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Three Factor Model: Some ideas about the Relationship between Law, Science and Technology

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Abstract
This paper argues that the relation between law, science and technology cannot be understood without taking into account a number of intervening factors, identifying which makes it necessary to approach the question from the standpoint of disciplines other than law and science themselves. Understanding this relationship would help us to explain why the law takes some scientific and technological advances into account while discounting others.
I present three such intervening factors, namely (a) paradigm shifts, (b) socioeconomic consequences, and (c) public debate, which I package into a model that brings out their interrelations: the more a particular technology goes through the stages described by these factors, the likelier it is to become the subject of regulation by law.
In the second part of this paper I address the role that law plays once a public debate on specific technology is underway: I postulate the view that the law seeks as far as possible to retain its old forms in implementing the view or policy forged, tending to pour new wine into old bottles rather than find new bottles for the new wine. A number of reasons account for this, but the one I focus on is law's specific mode of reasoning, that is, law reasons from analogy and metaphor, tending to preserve continuity with the past rather than breaking with it. I illustrate these ideas with the help of different cases related to IT law, in particular patent law and copyright law as they evolved in the US.

Keywords
Law; Science and technology; IT law; Research science; Regulatory science.

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> Like enemies cast in a lifeboat, the realms of technology and law are forced to face each other, despite their differences in pace and intention. (Karnow 1997, 2)

Introduction

The basic thesis of this paper is that the relation between law, science and technology cannot be understood without taking into account a number of intervening factors, identifying which makes it necessary to approach the question from the standpoint of fields and disciplines other than law and science themselves. Understanding this relationship would help us to explain why the law takes some scientific and technological advances into account while discounting others.

There are three intervening factors I present in Section 1 which enter and mediate between law and science: (a) paradigm shifts, (b) socioeconomic consequences, and (c) public debate. The first factor involves a philosophical discussion (section 1.1); the second, as its label suggests, is a matter to be investigated through a study in economics and sociology (section 1.2) ; and the third factor, public debate, I understand as debate such as you see unfolding on the political stage, and that would properly involve a study of politics (section 1.3). The three factors in question are purposely broad and subject to interpretation: they need to be applied to the case at hand—to the specific technology in question—to understand what they mean and what role they play in framing that technology's relation to law.

Having identified these three factors, I package them into a model that brings out their interrelations. And while I do not pretend this is an empirical model, I do believe that the more a particular technology goes through the stages described by these factors, the likelier it is to become the subject of regulation by law.

In the second part of this paper (Section 2) I address the role that law plays once the technology has reached the final stage of this model, namely once a public debate is underway: then the need is clear to think about how the technology in question ought to be regulated. A solution needs to be forged, offering a way to harmonize all of the competing interests, claims, and values at stake. What happens in this process, or how it unfolds, is something I work out in Section 2.1 by considering science in two roles that have been ascribed to it: (a) as research science, where the technology in question is first developed; and (b) as regulatory science, once the technology has made its way into the public debate, and law invokes science as a source to look to in understanding the new phenomenon as it relates to society. These two roles may be concurrent, but regulatory science does not come into play until (i) after research science has introduced a paradigm shift with social consequences and a public debate and (ii) lawmakers and policymakers have invoked it.

The input of regulatory science, and all the voices emerging from the public debate, then enter the public forum, where different views compete to decide on what the best way to regulate the new phenomenon might be (section 2.2). The law, or rather the people who make law and design policy, need not respond coherently in the process—especially since they all participate as both players and umpires in this game, which takes place in the public forum—but eventually something like a policy takes shape: the law takes this multiform input (heeding many concerns, none of which can be said to prevail over others in any definite way) and forges out of it a shared view, or a policy, under which to regulate the phenomenon in question.

One important feature that can be observed in this dynamic is the inertia law retains as an essentially conservative institution. That is, I postulate the view that the law seeks as far as possible to retain its old forms in implementing the view or policy forged in the crucible of debate, tending to pour new wine into old bottles rather than find new bottles for the new wine. A number of reasons account for this, but the one I focus on is law's specific mode of reasoning, that is, law reasons from analogy and metaphor, tending to preserve continuity with the past rather than breaking with it. I illustrate these ideas with the help of different cases related to IT law, in particular patent law and copyright law as they evolved in the US.

