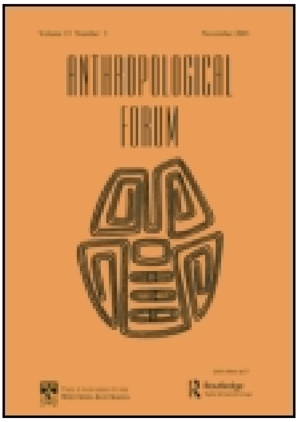

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Between Knowledge And Technology: Patenting Methods, Rethinking Materiality

Mario Biagioli[1]

How does the law construe certain things and activities as knowledge that can become the object of intellectual property? When we look at the quantitative trends in recent patenting activities—more people patenting many more things—we tend to view that, in part, as an effect of the law's ability to construe new kinds of innovation (software, genetic sequences, etc.) in ways that conform to established legal concepts of patentable invention. The assumption is that what changes is not the shape of the box called invention, but the objects that are made to fit that box. But in fact while new technologies produce new innovations, the very concept of invention has not just expanded but undergone substantial qualitative change. The wave of inventive activity associated with the industrial revolution led to an unprecedented reliance on patenting, but as the law articulated ways to protect those inventions, it also took their emblematic form—the machine—as the template for the legal concept of invention. Analogously, the recent reinterpretations of patent law to enable the protection of living organism and biological entities have challenged and modified the traditional machine-inspired concept of invention, initiating a trend toward a more developmental one. The information-based inventions discussed here may elicit a reconceptualization of invention in yet another way.

Keywords: Intellectual Property Law; Invention; Patents; Knowledge; Technology

How does the law construe certain things and activities as patentable inventions, that is, as property? And how does it transform new and yet unpatentable kinds of innovation into patentable ones? Typically the courts play up analogies between some features of the new inventions and those of traditional patentable entities, while de-emphasising or plainly ignoring those more difficult to normalize. The first patent for a genetically modified organism exemplifies that process.[2] But while new wine is

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often put in old legal bottles, the shape of the bottle has also changed quite radically since the Industrial Revolution. This essay considers a very recent segment of that trajectory—the history of the concept of patentable invention—by looking at the changes it is undergoing in the so-called Information Age.

The history of the concept of invention is related to, but distinct from, the history of technology and inventions. The wave of inventive activity associated with the industrial revolution led to an unprecedented reliance on patenting, but as the law articulated ways to protect those inventions, it also took their emblematic form—the machine—as the template for formulating the legal concept of invention. The 'mechanical form became the medium of legal technique'(Pottage and Sherman 2010, 15). Analogously, the recent reinterpretations of patent law to enable the protection of living organism and biological entities have challenged and modified the traditional machine-inspired concept of invention, initiating a trend toward a more developmental one (Pottage and Sherman 2011, 269). The kinds of inventions I discuss here—abstract diagnostic methods and business models—may be reconceptualising the notion of invention in yet another way, not through the form of the machine or the organism but through that of information and information processing.

Redefinitions and expansions of what can be patented have typically involved the redrawing of distinctions between discovery and invention, between nature and artefact. The explosion of genetic patenting has depended on a conceptualisation of genetic sequences not as purely natural entities but also partial products of human agency, at least to an extent sufficient to allow them to be moved from the category of discovery to that of invention, and thus from unpatentable to patentable. The trend toward patenting business models and diagnostic methods hinges, instead, on modifying the relation between patentability and the materiality of an invention. Not all patentable inventions need to be material anymore—at least in the United States.

Transforming Tangibility and Intangibility

In 1997 Bernard Bilski and Rand Warsaw filed for a patent for a general price-hedging model, which they applied to the specific field of energy commodity trading. The application concerned the model itself, not the software that may execute that model or the computer that may run it:

> (a) initiating a series of transactions between said commodity provider and consumers of said commodity wherein said consumers purchase said commodity at a fixed rate based upon historical averages, said fixed rate corresponding to a risk position of said consumers;
>
> (b) identifying market participants for said commodity having a counter-risk position to said consumers; and
>
> (c) initiating a series of transactions between said commodity provider and said market participants at a second fixed rate such that said series of market participant

> transactions balances the risk position of said series of consumer transactions (*Bilski vs Kappos* [2010] 561 U.S. 2, Opinion of the Court; 'Bilski').

