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Atoms want to be free too!
Expanding the critique of intellectual property

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Abstract: *"Atoms are the new bits" according to the Californian trade press. What do we get when this dictum is sampled with the old rallying cry: "Information wants to be free"? We suggest that this new imaginary upsets the predominant, bounded critique of intellectual property as it has been formulated by hackers and law scholars. Constitutive of that critique was the exceptionality attributed to information goods (bits) vis-a-vis tangible goods (atoms). It was thus intellectual property could be presented as something altogether different from private property. This way of framing the issue has had many tactical advantages. Still, we contend that it has stood in the way of a fuller understanding of what intellectual property is. When the critique of proprietary software is extended to include closed hardware, the boundary between intellectual property and traditional property ownership is destabilised. This enables us to renew our critique of the political economy of information. Such a revision is particularly timely since we are now witnessing a convergence between intellectual property and private property into something we elect to call "augmented property".*

Keywords: new media studies, science and technology studies, economic sociology, information, property, hackers, open hardware, hacking

1. Introduction

In the science fiction story *Printcrime* from 2006, Cory Doctorow canvased a future society where the development of 3D printers has made it possible to copy physical goods in much the same way as digital information can be copied today. Abiding to the tradition of the cyberpunk genre, Doctorow depicted a dystopia where an oppressive state working for a handful of global conglomerates had outlawed the practice of copying physical goods. Subsequently, the protagonist of the story has been found guilty of committing this crime. The story ends when he is released from the prison after having served a ten years sentence. He recognises his folly of having wasted time with printing electronic gadgets and pharmaceuticals. This time, he declares: "I'm going to print more printers. Lots more printers. One for everyone. That's worth going to jail for."

The idea behind the Printcrime story resonates with the ambitions of a group of university researchers and hobbyists who, since 2004, are working on an open source 3D printer. The name of the project, Rep-rap, is an abbreviation of 'self-replicating rapid prototyper'. Their goal is to design the 3D printer in such a way that it can print most of its own parts. In addition to copying itself, such a machine would be able to produce a range of useful and trivial goods. Many of the hobbyists ex-

pect that the emergence of small-scale home manufacturing, where cheap and user-friendly 3D-printers play a key part, will disrupt established patterns of mass-production, mass-consumption and global distribution networks. The ideas of Cory Doctorow are echoed in the discussion forum of the Rep-rap project. One can find many speculations about what kind of legal repercussions this technology will provoke. Partly responding to these concerns, one study has compared existing intellectual property rights in the UK, chiefly patents, copyright, trademarks and bans on passing-off, and concluded that none of these are likely to interfere with home 3D printing. (Bradshaw, Bowyer & Haufe, 2010). However, given the speed by which new intellectual property rights are being introduced today, this conclusion might not be much of reassurance. And at least some of the advocates of the Rep-rap project are eager to bring on an expanded conflict over intellectual property. A small token hereof was the launch in 2010 of ″The Product Bay″ by one of the founders of the (in)famous filesharing service ″the Pirate Bay″. Likewise, the development of the Rep-rap machine and its axillary projects are to some extent dictated by the same combative spirit among the hobbyists. A case in point is the efforts channelled into designing user-friendly 3D scanners. With a 3D scanner, new design files can be generated (scanned) from existing physical objects. It will increase the capacity of the Rep-rap machine to rip, mix and burn physical objects.

In this article, we will leave aside the question how the hobbyists' claims about what the Rep-rap machine will do in the future diverges from what it actually does. Certainly, the gap is considerable. Instead, we propose to take this example as a point of departure for reflecting over the political economy of information. Up until now, the case against intellectual property has largely built on the experiences of free software advocates and artists working with creative commons licenses. The political/tactical considerations of the activists have influenced the way intellectual property is conceived and criticised. For instance, intellectual property tends to be framed as something radically different from private property. This separation builds upon a more fundamental, not to say ontological, assertion about the otherness of the virtual realm. Its corollary is the exceptionality attributed to informational resources vis-à-vis physical goods. Dan Schiller has named this idea the 'information exceptionalism' hyphothesis. The article sets out to question this hypothesis. We propose that hackers, geeks, self-acclaimed pirates, and quite a few legal scholars too, are engaged in 'boundary work'. In other words, they are setting up a boundary between information and physical goods in order to exclude private property and free markets from their critique of intellectual property. This is convenient when seeking to unite the many, warring fractions of hackers and activists behind a common critique against the intellectual property regime. It is in this sense we mean that tactical considerations have stood in the way of a deeper analysis of the intellectual property regime.