But before we begin, I premise this discussion by briefly clarifying what I mean by the terms *law* and *science and technology*. Law will be understood in a strict sense as the body of written law—both statutory and case law, plus rules and regulations—as it pertains to a given subject matter. But since some of this law may be dead letter, and since the law is otherwise on the books because it needs to be applied, I will also refer to law in a broader sense as inclusive of the interpretive activity that surrounds it. Thus, Ross spoke of the law as "an abstract set of normative ideas which serve as a scheme of interpretation for the phenomenon of law in action" (Ross 2004, 18). And Gray referred to it as a set of "rules which the courts [...] lay down for the determination of legal rights and duties" (Gray 2009, 82).

The terms *science* and *technology*, for their part, are typically used in combination. The distinction between them is roughly that between theory and practice, technology being the use and application of what scientists discover. This means that it is impossible to think about a technology without thinking about underlying scientific theories and assumptions (or at least a technology that brings those theories and assumptions into play), entailing an "inextricable connection" (Tallacchini 2009, 274) between the two terms of the relation. So, as much as an intuitive distinction can be drawn between the two terms, *science* will be understood as inclusive of both science and technology (since I am less concerned with science as a set of theories about the world and more concerned with it as the activity of making useful discoveries) and *technology* will be understood as the employment of science for a useful purpose. Hence the close bond and interconnection between them.

1. The Three-Factor Model

As I have already mentioned, the basic idea behind the three-factor model is that a new scientific or technological development is more likely to come up on the radar screen of the law according to the extent that (a) it introduces a new paradigm in its area of research; (b) it carries socioeconomic consequences, or at least it *threatens* to do so, unsettling the established order; and (c), as a result, it gives impetus to a public debate originating within society at large and escalating to a public and political level, where finally it may find a point of contact with the law. So, in summary, the idea is that the more a technology does these things, the likelier it is to come under the purview of the law.[1]

The three factors in question are purposely broad and subject to interpretation: they need to be applied to the case at hand (to the specific technology in question) to see what they mean and what role they play in framing that technology's relation to law. Of course, I do not pretend my scheme to be a general rule. And in fact there have been cases where law has come into play *before* any socioeconomic consequences or public debate ever had a chance to take place. The law might act in this preventive role because the earlier it intervenes—that is, *before* the onset of any socioeconomic consequence or public debate—the more effective it will be at shaping the new technology in keeping with public policy, while the technology is still pliant.[2]

Another feature of the three-factor model, is that its three constitutive factors—new paradigm, socioeconomic consequences, and public debate—come into play in *that* order. Hence, conceivably, there can be no social consequences without the technology first introducing a paradigm shift, nor can there be a public debate about something that entails no social consequences. Having said that, we can now take up the three factors in turn.

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[1] This idea is not new. In fact, I consider it to be something of a truism. Bennet Moses (2006, 509), for instance, has put forward the similar hypothesis that the more people are affected by a technological advancement, the more will this increase a general public awareness of that technology, and the more urgent will be the need for political, legal, and professional institutions to respond.

[2] One instance in which this early intervention seems particularly called for is when the technology in question seems to attack a core human value. Thus, the law stepped in early to ban human cloning, before the procedure could ever be carried out, since such a practice would clearly undermine human dignity, as well as equality among humans, the sanctity of human life, and the values revolving around the ideas of a family. As much as (to the best of my knowledge) no human being has ever been cloned, the very idea of such cloning has been reason enough for it to be prohibited under the European Charter of Fundamental Rights and the United Nations Declaration on Human Cloning.

1.1. First Factor: Paradigm Shift

I will not be concerned here with scientific and technological developments as such, or how they come about, because that would involve us in a number of epistemological issues falling outside the scope of this discussion. My focus is rather on the *consequences* of a new scientific or technological development, especially as these consequences may travel beyond their own native field of study and spill over into other fields, and even into society as a whole. Central to such an account will be the idea of a paradigm shift.