The US Patent Office denied the patent, and all subsequent reviews—including the last one by the Supreme Court—upheld that decision. Strikingly, however, the Supreme Court did not find Bilski's invention unpatentable because of its immateriality. Many other abstract methods and processes have been granted patent protection in the United States over the last two decades, including one involving the correlation between a certain level of homocysteine in bodily fluids and vitamin B deficiency. This patent became the focus of a dispute—the *Laboratory Corp. of America Holdings (LabCorp) v. Metabolite Laboratories, Inc.* ([2006] 126 S.Ct.; 'Labcorp') case—that was taken up for review by the Supreme Court in 2005. However, in an unusual decision that probably signals the complexity of the issues brought up by this patent, in June 2006 the court decided to drop the case after hearing oral arguments—a decision on which Justice Breyer wrote an interesting dissent that has framed some of the subsequent discussions on similar patents (Labcorp, 2921, Breyer, J., Dissenting). The claim at the centre of the case concerned

> a method for detecting a deficiency of cobalamin or folate in warm-blooded animals comprising the steps of:
>
> (a) assaying a body fluid for an elevated level of total homocysteine; and
>
> (b) correlating an elevated level of total homocysteine in said body fluid with a deficiency of cobalamin or folate (Allen *et al.* 1990, Claim 13).[3]

Notice that this invention does not cover the testing technique or apparatus required to assay 'a body fluid for an elevated level of total homocysteine', but only the relation between quantities of homocysteine and vitamin B—a linkage between certain biomarkers and a certain medical condition (Collins 2007). While serious questions still remain about what tests the Patent Office and the courts should or will adopt to assess which abstract methods are patentable and which ones are not, there is by now an established trend toward patenting new and useful knowledge as such, unconnected to machines or material transformations of any sort.[4]

Traditionally, the law has conceptualised inventions as either fully or partially material. In the early modern period, patentable inventions were treated as things that performed useful tasks or yielded useful products. What mattered was not what we would see as the 'idea' of the invention but its ability to produce useful material effects (Biagioli 2006, 1132–34). Then, since about 1790 in both Europe and the United States, the law started to attribute an intangible dimension to the inventors' activities: the so-called inventive step or 'idea' of the invention (Biagioli 2006, 1134–40). But like the equally intangible author's 'personal expression' at the core of modern copyright law—an intangible form that needs to be fixed in a tangible medium to produce a protectable work—a patent could be issued only if the inventive step was deemed reduced to practice by embodying it into something material. The 1793 *US Patent Act*, for instance, required the inventor to describe 'the several modes in which [s/he] has contemplated the application of that principle or character'.[5]

Materiality (or, more precisely, the way the notion of materiality has been mobilised in legal doctrine and practice) has remained a central element of the legal notion of invention for the following two centuries. Current US patent law states that 'whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor'(*35 U.S. Code § 101*). Machines, products ('manufacture'), and chemical entities ('composition of matter') are obviously material. Moving to 'process'—not things but ways of doing things—this term (which used to be 'art' in older US patent acts) has been traditionally interpreted to mean activities and methods that produce useful effects through material transformations. Examples may include a process to cure rubber or a method to produce transgenic organisms (as distinct from the rubber products or the organisms themselves).

In the United States, this traditional conception of patentable processes has been formalised in the 'machine-or-transformation' (MORT) test recently adopted by the Patent Office—a test that defines patentable processes as those that are 'tied to a particular machine or apparatus or transform a particular article into a different state or thing' (United States Patent and Trademark Office 2009, 1). Behind a different terminology, European patent norms too associate invention to materiality—patentable inventions being defined as involving something 'technological', where 'technological' means 'material'. What had grown to be an essential (if unstable) conceptualisation of invention as a coupling of immaterial and material elements is now being openly challenged, complicating the life of those who write, examine and judge patents, but also providing important opportunities for historians and philosophers to reconsider the meaning of materiality and its relation to knowledge.

The law's traditional characterisation of an invention as involving intangible knowledge (the inventive step) coupled to something material replays old distinctions between knowledge as immaterial and technology as material, but these new patenting trends are forcing us to question both the immateriality of knowledge and the materiality of technology. As I hope to show, the notion of materiality (and of technology) involved in the Patent Office's MORT test is problematic. It posits materiality as self-evident without realising that the apparent stability of that notion may be the result of reification.[6] Conversely, the intangibility attributed to knowledge (in the form of the inventive step) results from a process of essentialisation or purification that is as problematic as the reification behind the law's conceptualisation of materiality.