The article goes on to argue that this boundary work is now being destabilised due to the new narrative element introduced by, among others, the hobbyists in the Rep-rap community. They are articulating a future where free copying has been extended to the realm of physical goods. However, it is important that this future is not simply expressed on a discursive level. Through the expenditure of labour, the hobbyists are bringing their dream to fruition. The fact that they have a proof-of-concept is significant for the creation of the new imaginary. We propose that they are thus destabilising the boundary between informational resources and tangible goods. It is for this reason the the information exceptionalism hypothesis looks increasingly untenable. We welcome this development since it puts intellectual property on equal footing with private property. It invites us to do an analysis founded in political economy. It show that in both cases, the legal protections arise from the same need to safe-conduct commodity production/circulation. When hacker-hobbyists shift their attention from proprietary software to closed hardware, the industrial economy as a whole is implicated in their critique against the intellectual property regime. The flip-side of this development, however, is deeply troubling. The fact that the adversaries of intellectual property are moving "away-from-keyboard" might be indicative of where the intellectual property regime as such is heading. That is to say, some of the more controversial aspects of the current intellectual property regime, for instance, the use of digital rights management technology, might not be restrained to the realm of information goods for much longer. What the future has in store for us might be even more sinister than anything dreamt up by Cory Doctorow: a future of "augmented property".

2. The anomaly of free information

'Information wants to be free'. This rallying cry of hackers and filesharers was first uttered at a hacker conference in 1984. It was Stewart Brand, a prominent figure in the American counter-culture movement and a pioneer in the computer underground, who coined the phrase. Sceptics have often retorted that "'information does not want anything". The rebukal, however, has failed to temper the enthusiasm of the believers. To unearth the *naïvité* which Stewart Brand is accused of, one must first take full measure of the truth of which he spoke. The reasoning of Stewart Brand was more advanced than is given away by the catch phrase. The full quote reads:

> *Information wants to be free. Information also wants to be expensive. Information wants to be free because it has become so cheap to distribute, copy, and recombine—too cheap to meter. It wants to be expensive because it can be immeasurably valuable to the recipient.*

(Brand, 1987, p.202)

As is seen from the quote above, no intentionality is attributed to information. Neither can Brand's reasoning be straightforwardly dismissed as a case of technological determinism. Instead, Stewart Brand counter-posed two warring tendencies and situated them in the political economy of information. His proposition sounds plausible, even prophetic. Contrary to first appearance, however, the main thrust of the argument is not that there is a tension between free and expensive in the political economy of information. Rather, the bottom line of his talk was that this contradiction is unique to the political economy of information, as opposed to political economy in general. The starting point is the familiar one about the exceptionality of information. As a non-rivalous good, information is assumed to be radically different from tangible goods. Following Dan Shiller, we will call this idea the 'information exceptionalism' hypothesis. Schiller polemises against the exceptional qualities attributed to information (Shiller, 1997). Although we share much of his critique, we find it lacking in one respect. By denouncing the information exceptionalism hypothesis as simply a misconception, Shiller and likeminded critics fail to see how how productive this idea can be to its adherers.

In our attempt to wrestle with the latter question, we will imitate the flanking maneuver developed in constructivist science studies. This strategy is deployed by science studies scholars to avoid getting bogged down in debates about the reality of one or another scientific fact. The limelight is instead placed on how the appearance of matter-of-factness is produced by the practitioners. Although such a line of attack seems to be beside the point, this argument can arrive at the essential by relay. When successful, the constructivist detour helps to bring out nuances which would be lost in a reasoning which starts with a positive assertion about how the world is. We propose to apply the same strategy to the information exceptionalism hypothesis. For the time being, we will bracket the question if the hypothesis is correct or false. Towards the end of the article we will return to this question and try to give a satisfying answer. For the time being, we will concentrate on showing how the argument about the non-rivalrous nature of information came about and acquired its current, elevated standing in most critiques against intellectual property.

