to pay. On the other hand, as the examples above show, patent holders would intuitively be wasting their idea if they simply excluded everyone. Perhaps the definition of waste is set by reference to the minimum use that any decent person would make of their property. An exact characterisation of the boundary between waste and merely sub-optimal use would require more sustained analysis than I can attempt here.³⁶ In any case, there is no good reason why the waste proviso should not apply to the appropriation of physical and intellectual goods alike. Thus, patents do not trivially satisfy the waste proviso.

4.4. State of nature, and the violation of pre-existing rights.

I have argued against the popular claim that the Lockean provisos are always trivially met in the case of intellectual property. However, it would still be possible for a defender of the Entitlement account to claim that in the vast majority of cases, the provisos are substantively met. In which case, while on less strong ground than they initially appeared, patents would still be justified in most

³⁶ For discussion of the waste proviso in relation to intellectual property, see Hull (2009)

cases on entitlement-based grounds. In this section I want to show why even this claim is problematic. The problem comes from the fact that these writers mistakenly apply state-of-nature theorising to a civilised context. They assume that because new inventions are unowned, claiming property rights in them involves only the same moral considerations that would apply in the state of nature. But, I argue, because we are not in the state of nature, we must also consider pre-existing property rights, which conflict with patents. This ultimately undermines an entitlement-based justification of patents.

Recall that Locke's purpose is to show how, in the state of nature, unowned resources can become legitimately owned. Because they deal with the just appropriation of unowned resources, and new ideas are unowned, it is understandable that neo-Lockeans turn to the provisos when attempting to justify patents. But the state of nature is clearly very different to a state of civilisation. Even if the Lockean provisos constitute a correct account of the legitimate appropriation of unowned goods in the state of nature, they might not be a correct account of the appropriation of unowned goods in a modern context. In the state of nature, most physical stuff is not owned, as nobody has many property rights. But in the real world, almost all physical stuff is owned by someone. There are many pre-existing property rights. The appropriation of an idea will have different consequences depending on whether it is appropriated in the state of nature, or in a civilised context.

Imagine a savage in the state of nature who, unlike his peers, boils rice and juices vegetables. One day he invents a method for cooking a nutritious meal, by boiling rice in vegetable juice. A particularly advanced savage, he decides that he will claim this method as his property, such that others must ask his permission if they want to use this method. In a state of nature, the appropriation of a method for cooking a nutritious meal would not conflict with anybody's pre-existing property rights, because (we can assume) nobody owns any rice, vegetables or relevant cooking equipment. If the provisos are also met (i.e. claiming property rights in this method leaves enough and as good, and does not get wasted), then according to the entitlement account, claiming the method as his property would be legitimate.³⁷ This is not the case in the modern day. When Juizup gained ownership over the method of boiling rice with vegetable juice, many people around the world lost one of their freedoms. Prior to the granting of the patent, anybody who owned rice, vegetables and relevant cooking equipment were free to combine them to make vegetable-nutrient enriched rice for personal or commercial use; afterwards, this was not the case.

The same applies for other examples. Before the Silken apple tree patent was granted, anybody who owned a Honeygold and a Sunrise tree was free to cross those trees in such a way as to create a hybrid Silken tree. Prior to the patent on the synthetic biology vectors, researchers were free to combine cells into the compositions covered by the patent. Until the anti-AIDS drug was patented, developers were free to select the combination of ingredients mentioned in the patent and create a drug out of them.

Neo-Lockean defenders of patents have been misled by the fact that new ideas are unowned into thinking that the Lockean provisos exhaust the conditions under which property rights in unowned objects can be legitimately claimed. But given that we are not in the state of nature, we should not focus solely on the provisos. We must also consider pre-existing property rights. Even if the provisos can be substantively met in the case of intellectual property, there is a further problem with the granting of patents; they take no account of pre-existing property rights. Property rights in ideas inevitably violate these pre-existing rights in the ways outlined in the examples above. Lockean 'state-of-nature' style theorising blinds defenders of the entitlement account to the existence of this rights violation.