At first, the patenting of abstract methods, processes, and models seems to fit an ongoing trend within the 'knowledge economy' toward the production of an increasingly wider range of intangible assets. That kind of lose talk about intangible property obfuscates, however, some very significant and interesting differences. While in the past the intangible was the 'form' that the inventor gave to a tangible invention, now the whole invention is becoming conceptualised (in these cases) as intangible itself—a slippage from the form of the invention to the invention as form.[7] With information-based inventions like Bilski's price hedging scheme or Metabolite's correlation between biomarkers and medical conditions, the law is no longer grafting immateriality over materiality but seems to be doing away with materiality altogether. This is a qualitatively different transformation not only because it goes from expanding forms of immaterial property to rendering materiality unnecessary, but because, in doing so, it breaks down the tangible/intangible distinction or dichotomy that has been fundamental to modern patent law and intellectual property law more generally. Tangibility and intangibility are, I believe, impossible to define as separate, free-standing concepts. In the past, intellectual property law has managed this difficulty by defining the tangible and the intangible through a relationship of complementarily—saying, for instance, that the intangible idea is the 'form' that shapes tangible 'matter' into an invention (Pottage and Sherman 2010, 12-13). That dichotomous framework, however, is now being undone, making the meaning of *both* tangibility *and* intangibility to drift.

Peculiaries of 'Information'

This might stem from the fact that these inventions concern information and information processing, and that information is a rather peculiar kind of concept. It is not clear, for instance, where information stands in the spectrum that goes from materiality to immateriality, or whether that is even the right way to frame the question. Information can be thought of as something immaterial in the sense that its effects are not reducible to the materials on which information is carried, as indicated by the fact that there are typically different material sub-strata and coding formats that can hold and convey the same information. Also, while information and information processing do have detectable effects (not just informational outputs but also changes in the materials involved in information processing and storage) those effects are not easily captured by the idiom of materiality that patent law has developed from its early engagement with mechanical and chemical inventions. In comparison to those traditional kinds of inventions, information looks more like form than matter. And yet, information is very 'material' in the sense that it always relies on some material difference or trace to signify or 'carry' it—the binary setting of a computer's flip-flop register, different voltage levels, different wave frequencies and amplitudes, different markings on a piece of paper, wood, stone, and so forth.

In a digital environment the figure of the switch best captures the ways in which information is both material and immaterial, or perhaps neither. From telephone switchboards to computer central processing units, the switch stands for binary information—open/closed, yes/no, 1/0. But while the switch is obviously material, the difference that makes a difference is its *position*, its capacity to contain a flow and direct it in one *direction* rather than another. What changes in a switch is its configuration, not its shape or composition. The way a switch performs that function may be specific to the materiality of the specific flow involved—a semiconductor is materially different from both an electromagnetic relay and a hydraulic valve—and yet the fact that we can build computers performing the same operations through very different techniques and materials indicates that while information is tied to material differences, it is not tied to the specific materials instantiating those differences. You can build a Turing machine from Lego blocks (see Nissen 2009).

The figure of the switch indicates that information is not only not bound to a specific form of materiality (so as to make it much more matter-generic than traditional inventions, if not altogether immaterial or matter-free) but also that matter plays an altogether different *role* in information-based technologies compared to those of the Industrial Revolution.[8] Matter has a structural role in traditional mechanical inventions—the cast iron in a textile machine makes it stand, carry loads, work the fibres—but it has only a signifying role in information-based inventions. You still need materials like paper and pencil, electrical currents and circuits, and so on, but you use them to mark differences and elaborate them. This seems to invert the traditional conceptualisation, mentioned above, of the invention as the form or mould which shapes matter into a product or machine that can be reproduced in virtually identical copies, precisely because they are produced by that one form or idea (Pottage and Sherman 2010, 19–22). In information-based inventions, instead, matter is not there to be shaped into a product by the invention's form, but rather to provide a medium in which the differences that make up the form can be detected and elaborated. Matter is not the 'stuff' of invention is made of, but the material substratum that signifies the invention. The same ream of paper can be fed into a printing press to produce many impressions of the same page, but it can be also turned into the paper tape that a Turing machine moves to read both instructions and data, write partial results, reread those results as subsequent inputs, and so forth, as it goes through all sorts of different computations. In the first case the paper ream functions like matter, but in the second? As in the duck-rabbit exercise dear to Gestalt psychology, when we look at information-based inventions the matter of the invention can appear to be its form, and vice versa.