Our proposition is as follows: the information exceptionalism hypothesis builds on an anomaly in a specific, scientific paradigm. We use the term ″anomaly″ in the strict sense given to it by Thomas Kuhn. In his classic theory of science, to put it briefly, an anomaly is defined as something which gainsays the prevailing scientific wisdom of the day. It is hard even to catch sight of the inconsistency, and impossible to resolve it within the scientific worldview of the day. Hence, an anomaly

points beyond the established order, towards a new scientific paradigm which can make better sense of the observational data. However, since no way of conceptualising the world can give the ultimate and exhaustive explanation of reality, new anomalies are bound to crop up again.

The paradigm we have in mind is the economic science and its predominant traditions, large part of the classical and basically the entire neo-classical economic theory (Daoud 2011). A common denominator and key postulate of those two schools is the omnipresence of scarcity.# Because resources are limited in relation to unbounded human needs/fancies, humans act as economic, maximising agents. It is for this reason, or so the argument goes, that economic theory can make predictions about human behaviour. It is a worldview which must posit scarcity in order to see anything at all. To such a science, the existence of something non-rival becomes an anomaly. This phenomenon has been recognised by economists as the problem of "public goods", usually though to lead to market failures. The very act of defining public goods as a special problem does not resolve the anomaly, however, it only reaffirms the starting assumptions of the economic science. An example more closely related to the present argument is the talk about the rise of a so-called "attention economy" (Simon 1971). The abundance of information is said to have resulted in a new scarcity, i.e. the lack of attention among audiences. Hence, the market in information is superseded by a market in attention. Abundance is here defined as a scarcity of scarcity. Our point is not that non-rival, abundant goods exists in the world and the economic science is flawed to the extent it fails to acknowledge them. Rather, what is important is that the anomaly is itself a product of the economist's particular way of seeing the world.

Being a product of the economic science, it follows that the problem with non-rival goods arose at the same time as this science was invented. To the founding fathers, however, it was light rather than information which caught their puzzled attention. Henry Sidgwick observed that "[...] the benefits of a well-placed lighthouse must be largely enjoyed by ships on which no toll could be conveniently imposed." (Sidgwick, 1901, p.412). John Stuart Mill concurred that the service provided by lighthouses was best administrated collectively as a public good (Mill, 1965, p.968).# A hundred years later, Ronald Coase returned to the debate over lighthouses and affirmed that it still posed a challenge to economic theory (1974). The connection between light and ideas was made by Thomas Jefferson. He famously concluded that both must be freely shared. Inventions cannot, by their very nature, be subject to exclusive private ownership. All of those statements converge in the claim that the political economy of information abides to laws different from those found in the political economy in general. This assumption was more systematically explored by the economist Fritz Machlup. He underlined the unusual properties of information:

> *If a public or social good is defined as one that can be used by additional persons without causing any additional cost, then knowledge is such a good of the purest type.* (Machlup, 1984, p.159).

When Stewart Brand declared that information wants to be free, he jumped on an anomaly in the economic science. His intervention was timely, since this was the decade when copyright ownership was extended to include software in most Western countries. Grievances about intellectual property law could now be addressed by turning the economic science against itself. It laid the foundation for the present, dominant critique of intellectual property in its innumerable variations. Despite the many garden varieties, the argument pivots around the discrepancy between endless digital resources and limited tangible resources. The non-existent marginal cost of reproducing knowledge is said to be in conflict with its treatment as a scarce property. It is for this reason intellectual property law is found guilty of the cardinal sin in the economic sciences: sub-optimal efficiency. Hence, the same judgement is passed on it as would befall any other obsolete industry or sector: it must perish. This conclusion is underlined by connecting back from time to time to economic theory. In the case of Yochai Benkler, this connection is even written out in the title of his book: *The wealth of networks*. It is a beautiful rhetorical move. In a world where the economic science has shaped much official discourse and human self-understanding, a self-contradiction within the same worldview becomes a powerful leveller for delivering critique against *status quo*. With the same self-assurance as economists lay down the omnipresence of scarcity and the inescapable laws of the market, critics of intellectual property assert the non-rival nature of informational resources and its exception from those same laws.