Before we proceed any further in this account, I will thus lay the groundwork for this construction by presenting two related theses. First, I stipulate that in order for something to become a new paradigm, it must be significant enough to have consequences. This makes paradigms different to simple innovations: when we innovate, we improve or perfect something *within* an existing paradigm; in a paradigm shift, by contrast, we step *outside* the current paradigm and move into uncharted territory, and that means we are thinking "outside the box," as the expression goes, literally outside the old paradigm. Whence the consequences inherent in, or necessarily entailed by, a new paradigm.

I further stipulate that a paradigm shift is a necessary, but not a sufficient, condition for these consequences to take place: necessary because anything less meaningful than a paradigm shift is only a *refinement* of the prior art, and so by definition it cannot do anything more than what the prior art has done.[3] At the same time, though, while paradigm shifts are *necessary* for any consequence outside their native scientific domain, they are not thereby *sufficient* to bring about such broader consequences.[4]

With these two stipulations in place, we can illustrate what the full paradigm cycle would look like with its consequences extending beyond science and into society, thereby rolling out the entire three-factor model. We start with a new paradigm in a given scientific or technological field, and by definition this new paradigm will cause that field to "reprogram" itself (first factor): this reframing of theory and practice within a scientific field we might call an *internal* consequence, because we are still within its place of origin. Now, if we assume that this new paradigm is significant or perturbative enough to extend beyond these boundaries, it will first affect related disciplines and will then spill over into society at large (second factor), whereupon it will set in motion a public debate (third factor).

However, the three-factor model does not necessarily work itself out completely, and for this reason we are first going to consider what the paradigm shift is.

1.1.1. Kuhn and the Structure of Scientific Revolutions

As we know, it was the philosopher Thomas Kuhn who introduced the term paradigm shift (Kuhn 1962) as a device by which to distinguish science from nonscience: his initial interest lay in distinguishing physics from the social sciences. He noticed that, while physicists widely agree on the main problems to be investigated, the methods to be used, and the research directions to be followed, social scientists are very much at odds with one another in all three respects, failing to agree on the important issues, the proper methods, and the direction of future research. In physics, then, scientists are focused on certain issues, which are studied in certain established ways, and the discussions regard the results more than the methods by which to achieve them. In the social sciences, by contrast, results do not matter anymore than the issues themselves, and in fact everything is open to question, not just the issues worthy of study but also the methods by which to study them and the results achieved. This discrepancy between two fundamentally different ways of doing research and facing scientific challenges is one problem which Kuhn set out to investigate and explain, and to solve which he advanced his theory of scientific revolutions with its component idea of a paradigm shift.

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[3] Note that this does not rule out socioeconomic consequences and a public debate owed to sources *other than* a new paradigm. This is because it is specifically as a *scientific* construct that a paradigm acts in this role. So, while the *idea* of paradigms can be extended to fields and areas of activity beyond the scope of science, it is only as part of a scientific undertaking that in the three-factor model a new paradigm acts as a necessary condition of socioeconomic consequences.

[4] This is because (a) paradigm shifts are an intuitive notion, thus open to interpretation, and (b) this is not an empirical theory of social change, which is to say that the three-factor model is precisely that, a model, and not a predictive, testable account with law-like statements.

Another such problem was to explain how it is that scientists at any one time can believe claims and theories that later turn out to be manifestly false. For example, how could scientists once have believed that the earth was propped up by three elephants? Were these scientists less clever than scientists after Galileo? How could subsequent generations of scientists observe the same things as the previous generations and see things differently?