We could say that information does not solve the problems inherent in the form-matter or material-immaterial duality, but rather that it internalises it. If in the past invention was defined as an intangible (the inventive step) connected to a tangible entity (a mechanical assemblage, a chemical compound, or the like), inventions involving abstract methods and processes now fold the tangible–intangible relation within the inventive step because theirs is an inventive step that involves information or information processing. What is distinct about these inventions is not their immateriality but the location where the nexus between tangible and intangible is articulated or activated. That nexus is now *within* the inventive step rather than *between* the inventive step and its material embodiments. Also, the role (and thus the meaning) of materiality in this kind of invention is no longer (or not always) what it was when it became an essential component of the legal notion of invention around 1800.

Bilski Goes to Court

In the United States, the required materiality or material effects of patentable processes and methods was traced to the Constitution that, in the article pertaining to intellectual property, states that protection can be granted only to inventions that contribute to the 'progress of the useful arts'.[9] Until recently, the term 'useful arts' has been read to mean 'technological arts' or material technology, thus categorising abstract methods as non-technological and thus unpatentable. This is the position upheld by the modern critics of the patenting of abstract methods, including several attorneys and scholars who wrote amicus briefs to the Supreme Court assailing the patentability of Bilski's invention. Based on the questions they posed during the oral arguments in November 2009, some justices leaned toward that position as well:

> JUSTICE BREYER: You know, I have a great, wonderful, really original method of teaching antitrust law, and it kept 80 per cent of the students awake. They learned things—
>
> (Laughter)
>
> JUSTICE BREYER: It was fabulous. And I could probably have reduced it to a set of steps, and other teachers could have followed it. That you are going to say is patentable, too?
>
> MR. JAKES [Bilski's counsel]: Potentially.[10]

Justice Sotomayor, another Democrat, sought comical effect by addressing, but implicitly deriding, the implications of the trend exemplified by Bilski:

> JUSTICE SOTOMAYOR: So how do we limit [patents] to something that's reasonable? Meaning, if we don't limit [patents] to inventions or to technology, as some amici have, or to some tie or tether... to the sciences, to the useful arts, then why not patent the method of speed dating?[11]

Conversely, those in favour of the patenting of abstract models—the financial industry among them— are arguing that 'technology' needs to be understood much more broadly than what it meant during the Industrial Age. As Bilski's counsel put it during the oral arguments to the Supreme Court:

> Today the raw materials [of invention] are just as likely to be information or electronic signals, and to simply root us in the industrial era because that's what we knew I think would be wrong and contrary to the forward-looking aspect of the patent laws.[12]

Technology started by producing material inventions, but then added immaterial ones to its repertoire—a development that could not have been envisaged by those who initially crafted patent law. They allowed for the patenting of processes and those processes happened to be material at first, but we should not now turn an accident of history into an ontology.

A few months later, in June 2010, the Supreme Court unanimously affirmed the finding of the lower courts against the patentability of Bilski's invention. The justices, however, failed to agree on the reasons for the decision, producing different opinions on the matter, pretty much along party lines. The more politically conservative ones upheld the emergent view of technology put forward by Bilski's counsel, emphasising the difference between inventions of the 'Industrial Age' and those of the 'Information Age' (Bilski, 7, Opinion of the Court). Attributing an equally emergent meaning to 'process', they have concluded that processes do not necessarily need to be tied to a machine or physical transformation in order to be patentable. They have found Bilski's invention unpatentable, but have related their decision not to the immateriality of that invention, but to the fact that it cannot not be classified as a 'process' even in the broad, emergent definition of the term they have come to adopt (Bilski, 2, Syllabus).

The more liberal block has joined Justice Stevens, arguing that while they concur in the court's judgment against Bilski, they disagree with its reasoning: Bilski is unpatentable because it is a business model, and 'methods of doing business are not, in themselves, covered by the statute' (Bilski, 47, Stevens, J. concurring in judgement). They may be processes but are not what the law defines as patentable processes. They are not part of the 'useful arts' mentioned in the Constitution and are not, consequently, a technology. The term 'process' should not be treated as an overly broad term comprising all sorts of practices or simple 'human activities', but a legal term of art referring specifically to physical, material or technological processes.[13] To assume a broad definition of 'process' amounts to including in it things that term was meant to exclude.