The drawback with this critique of intellectual property is that it has taken over the limited horizon of the economic science. The anomaly of non-rival (informational) goods is always-already inscribed in the logic of omnipresent scarcity. Information goods is a one-of-its-kind in relation to how the outside world is supposed to work. The indebtedness to economic theory can also be seen in the way many critics conceptualise information. It tends to be spoken of as ready-made, predefined and unchangeable units of content. In much the same way as economists are reifying the labour process, information is understood as something which can be divorced from the flow of communication and the social entanglements in which it has been made. Critics abiding to this idea tend to direct their grievances against the imposition of intellectual property claims over the potentially unlimited circulation of information. What has been violated is the economic imperative of maximising

the output of (information) goods. With such an outlook, however, one will fail to understand that the problem with intellectual property starts much earlier. That is to say, it begins already with the conceptualisation of information as alienable units of content. Once information is conceived accordingly, the assignment of a content provider with intellectual property claims follows like a brief postscript. Hence, the rallying call ”information wants to be free” contains the seed of its own unfreedom: commodification.

Information exceptionalism as a boundary object

In what follows, we will recapitulate some of the critique against the notion of 'information' advanced in the social sciences. Thereby we do not mean to suggest that the Achilles heel of the intellectual property regime consists in an erroneous definition of information, to be corrected in thought and writing alone. Indeed, we cannot even say for certain that the adversaries of intellectual property would be better off with a more nuanced and sociologically informed concept of ‘information’. Some of the arguments below suggest the contrary. A limited, one-sided and mythical framing of 'information' is attractive partly because the activists need to win over a public opinion thralled to the same mythical worldview and self-understanding. Nevertheless, we are convinced that there are serious drawbacks with the information exceptionalism hypothesis, analytically if not politically. A closer examination of the idea of 'information' is called for.

As is well known, today's dominant conceptualisation of information owes much to Claude Shannon's article *A Mathematical Theory of Communication* from 1948. He sought to define information in terms of codification and transmission of messages. In other words, as signals indifferent to the meaning that they convey to the receiver. As Rafael Capurro has argued, this marked a watershed compared to how information had been understood in previous ages, going all the way back to the days of the Greeks and Romans. The concept of information used to have a broader meaning than ”sending messages”. It implied the act of giving form to something, such as knowledge or the human mind. This in turn implied a context dependent language and meaning creation (Capurro, 2009). It is no accident that context and meaning was taken out of the equation by Shannon. Cathrine Hayles has shown how his definition answered to the needs of an ascending techno-scientific industry. The industry wanted a definition that allowed reliable quantifications. Competing definitions was proposed at the time, according to which information and its content were treated as part of an inseparable whole. To assess 'information as meaning', however, would require some means of measuring what had changed in the head of the recipient. It was such practical consider-

ations which persuaded the scientific community to side with a narrow, mathematical, and de-contextualised definition of information (Hayles, 1999).

Information is thus set apart from the material substrate in which it is inevitably inscribed. Building on this cultural invention, notions about 'cyberspace' and 'virtual reality' flourished from the 1990s and onwards. The Internet was customarily depicted as a disembodied realm of information. The attractiveness of this idea can partly be explained by that it drew strength from an age-old dualism in philosophical thinking, sometimes spoken of as an opposition between form and matter, other times as mind and body, and so on (Hayles, 1994). In the new media studies literature, variations upon this dualism have been equally prolific. For instance, the same opposition has resurfaced when the ″virtual community″ was contrasted with real, geographically bounded communities (Proulx & Latzko-Toth, 2005). Among legal scholars, a parallel discussion has raged if there needs to be laws written specifically for virtual worlds (Lastowka & Hunter, 2004). The picture of cyberspace as a disembodied realm of information has come under sustained scholarly critique in the last decade. Indeed, in some literary studies departments, expelling dualism and/or transcendentialism has become the stock-in-trade of the academic′s job. If we hesitate to go down this road, it is because the history is full of examples of how the idea of a transcedential Beyond has served as a point from which the positivity of empirical existence could be attacked. Some examples from different ages include a kingdom of heaven, natural rights, or the declaration of independence of cyberspace. The now infamous declaration by Perry Barlow would have been pointless if he had thought that cyberspace was otherwordly in an absolute sense. While cyberspace allegedly was out of reach from the states of the industrial world, Barlow hoped that a wind of change would blow from this virtual Beyond and transform the old into something new and better. The lesson hereof is the following: The moment something (information, cyberspace, etc.) is posited as separate from its surroundings, it has already spilled over that boundary and begun to affect the 'outside'. Indeed, was is this over-spilling effect which Barlow longed for, and which are now sought by the adversaries of the current intellectual property regime.