³⁷ Of course, with no state-enforced patent system, this right may not be respected; but it would still be legitimate.

How should this be resolved? Entitlement-based defenders of patents might claim that even if patents create conflicts with pre-existing rights over token property, it's not clear why the patent owner should always lose out. Shouldn't we first weigh up the interests of both the patent owner and the owners of the token property affected by the patent, and decide on that basis which should prevail? Making such comparisons already gives up too much to the patent owner. In cases where two existing rights conflict, it may be appropriate to consider which rights-holder's interests have greater moral weight than the other. But we are not here considering a case of two conflicting rights. Rather, we are considering a conflict between the pre-existing property rights of one party (the token property owners), and the interests of the would-be patent owner. In such cases, according to the entitlement account, it is pre-existing rights which must prevail. For imagine a similar case in which I come across your land, mistakenly believing that it is unowned. I begin to farm it, and claim that I am thereby entitled to property rights in the land. According to the Lockean account, I am mistaken; I cannot claim property rights in the land because that would violate your pre-existing property rights. In the same way, claiming property rights in ideas would violate the pre-existing rights of the owners of token property. It is these pre-existing property rights which should prevail against any interests an inventor may have in claiming property rights in her idea.

5. Conclusion

To summarise the arguments so far: Patents restrict access to the fruits of scientific and technological progress. They therefore appear to conflict with the laudable Mertonian ideal of universal access to these fruits, and stand in need of justification (section 1). A number of philosophers have responded to this challenge, proposing both *consequentialist* and *deontological* justifications (2); this dissertation has focused on the latter. I distinguished between *desert* and *entitlement* based deontological arguments, which are often conflated.³⁸

I argued that even if we grant the premises of desert-based arguments, they still do not give us reason to choose the patent system over alternative systems (3). Because patents cover tokens and not types, the profits one can gain from licensing them do not correlate to the level of reward actually 'deserved', and they actually punish rather than reward maximal contribution to the social product (3.2). They also fail to reward many 'deserving' labourers (3.3). Alternative systems would be better at distributing the deserved level of reward to a greater number of deserving labourers.

In (4) I considered entitlement-based accounts, which appeal to Locke's theory of the just acquisition of goods in the state of nature (4.1). I argued that this move is problematic. Locke's provisos are not always satisfied in the case of intellectual property, as Rosenberg and others claim. Claiming property rights in ideas potentially does involve a loss to the commons, whether we conceive of the metaphysics of invention in terms of *Genesis* or *Platonic Discovery*, and as such, the 'enough and as good' proviso does apply (4.2). When ideas are owned, they can be wasted (4.3), thus invoking the wastage proviso. Furthermore, exclusively appealing to the provisos is problematic. While they may be appropriate for state-of-nature theorising, we are not in the state of nature. New inventions are born into a world where the physical goods they relate to are already owned. As such, they will inevitably conflict with pre-existing property rights (4.4).

Sections 3 and 4 together show that there are significant problems for the deontological approach in

³⁸ We can now note that they are not only distinct accounts, but may also not be mutually supportive; one might be *entitled* to patent rights without *deserving* them, and vice-versa. See Feinberg (1970, p86), for the conflict between desert and entitlement.

both its guises. As previously mentioned, this conclusion leaves open the possibility of a consequentialist justification of the patent system, that is, by reference to the system's overall effect on innovation, social benefit or some other plausible end. This would require strong empirical evidence, which philosophical analysis alone cannot provide.

But note that even if such a consequentialist argument were successful, it would not necessarily present the same kind of rights-based conflict with the Mertonian ideal of sharing the fruits of scientific labour. Empirical research might reveal that the implementation of a patent system is the most efficient way to maximise and fairly distribute these fruits. Either way, the arguments presented here against the deontological approach allow us to reach an important conclusion. Debates about intellectual property rights frequently imply that the rights of creators are always necessarily pitted against the interests of wider society. But if there are no sound deontological arguments for patents, then there is no fundamental, rights-based conflict between the interests of inventors and the realisation of the Mertonian ideal. The justification of the patent system rests instead on advancing a plausible analysis of its likely consequences – the burden of proof for which rests with the system's proponents.