From Materiality to Specificity

Because they rest on incompatible assumptions, the conceptual and philosophical differences between those who claim that patentable inventions must be material or induce material transformations and those who instead claim that new and useful immaterial inventions may be patentable too are, I believe, irresolvable—even more so when they are coupled with opposing views of capitalism and innovation such as the emergent/laissez faire view of the Republican justices versus the more 'regulatory' stance of the Democratic ones. It may be more useful, therefore, to question the very divide between materiality and immateriality that structures these debates, so as to scramble both the conceptual and political stalemate. Rather than accept that 'invention' is becoming immaterial or that it should never be anything but material, can we rethink invention as something that is neither material nor immaterial? The evidence from the Bilski case and others (coupled with strong evidence that the range of inventions involved in this trend is remarkably wide and widening precisely because of its disconnect from materiality) already points to interesting slippages and partial breakdowns in the dichotomy between materiality and immateriality. It is not at all clear that materiality is still the opposite of immateriality, or of abstractness. An opposition remains, but the law redraws and re-establishes it between attributes of the invention other than tangibility and intangibility. Patent law may be translating (in the literal sense of relocating) its fundamental distinction between *tangible and intangible* to one between *specific and generic*.

Patent history indicates that the resistance to immaterial or abstract inventions was rooted in concerns with the size of the monopoly that would be created by allowing for the patenting of abstract principles, methods, or ideas. Still much-cited (and relevant to current debates over patentable subject matter) is the 1853 US Supreme Court decision against Samuel Morse's attempt to seek a patent on any electromagnetic technology for communicating printed messages. In Claim 8, Morse stated:

> I do not propose to limit myself to the specific machinery or parts of machinery described in the foregoing specification and claims; the essence of my invention being the use of the motive power of the electric or galvanic current, which I call electro-magnetism, however developed for marking or printing intelligible characters, signs, or letters, at any distances, being a new application of that power of which I claim to be the first inventor or discoverer (Morse 1848, Claim 8).

If Morse did not quite claim the whole of electromagnetism as his invention, he still claimed patent rights to all possible uses of electromagnetism for the purpose of 'marking or printing intelligible characters, signs, or letters, at any distances'. The extraordinary breadth of that claim was obviously connected to untethering his invention from any specific telegraphic apparatuses—a move that enabled him to claim all known *and unknown* uses of electromagnetism for telegraphy. By not limiting his patent claim to an apparatus he would have secured a monopoly on something he had claimed but not disclosed, like saying 'I am the owner of vast new lands I have recently discovered out West' without saying where exactly that property starts and ends. Furthermore, by claiming but not describing the 'motive power of the electric or galvanic current … for marking or printing intelligible characters, signs, or letters, at any distances', Morse would have effectively obtained a patent also on future knowledge about the applications of electromagnetism to telegraphy. The Court found that 'the claim is too broad, and not warranted by law.'[14]

Asking for the idea—the inventive step—to be connected to a machine was therefore a way to circumscribe the present and future scope of the inventor's monopoly. It functioned a bit like the lamp that contained and thus controlled Aladdin's genie. So, for instance, the landmark 1981 Supreme Court decision in *Diamond v. Diehr ([1981] 450 U.S.,* 175) (which opened the door to software patenting) stated that while an abstract mathematical formula central to the invention could not be patented in and of itself, one could patent the software running that formula on a computer that was in turn embedded in a rubber-curing system—a system made new and better by the temperature control protocols enabled by said formula. We see, therefore, that despite their superficial similarities, abstractness, immateriality, and intangibility are different concepts. What made them look similar were their similar effects, that is, that they could all enable very large patent claims. Conversely, the materiality requirement (either the invention's connection to a machine or to material transformations) was not a statement of the technological value of materiality per se—'only material inventions are good inventions'—but rather a mobilisation of materiality to both provide a definition of what an invention was (through the form/matter duality) and, by the same token, to limit the size of the claim to a set of material embodiments. What mattered about materiality in this context was that it could make the claim mappable and circumscribable. Material fields are much easier to measure and surround by fences than immaterial ones.

I would add spatial location—a notion conceptually unrelated to materiality—to the list of monopoly-control strategies. Especially in the Renaissance and early modern period (when inventions were conceptualised as usefully performing machines rather than ideas embedded in a machine that produced useful effects) it was common to find patents that limited the privilege on the use of an invention to a specific place: a windmill on a certain hill, a boat of a certain design on a given river, a certain industry at a certain distance from a city (see for instance, Prager 1946; Mandich 1948, 1960). Even if you grant broad patent claims, the *effect* of their monopoly will be substantially limited by restricting the inventor's use of his/her patent[15] to a narrow place or jurisdiction—especially if that invention or its products were difficult to move around.