The observation above can be further elaborated on by borrowing two terms from the science studies literature, boundary work and bounday objects. The first term was proposed by Thomas Gieryn. He used it to describe how science is separated from non-science by the efforts of scientists to uphold their professional status vis-à-vis amateur scientists and religious contenders. The lesson worth emphasising in the context of the present argument is that the boundary is not naturally given. It does not exist independently of the practitioners' whereabouts. On the contrary, the boundary has to be perpetually maintained, defended and re-negotiated (Gieryn, 1983). The sec-

ond term was introduced by Susan Leigh Star and James Griesemer. Their contribution consisted in treating the boundary not merely as a marker of difference but equally as an interface enabling communication across heterogeneous, scientific communities. The boundary object was plastic enough to adapt to local needs , while robust enough to maintain a common identity across different sites (Star & Griesemer, 1989; Lamont & Molnár, 2002). The original definition of boundary work does not match perfectly onto the information exceptionalism hypothesis outlined above, but it does a good enough job to bring home our most important point. The boundary between informational resources and physical goods is not a given. It must be upheld through continuous work. The exceptionalism of information and the separateness of the virtual realm constitute the boundary object of the campaigners for information commons. In line with Susan Leigh Star and James Griesemer's understanding of the term, the vagueness of the notion "information" is not a flaw but a strength. It is this imprecision which allows hackers and activists of varying persuasions to communicate and collaborate with each other. This is probably even more important to hackers than to the average science community, given the sharp ideological differences which are housed in the same subculture. This corresponds in a way with the observation about the "political agnosticism" of hackers outlined by Gabriella Coleman (Coleman, 2004) There is a less innocent side to this story. As Susan Leigh Star and Geoffrey Bowker clarified in a later work, the classifications laid down by a boundary object have biases which validify some points of view while rendering other positions invisible and/or unspeakable.

In order to see what has been rendered invisible in the boundary object that we call the information exceptionalism hypothesis, a quote by one of the chief architects behind the movement for creative commons licenses, Lawence Lessig, will be instructive. After having made a passionate case in favour of that information and culture should be distributed in a commons and free of charge, Lessig reassures his readers that markets and commons can coexist side-by-side. He underlines that not all resources can nor should be organized in a commons: "While some resources must be controlled, others can be provided much more freely. The difference is in the nature of the resource, and therefore in the nature of how the resource is supplied" (Lessig, 2001, p.94). It is in the nature of informational, non-rival resources to be organised in a commons. In the same vein, rival, tangible resources are thought of as suited for markets. It is the nature of the resource which determines if a product is rival or non-rival. Subsequently, the proportionality between the two categories, commons and markets, is assumed to be naturally given and constant over time. If policy makers were just better informed, or, perhaps, less corrupt, they would face a straightforward and technical task of choosing between commons and markets, depending on the nature of the re-

source in question. In conclusion, the information exceptionalism hypothesis sends a clear and strong signal to policy makers and the business community. It says: ″Our critique against the current intellectual property regime has nothing to do with a general critique of private property.″