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References:

- Angell, M., (2004) *The Truth About the Drug Companies* (New York: Random House).
- Arkin, A. (2008) "Setting the standard in synthetic biology", *Nature Biotechnology*, Vol. 26 #7 2008
- Barber, B.,(1953) *Science and the Social Order* (London, Allen & Unwin)
- Barrow, C. J. 2000. *Social Impact Assessment: an Introduction*. (London: Arnold.)
- Borges, L. B., (1962) "Pierre Menard, Author of the Quixote" in *Labyrinths: Selected Stories & Other Writings*. New York: New Directions 36-44.
- Boyle, J. (2008), *The Public Domain: Enclosing the Commons of the Mind*, Yale University Press
- Damstedt, B. G. (2003) "Limiting Locke: A Natural Law Justification for the Fair Use Doctrine," *Yale Law Journal* 112, 1179-1221
- Dick, J., 1975, "How to Justify a Distribution of Earnings", *Philosophy and Public Affairs*, 4: 248-72.
- DiMasi, J., Hansen, R., Grabowski, H., (2003). "The price of innovation: new estimates of drug development costs". *J Health Econ* 22 (2): 151–85
- Feinberg, Joel, 1970, "Justice and Personal Desert", *Doing and Deserving* (Princeton, NJ, Princeton University Press), 55-94
- Fisher, W. (2001), "Theories of Intellectual Property", in S.R. Munzer (ed.), *New Essays in the Legal and Political Theory of Property*, Cambridge: Cambridge University Press
- Franklin, B, (1793), *The Autobiography of Benjamin Franklin*, Frank Woodworth Pine, ed. (Garden City, N.Y.: Garden City Publishing Co., 1916 ed.; originally published 1793), 215–16.
- Hagstrom, W. (1965), *The Scientific Community*. New York: Basic Books.
- Himma (2007), 'The Legitimacy of Protecting Intellectual Property Rights: The Irrelevance of Two Conceptions of an Information Commons'. *Proceedings of the 2007 International Conference of Computer Ethics – Philosophical Enquiry (CEPE 2007)*
- (2008), "The Justification of Intellectual Property Rights: Contemporary Philosophical Disputes" (Perspectives on Global Information Ethics), *Journal of the American Society for Information Science and Technology*, 59: 2–30.
- Hull (2009), "Clearing the Rubbish: Locke, the Waste Proviso, and the Moral Justification of Intellectual Property", *Public Affairs Quarterly* Vol. 23, No. 1, pp. 67-93, January 2009