Not all these controlling or restricting techniques functioned equally well with all inventions, or notions of invention. The use of geographical restriction, for instance, could be effective in patent regimes that conceptualised inventions as soulless machines that may deserve protection within the legal jurisdiction of a given nation, but not in legal frameworks that, since about 1800, have cast them as ideas embedded in machines entitled to protection on an increasingly global scale. In the latter case, restricting the geographical scope of the patent would not control its effective scope. Because the 'soul' of the invention can, so to speak, leave the body behind and travel through publications, it can potentially enable the expansion of the patent monopoly elsewhere.

Conclusion: From Things in Space to Ideas in Matter to . . .

We could therefore say—but this is only a hypothesis—that while the effective breadth of the claims of pre-1800 inventions was controlled or curtailed by delimiting both the geographic location of the operation of the invention and the legal jurisdiction of the patent grant, post-1800 patent law pursued a comparable goal by imposing requirements about the materiality of the invention or of the transformations it produces. The former uses space, the latter matter. It may be surprising to see space treated as a key element of the early modern patent regime and materiality associated, instead, with modern patent law, given that the former conceptualised invention in strictly material terms (a usefully performing material device), while the latter pinned it on an immaterial inventive step only subsequently tied to a machine.

What I mean is that precisely because the early modern conceptualisation of the invention construed it as a machine that was new and useful in a specific legal and political jurisdiction, it provided few (if any) conceptual or legal tools to say what invention was, apart from pointing to the morphological features or effects of a specific patented machine.[16] This is somewhat comparable to the limits of Darwin's original population-based notion of species: you may define 'horse' as a member of an interbreeding and reproducing population occupying a certain geographical niche, but you would not be able to define what 'horseness' is. The early modern patent regime could protect specific material inventions in certain places but could hardly define 'invention'. Whatever it was, that was effectively folded within the specific material invention at hand. The conceptual (and bureaucratic) tools to construe a legal notion of invention distinct from its specific material embodiments would develop only after about 1800, in a radically different episteme of invention (Pottage and Sherman 2010).

It is in this sense, then, that the early modern geographical restriction on the use and protection of an invention (still conceptualised as a material thing) functioned as an indirect way to curtail the largely unspecified (and virtually unspecifiable) claim of the invention—a dimension of the invention that was to emerge, in its modern form, only later. I would say, therefore, that the early modern regime conceptualised the invention as material and controlled its scope through spatial limitations, while the modern regime conceptualises it largely in terms of its idea and then controls its scope through its material embodiments.

The differences between modern, post-1800 patenting scenarios and those produced by contemporary information-based inventions such as Bilski and Metabolite may be a replay, *mutatis mutandis*, of those between inventions as things and inventions as materially embedded inventive ideas. Restrictions of a spatial nature could function relatively well to limit the effective claims of inventions that were both conceptually and materially 'local': inventions legally defined as things protectable only within specific jurisdictions, and at the same time bulky and unstandardised to require a great deal of local expertise and hands-on training for their construction and operation. That technique, however, would not have performed well with inventions that, after about 1800, came to be expressed (and thus potentially copied or disseminated) through a publicly accessible textual and pictorial specification of their 'inventive step'. The materiality requirement became the key legal technology for controlling the scope of the patent claim in that more modern regime, while the development of international patent treaties helped to control the unauthorised copying of inventions across different legal jurisdictions.

When we move up to more recent information-based inventions we quickly see, however, that the materiality requirement becomes either blunt or ineffective, or both. The immateriality of abstract inventions enables them to migrate widely—not only in the sense of being able to be easily pirated or licensed on a global scale (like most of information-based products such as texts, music, film), but in the more important sense of entailing indefinitely broad claims. Because of its abstractness, a hedging method can be applied to an indefinitely broad set of contexts, as is Pythagoras's theorem. But if in 1853 the Supreme Court could control the scope of Morse's patent by invoking the materiality requirement to void his extraordinarily broad claim quoted above, that tactic would not work with information-based inventions of the kind instantiated by Metabolite's claim to the correlation between homocysteine and vitamin B deficiency.

Even the broadest of Morse's claims still had some distinctly material dimensions to it: '*marking or printing* intelligible characters, signs, or letters, at any distances' (Morse 1848, Claim 8; emphasis added). Metabolite's invention, instead, involves no material effect such as marking or printing, only the establishment of a mental linkage between levels of homocysteine and vitamin B deficiency. Morse left unspecified the indefinitely many modes of the invention's material embodiment in an attempt to claim all of them, even those he could not envisage yet. But the reason the Metabolite patent lists no specific modes of embodiment is that they are all external to its main claim. The useful results claimed by Metabolite take place *in the diagnostician's mind*, not in things or material media external to the mind.[17] While Morse listed no modes of his invention's material embodiment to claim all of them, Metabolite claims none because it has none. When applied to Metabolite, the materiality requirement that served well to curb Morse's expansionist claim would look like trying to catch the genie with a butterfly net.