Everyone who wants to play ball must subscribe to this bias of the boundary object, including those who belong to the ″leftist″ fringe. For instance, Richard Stallman, the founder of the Free Software Foundation, has been untiring in campaigning against the word ″intellectual property″. In his opinion, the word ″intellectual monopolies″ is more appropriate. Intellectual property is not a property right, the argument goes, but a state sanctioned monopoly. The underlying assumption is that private property exists independently of the state and its legal powers. While intellectual property is said to create artificial scarcity, traditional property is assumed to be grounded in objectively existing limitations in the real world. Ownership of tangible, rival goods is ″operational″, not to say ″optimal″. It is the same thought which underpins another parole of the Free Software Foundation, namely that free software is ″free as in free speech, not free as in free beer″. By framing the issue in this way, the case for information commons can be portrayed as a defence of civil liberties, rather than being seen as an attack on private property and thus a struggle for economic redistribution. No one can deny that this way of presenting the issue has advantages. Had the Free Software Foundation not adopted a pragmatic stance, they would have been marginalised and become yet another 'beautiful soul'. Indeed, it could even be argued that the case for information commons becomes all the more efficient in criticising private property and free markets by not giving itself away as such a critique. Suspicions of this kind have been voiced by conservative commentators in the US. It has sparked debates about ″commonism″ and Marxism/Lessigism, generating much heat and no clarifying light (for a summary, see Dan Hunter, 2004) Although we appreciate the pragmatic stance of the free software advocates, the question must nonetheless be raised: can the ills of the intellectual property regime be effectively combated from an intellectual position which stops itself from investigating the political economy of information? To the extent that one believes that praxis needs to be guided by theory, the answer is ″no″.

Political economy of information

This far into the argument, it is time to close the bracket in which we initially put the question, if the information exceptionalism hypothesis is a false proposition. Our tentative answer is that the exceptionalism attributed to information is not incorrect, as much as it is partial and one-sided in its portrayal of the world. It holds out the wrong end of the rope when starting an inquiry into intellectu-

al property and information commons. If this seems like a minor correction, hardly worth all the stir previously made in the article, then we contend that a slightly different research program can lead to an altogether different result, both analytically and politically. The crux is the notion of scarcity, the alpha and omega of the economic science which gives raise to its Other, inexhaustible abundance of informational resources.

An implicit assumption of the information exceptionalism hypothesis is a matter-of-factness assertion about the positive existence of scarcity in the physical world. This point of departure can be contrasted with a historically and sociologically informed approach, according to which scarcity (both of information and tangible goods) always is inscribed in prevailing social relations. It is the historical transformation of those social relations as a whole which must be put under scrutiny. This claim might come across as counter-intuitive. A non-believer will not be approachable to this kind of argument without first having suspended her sense-certainty in the prevalence of scarcity. This is much to ask for, since that certainty is grounded in everyday experiences of shortage and want. When she lift herself above this immediate experience, however, scarcity can be interpreted with new eyes, now looked at from the viewpoint of society as a whole. Such a horizon is offered in the anthropological approach of Marshall Sahlins. In his study of archaic societies, he made a lucid comment about the condition of life in modern society:

> *The market-industrial system institutes scarcity, in a manner completely unparalleled and to a degree nowhere else approximated. Where production and distribution are arranged through the behaviour of prices, and all livelihoods depend on getting and spending, insufficiency of material means becomes the explicit, calculable starting point of all economic activity. (Sahlins, 1972, p.4)*

A long row of historians have demonstrated how this state of affairs begun with the enclosure movement in fifteenth and sixteenth century England. Land that previously had been held in common was fenced in and assigned to individual rights holders. Crucially, with this historical perspective, the political economy of information is not treated as a one-odd-out. The current expansion of the intellectual property regime is, in James Boyle's memorable words, "a second enclosure movement" (Boyle, 2003). The stress is placed on historical continuity rather than discontinuity. Furthermore, the internal relation between private property and intellectual property is given due credit. Nothing said so far denies the common sense perception that there is a qualitative difference between information and tangible goods. Nor do we deny that it can be meaningful to reflect over this

difference. What is in question is how to best frame such an inquiry. The point was forcefully made by Dan Schiller in his critique of the information exceptionalism hypothesis:

> *As against the postindustrialists' assertion that the value of information derives from its inherent attributes as a resource, we counter that its value stems uniquely from its transformation into a commodity—a resource socially revalued and refined through progressive historical application of wage labor and the market to its production and exchange.* (Shiller, 1988, p.41)

The informational use value and its inherent characteristics should be taken as the referential point for an analysis. The reason is that the informational product is not a solid, stable entity in its own right. It is a stage in the metamorphosis of the labour process. This claim does not necessarily refute the sensation that there has been a rupture, which roughly corresponds with the spread of information technology. If there is a discontinuity, however, it should not be sought in a discrepancy between non-rival informational goods and tangible, rival goods. It is better described as a rupture in the labour process. Numerous scholars have attempted to name this rupture, some examples include: immaterial labour, social labour and scientific labour. The controversies surrounding these claims can be left aside for now. What is important here is that the contradictions arising from the political economy of information cannot be satisfyingly accounted for as 'infinite reproducible information treated as a scarce resource'. It is more appropriate to think of it as private property being straitjacketed onto a socialised labour process that flows from communication. The chief advantage with the latter description is that it enables a more dynamic analytical approach. It allows us to study given reality as transitional in its becoming. The strengths of the this approach is plain to see when the object of study is perpetually transformed by technological change and creative destruction.