- Kaiwen, H. (2005) "On the Model of Open Access Movement of the Online Information Resource" *Journal of Academic Libraries*, 2005
- Krikorian, G., and Kapczynski, A., (eds.) (2010) *Access to Knowledge in the Age of Intellectual Property*. Zone Books
- Lamont, Julian, (1997), "Incentive Income, Deserved Income, and Economic Rents", *Journal of Political Philosophy*, 5: 26-46
- Lamont, Julian and Favor, Christi, (2008) "Distributive Justice", in Edward N. Zalta (ed.) *The Stanford Encyclopedia of Philosophy* (Fall 2008 Edition)
- Lessig, L., (2004), *Free Culture* New York: The Penguin Press.
- Locke, J., (1689), *Two Treatises of Government*, P. Laslett (ed.), Cambridge: Cambridge University Press, 1988
- Merton, Robert K. ([1942] 1973). "Science and Technology in a Democratic Order", *Journal of Legal and Political Sociology*, 1: 115–126, 1942. Reprinted as "The Normative Structure of Science", pp. 267–278 in Robert K Merton, *The Sociology of Science. Theoretical and Empirical Investigations*, Chicago: University of Chicago Press.
- Mercurio, B. C., (2004) "Trips, Patents, and Access to Life-Saving Drugs in the Developing World". *Marquette Intellectual Property Law Review*, 2004
- Milne, H., (1986), "Desert, effort and equality", *Journal of Applied Philosophy*, 3: 235-243.
- Miller, David, (1989) *Market, State, and Community* (Oxford: Clarendon Press)
- (1976) *Social Justice* (Oxford: Clarendon Press)
- Moore, A.D, (1998) "A Lockean Theory of Intellectual Property." *The Hamline Law Review* 21 (January, 1998): 65-108.
- (2008) "Personality-based, Rule-Utilitarian, and Lockean Justifications of Intellectual Property" in H. Tavani and K. Himma (eds.), *Information and Computer Ethics*, Hoboken, N.J.: John Wiley & Sons, 105–130.
- Nozick, Robert, (1974) *Anarchy, State, and Utopia*, New York: Basic Books
- Olsaretti, Serena, (2003) "Introduction: Debating Desert and Justice" in *Desert and Justice*, Oxford: Oxford University Press.
- (2004) *Liberty, Desert, and the Market*, Cambridge, UK: Cambridge University Press
- Palmer, Tom G., (2005), "Are Patents and Copyrights Morally Justified? The Philosophy of Property Rights and Ideal Objects," *Harvard Journal of Law and Public Policy* 13 (1990): 817–866.
- Pogge, Thomas. (2002), *World Poverty and Human Rights*. Cambridge: Blackwell

- Proudhon, P.J., (1840), *What is Property? An Inquiry into the Principles of Right and of Government*, D. Kelly and B. Smith (trans). New York: Cambridge University Press, 1994.
- Rai, A. K., (1999) “Regulating Scientific Research: Intellectual Property Rights and the Norms of Science,” *Northwestern University Law Review* 94 (1999): 77, 89–90.
- Resnik, D. (2002) “Discoveries, inventions, and gene patents” in Magnus, David, and Caplan Arthur McGee Glenn L., (eds) *Who owns life?* Amherst, N.Y., p.291
- Riley, Jonathan, (1989) “Justice Under Capitalism”, *Markets and Justice*, ed. John W. Chapman (New York: New York University Press), 122-162
- Rosenberg, A. (2004), “On the Priority of Intellectual Property Rights, Especially In Biotechnology”, *Politics, Philosophy, and Economics* 3: 77–95
- Sadurski, W., (1985), *Giving desert its due : Social Justice and Legal Theory*. Dordrecht: D. Reidel Publishing Co.
- Shapiro, Ian, (1991), “Resources, Capacities, and Ownership: The Workmanship Ideal and Distributive Justice,” *Political Theory*, 19: 47–72.
- Simmons, A. John, (1992), *The Lockean Theory of Rights*, Princeton: Princeton University Press.
- Stallman, R.M. (2011) "Did You Say "Intellectual Property"? It's a Seductive Mirage". From Free Software Foundation, Inc. Retrieved June 1st 2011 from www.gnu.org/philosophy/not-ipr.html
- Spinello, R.A. (2003) “The future of intellectual property” *Ethics and Information Technology* 5: 1–16, 2003. Kluwer Academic Publishers.
- Stiglitz, J.E. (1999) “Knowledge as a Global Public Good” in Kaul, Grunberg and Stern (eds.) *Global Public Goods*, Oxford University Press, Inc.
- Sher, George, (1987), *Desert*, Princeton, NJ: Princeton University Press
- United Nations (2011). *Universal declaration of human rights*. Retrieved June 1st 2011 from <http://www.un.org/en/documents/udhr/index.shtml>
- Varian, H.R., (1990) *Microeconomic Analysis* WW Norton (New York)
- Wilson, J. (2009) Could there be a right to own intellectual property? *Law and Philosophy* (2009) 28:393–427
- Williams, H.L, (2010) “Intellectual Property Rights and Innovation: Evidence from the Human Genome” *NBER Working Paper No. 16213*