One of course could follow Justice Stevens and his liberal colleagues in trying to simply rule abstract methods patents out of existence. Doing that, however, requires drawing an essential and essentialising distinction between what technology is and is not, and what materiality means. A more interesting alternative would be to rethink the material/immaterial dichotomy that has framed both modern patent law and its response to abstract methods. That rethinking is already immanent in patents such as Metabolite's where specificity is coming to play the role that materiality or concreteness (or similarly 'solid' but actually remarkably vague adjectives) had played in traditional patent discourse. As already identified by some legal scholars, in information-based inventions the opposite of 'abstract' is no longer 'material' but 'specific' (Lemley, *et al.* 2011).

What has been patented in Metabolite is not a general model whose application is then narrowed down to a specific context (such as Bilski's general hedging scheme that is then restricted to energy commodities trading), but something that was never general and always specific to the two entities it connects: levels of homocysteine and vitamin B. Metabolite's invention was 'born local', not born general and subsequently narrowed down to a particular context of use. While Bilski's Claim 1 presents a 'method for managing the consumption risk costs of *a commodity*'—thus implying that this is a method applicable to a variety of entities of a certain kind, Metabolite talks about homocysteine—one single specific entity, not a class of entities (Bilski and Warsaw 1997, Claim 1, emphasis added). Metabolite has no other known contexts of application, at least at the time of the patent application. While the meaning of 'applied' and 'specific' may seem quite similar, the invention claimed in Metabolite is indeed specific, but certainly not applied according to the common meaning of the term. If 'specific' and 'applied' sound similar by virtue of both being starkly different from 'abstract', the analogy ends there. They are both very different from 'abstract', but in very different ways. In this context, to say that something is specific does not mean that it was something abstract that was then made material. Specificity is neither material nor immaterial.

We could say that the specificity of an immaterial invention such as Metabolite creates effects comparable to the early modern spatial limitations imposed on the uses of some very material inventions, like windmills on hills. Of course specificity does not 'locate' an invention spatially, but it can be said to do so conceptually. It literally points to where the invention 'is' in the sense of what entities are involved in the inventive step and what the relation is that produces the new and useful effects claimed by the invention—in this case in the diagnostic relation between homocysteine and vitamin B, in whatever mammalian body those two entities might be found. In this case, the materiality or immateriality of the invention no longer seems to be a distinction that makes a difference.

This does not mean, of course, that the trend exemplified by Metabolite is one we should endorse or support, or that it will lead, as the founding fathers wished, to the 'progress of the useful arts'. The pros and cons of intellectual property are as debatable as ever, and the patenting of immaterial inventions—even intriguing ones like Metabolite—may in fact bring up some pretty intractable problems within the larger framework of intellectual property law.[18] I would not be surprised if, down the road, these developments may lead to such an extensive patenting of any new and useful idea to force an extensive and intensive rethinking of the entire edifice of patent law. Personally, I would welcome that.

For the moment, however, I hope to have shown that while material ontologies may sound sophisticated and perhaps even comforting in today's social sciences and humanities' circles, they do not seem to capture the complexity of technological innovation, and are certainly not providing effective tools to limit the scope of abstract methods' patents and enlarge the knowledge commons many of us care about. What I have tried to show here is that there are in fact new notions or features of 'invention'—such as specificity—that are being articulated or mobilised with the very emergent technologies they are trying to conceptualise. And while these new conceptualisations are embedded within fairly esoteric contemporary debates about patenting, they are effectively redefining the meaning of technology, materiality, immateriality, and their relation.

Notes

[1] I thank James Leach and the two anonymous referees for their useful comments and criticism, Richard Davis and (once more) James Leach for inviting me to the workshop on 'Recognising and Translating Knowledge' (UWA, February 2011), and the workshop participants for two

days of lively and engaging conversations. An earlier shorter version of this essay is appearing in Penelope Harvey, ed. *Objects and materials: A Routledge companion* (London: Routledge, 2013).