The line between informational and tangible goods, the virtual and physical realm, and, by implication, commons and markets, might at one point have seemed stable and self-evident. Arguably, it looks less stable the more hardware and software technologies converge. There is a lot of political clout behind bringing about such a convergence, as is suggested by numerous policy documents about an ‘augmented reality’ and the ‘Internet of things’. EU money is poured into research developing these technologies. On the production side of things, hardware is being designed to resemble software. A case in point is field-programmable circuits, widely used in the computer industry since more than a decade back. These circuits are manufactured in such a way that

the final design can be reprogrammed at a later date. From these examples, it might sound as if we had introduced technological deterministism to make our analysis more dynamic. Not at all. That the breakthrough of field-programmable circuits owed to something else than an innate trajectory of technological development can easily be verified. A testimony from an industry leader in the 1990s, anticipating the increased use of field-programmable circuits, puts our point succinctly: "Our edge is that we can use easily available programming skills to do what previously required expensive and hard-to-recruit chip designers " (Gibson, 1999, p 38). Having said that, we do not want to imply that everything can be reduced to the urge of capital to reduce labour costs. The hobbyists building open source 3D-printers give proof of other rationales for striving towards a convergence between hardware and software. By articulating their dreams, and, crucially, through the exertion of their labour, the hobbyists are contributing to a reconfiguring of the world (virtual and real) along the same lines.

Having put this much stress on the transitory character of the given reality, and after having borrowed extensively from constructivist science studies, we need to add a word of caution. What has been said so far does not mean that the world can be reshaped effortlessly and at will. To get anywhere at all, the hobbyists in the Rep-rap community have to overcome one technical hurdle after the next, sometimes coming to a full stop when the difficulties they encounter are overpowering. This caveat is also made by constructivist science scholars. We diverge from many of them, however, in that we do not believe that all explanatory weight can be placed on locally situated practices. The latter intellectual position goes astray in its disregard for historical forms, or, with a different terminology, the inertia of path-dependency. What is thereby sacrificed is a sense of proportions and gravity (Söderberg & Netzen, 2010). If we were to weight the impact of the Rep-rap community against, lets say, the reorganisation of the labour process by capital, we would find that the latter has been a much more important factor for influencing technological change. Nevertheless, the example with the open source 3D printer helps to demonstrate our argument. Namely, that there can be no once-and-for-all, *a priori* demarcation line between informational resources and physical goods. This line is continuously created and redrawn in the labour process, broadly understood. Hence, the information exceptionalism hypothesis, and all the arguments which rest on top of it – including the predominant critique of intellectual property – comes up short. Faith in this hypothesis is likely to persist no matter what, for all the reasons outlined above. Still, we believe that by deciding against such an analytical procedure, in favour of an intellectual approach anchored in political economy and where the stress is placed on historical continuity, one can get a better sense of the future struggles over the intellectual property regime.

Conclusion – freeing information, freeing atoms

In the present article, we have questioned the self-evident appearance of what we elect to call the information exceptionalism hypothesis. This hypothesis underpins most of the critique against intellectual property today. The argument is compelling because it constructs a string of statement following from something which seemingly is self-evidently true. Namely, the claim that information is substantially different from material resources. We have argued that the self-evident appearance of this claim does not simply rest on it being an accurate description of what information ″really is″. Rather, it owes partly to the fact that the information exceptionalism hypothesis has been cut out of the same cloth as the economic science. Some of the matter-of-factness which defines the economist's worldview has thus been endowed this hypothesis.