[2] Ananda Chakrabarty's patent for a modified bacterium—the first of its kind—was initially denied by the Patent Office because it included a feature—life—deemed to exceed the boundaries of patentable subject matter. That decision was reversed on appeal when 'life' was declared irrelevant to patentability. The patent was then confirmed in 1980 by the Supreme Court, which analogised the modified bacterium to a 'composition of matter'—a traditional kind of chemical invention. The full story is in Eisenberg (2005).

[3] Metabolite is not the patent's assignee, but its exclusive licensee.

[4] I focus primarily of some of the issues that have emerged from the Bilski and Metabolite cases, but time and space constraints force me to skip the important *Mayo Collaborative Services v. Prometheus Labs. Inc. ([2012] 566 U.S.)*, decided by the Supreme Court in March 2012.

[5] US Patent Act of 1793, Ch. 11, 1 Stat. 318-323 (February 21, 1793), Sec 3.

[6] In particular, the distinction found in US patent law between inventions as things and inventions as processes become suspect when one looks at nineteenth-century attempts to come up with a legal definition of the invention as machine. Although one would expect the machine to be conceptualised as a thing, it was in fact thought of as a repetitive, periodical mode of operation that yielded certain results. In other words, the machine was not conceptualised as a thing but as a movie—albeit a very boring one due to its repetitiveness (Pottage and Sherman 2010, 84). Even when the invention was thought of as a thing (as in the case of the machine) it was, in fact, always already a process.

[7] United States Court of Appeals for the Federal Circuit, In re Bernard L. Bilski and Rand A. Warsaw, 2007-1130 (Serial No. 08/883,892), Newman, Circuit Judge, dissenting, p. 31.

[8] In this sense, information-based inventions may be seen not as the opposite of material inventions in general, but rather the opposite of chemical inventions—'composition of matter' in US patent law parlance—where the specificity of the matter involved is paramount.

[9] *US Constitution*, art. 1, §8: 'The Congress shall have Power To… promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries.'

[10] Official Transcript Proceedings Before the Supreme Court of the United States, Bernard L. Bilski and Rand A. Warsaw, Petitioners, v. David J. Kappos, Under Secretary of Commerce for Intellectual Property and Director USPTO, Case No. 08-964, November 9, 2009, 9.

[11] *Ibid.*, 7.

[12] *Ibid.*, 18.

[13] 'The statute defines the term 'process' as a 'process, art or method [that] includes a new use of a known process, machine, manufacture, composition of matter, or material.' §100(b). But, this definition is not especially helpful, given that it also uses the term 'process' and is therefore somewhat circular' (Bilski, 11, Stevens, J. concurring in judgement)..

[14] 'While he shuts the door against inventions of other persons, the patentee would be able to avail himself of new discoveries in the properties and powers of electro-magnetism which scientific men might bring to light. For he says he does not confine his claim to the machinery or parts of machinery which he specifies, but claims for himself a monopoly in its use, however developed, for the purpose of printing at a distance. New discoveries in physical science may enable him to combine it with new agents and new elements, and by that means attain the object in a manner superior to the present process and altogether different from it. And if he can secure the exclusive use by his present patent, he may vary it with every new discovery and development of the science, and need place no description of the new manner, process, or machinery upon the records of the patent office. And when his patent expires, the public must apply to him to learn what it is. In fine, he claims an exclusive right to use a manner and process which he has not described and indeed had not invented, and therefore

could not describe when he obtained his patent. The court is of opinion that the claim is too broad, and not warranted by law' (*O'Reilly v. Morse [1853] 56 U.S.* 113).

[15] It is anachronistic to talk about 'claims' of a patent prior to the modern regime of patent specification, but find the analogy productive in this specific discursive context.

[16] I am compressing a substantial amount of historical evidence into a synthetic claim that may seem to go against the familiar fact that in some countries, patents were granted to inventions that were described through texts, diagrams, or models. I have argued, however, that such evidence was neither enabling (insufficient to allow for the reproduction of the invention by a third party) nor sufficient to identify the invention. My claim is that the legal (not the technological) notion of invention did not emerge till the end of the eighteenth century (Biagioli 2006, 1132–40).

[17] The ultimate utility of the invention rests on its diagnostic role, that is, the ability to guide therapeutic actions. In this sense, one could say the effects of the invention start in the diagnostician's mind but then unfold in actions external to that mind.

[18] Brief for Amicus Curiae Law Professor Kevin Emerson Collins in Support of Neither Party, in re Bilski, 545 F.3d 943 (Fed. Cir. 2008) (No. 2007-1130).

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