It is thus the critics of intellectual property are able to exploit an anomaly in the paradigm of economic science. Its key postulate about the omnipresence of scarcity has been inverted to its radical Other, abundance of non-rival, informational goods. Hence, the rationale for intellectual property is overthrown from within the citadel of private property. The liturgy of free markets is now being sung in praise of the information commons. The irony of this reversal is easy to appreciate, as are the tactical advantages. The price to pay, however, is that the blind spots of the economic science are duly reproduced in the critique of intellectual property. Our claim can be examplified with two high-profile champions of the information commons, Lawrence Lessig and Yochai Benkler, together with their innumerable followers. There are also some shining exceptions among the legal scholars. James Boyle has formulated a critique of intellectual property which incorporates the historical insights of political economy and draws parallels to the first enclosure movement. The latter analysis opens up to a broader critique of private property and commodification. This has not, however, been the road travelled by most critics of the intellectual property regime. A lot of work has instead been put into policing the borders between intellectual property and private property. A case in point is when free software advocates distinguishes between free as in “free speech” and free as in “free beer”. The point being that free software is strictly about civil rights issues, while protestations over price and markets are exempted from the struggle against the intellectual property regime. We believe that this approach is about to exhaust itself. Our claim can best be illustrated with a quote from Paolo Virno, although it was uttered in a completely different context. Free beer has become indistinguishable from free speech, in:

[. . .] the era in which language itself has been put to work, in which language itself has be-

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> *come wage labour (so much so that 'freedom of speech' nowadays means no more and no less than the 'abolition of wage labor')* (Virno, 1996, p.271).

We are working ourselves towards the same conclusion but starting from a different point of departure. It was proposed that the boundary work of hackers, activists and academics campaigning against intellectual property is being destabilised due to the introduction of a new narrative element. Namely, the exclamation that, to put it in the jargon of the Californian ideology: "atoms are the new bits". At the centre of articulating this new imaginary is the hobbyists building open source 3D printers. Many of them are convinced that their work will result in an expanded conflict over intellectual property, soon to encompass physical objects too. In fact, the first cannonade has already been fired. In February 2011, a DMCA takedown notice was issued for printable 3D objects. The notice was sent to Thingiverse, a repository for 3D objects used by many hobbyists in the Rep-rap community. The individual designer making the complaint, Ulrich Schwanitz, protested that an object which he had created, an impossible shape called a "penrose triangle", had been reverse-engineered and uploaded to Thingiverse. After a protest storm he dropped the charges and soon released his design in the public domain. Nevertheless, in the Rep-rap community and on the Thingiverse blog, this event was hailed as a first skirmish in the upcoming struggle over 3D designs and home printing. The expectation is that once a consumer market in 3D printers has been established, many industries will start to lobby for legal protections, just as the music and film-industries did in the late 1990s.

Without necessarily endorsing the many claims made on behalf of the Rep-rap project, we recognise its importance for having contributed to a new imaginary. This imaginary suggests that there can be no stable demarcation lines between commons (in which informational resources can circulate freely) and free markets (in which property ownership over tangible goods are traded), ultimately grounded in the nature of the resource in-itself. Hence, where to draw the line between the two will be decided in a test of strength between opposing forces. This is essentially a political struggle, although for most part it will be mediated through technological innovation and expertise. In fact, the opportunity has already been spotted by conservative think-tanks. In a re-examination of the old debate about lighthouses and public goods, one economist has observed that light is now being replaced with radio signals as a means for assisting navigation. The latter technology is designed in such a way that rent can easily be extracted from the service. The writer rejoices: Due to technological change, there are no such things as natural public goods anymore. It is only institutional inertness which holds back the unbounded expansion of markets (Foldvary, 2003).

Indeed, with information technology, the granularity of private property can be made infinitely small. Examples hereof abound in the new markets which have flourished on the Internet for some years. Infinite are the ways to parse up information and provide it on a pay-per basis. Herein lies the truth of the statement ″atoms are the new bits″. Till now, payments for most services and goods has taken the form of what migth be called, with a computer term, ″batch processesing″. The crudeness of this calculative method will, when looked back at in a few years time, appear like an endless long tail of market failuires. With real-time processing of personal debt, in contrast, every moment of our consumptive being can be charged for with surgical precision. It is this promise which fuels the convergence between intellectual property and private property. Of course, this will only work if digital rights management schemes are embedded in our everyday existence. Piracy will be generalised to every corner of society. And the battle-cry will ring out: atoms want to be free too!

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