Kuhn saw a parallel between the two problems at issue—that of the social sciences versus physics, and that of the patent erroneousness of past scientific beliefs—and found the key to both of them in what he called a paradigm. He observed that scientists and researchers work in communities, and that each such community works within a shared complex of basic assumptions, beliefs, attitudes, and methods: each such complex makes up a research paradigm, and paradigms mark the passage from the scientific beliefs of the past to those of the present. He explains this shift in narrative fashion by drawing a distinction between "normal science" and "revolutionary science." Normal science is described by Kuhn as a puzzle-solving activity, meaning that there is a basic framework within which scientists operate: there is a problem to be solved (the puzzle), and there is a solution to be found, following certain established rules. The whole of a given science is thus set up as a cumulative enterprise, or as a big jigsaw puzzle that scientists work at to gradually compose, piece by piece, identifying these pieces and putting them in the right place. Once every while, however, the scientists come upon an odd piece that cannot find a location, so these pieces are set aside as anomalies and do not make it into the big picture. But in time, as more and more of these anomalous pieces crop up, the scientists will begin to take a second look at their puzzle, and in so doing they will discover a puzzle within the puzzle: this realization sets the stage for the emergence of revolutionary science. A tension emerges as scientists find that the two puzzles bear little resemblance to one another: the older puzzle and the newer one—normal science and revolutionary science—cannot be made to cohere, so much so that Kuhn describes them as incommensurable and it is in virtue of this incommensurability that a crisis is provoked in normal science, with some scientists supporting the new science and others rejecting it, arguing that the correct puzzle-solving technique rests with normal science. But if more anomalous (or incommensurable) pieces come in and pile up, scientists will increasingly feel that such evidence can no longer be ignored and will accordingly set out to compose a new puzzle by which to explain the anomaly. This new puzzle—the revolutionary science making up a new paradigm—thus emerges from the breakup of the old puzzle (normal science within the old paradigm), and with this new puzzle comes a new agenda for scientists: consensus will build around a new set of problems and methods, at which point the new paradigm will have established itself and will persist until a new crisis sets in (as new anomalies mount), calling into question the old establishment and requiring a new way of thinking (a newer paradigm still).

The scientists supporting the new paradigm will also agree on what this paradigm entails for their field of research. This agreement or consensus of the scientific community serves as a criterion by which to distinguish scientific disciplines from nonscientific ones: where no such community-wide consensus exists, there you have a nonscientific discipline; consensus around a single research paradigm, Kuhn observed, is specific to the hardcore sciences, and he thought this was not incidental—there must be a reason for it—so the presence of an agreed paradigm became for him a litmus test, on the basis of which to class physics as scientific and philosophy, linguistics, law, and sociology, among many other disciplines, as instead lacking scientific status.

However, my interest in Kuhn's idea of a paradigm lies not in its use as a device by which to distinguish one discipline from another but in the use we can make of it to explain how theories and ideas change over time. I therefore extend the idea to see how it applies to the relation between science and society.

1.1.2. Kuhn's paradigms in the Three-Factor Model

I will not be concerned here with scientific and technological developments as such, or how they come about, because that would involve us in a number of epistemological issues falling outside the scope of this discussion. My focus is, rather, on the consequences of a new scientific or technological development, especially as these consequences may travel beyond their own native field of study and

spill over into other fields, and even into society as a whole. Central to such an account is the idea of a paradigm shift.

Before we proceed any further in this account, however, the caveat must be introduced that paradigms and paradigm shifts are understood here to be intuitive concepts, not rigidly defined ones. This means, in the first place, that we must exercise judgment in deciding whether something counts as a paradigm or a paradigm shift; the entire construction being offered here is subject to interpretation, especially in view of the difficulties involved in finding consensus on what counts as a paradigm or a paradigm shift. And, in the second place, the intuitive nature of the concept of paradigm means that the construction built around this concept will likewise be intuitive.

At the same time, though, intuitive should not be taken to mean "vague and formless." I will thus lay the groundwork for this construction by presenting two related theses. First, I stipulate that in order for something to become a new paradigm, it must be significant enough to have consequences. This makes paradigms different to simple innovations: when we innovate, we improve or perfect something within an existing paradigm; in a paradigm shift, by contrast, we step outside the current paradigm and move into uncharted territory, and that means we are thinking "outside the box," as the expression goes, literally outside the old paradigm. Whence the consequences inherent in, or necessarily entailed by, a new paradigm.

I further stipulate that a paradigm shift is a necessary, but not a sufficient, condition for these consequences to take place: necessary because anything less meaningful than a paradigm shift is only a refinement of the prior art, and so by definition it cannot do anything more than what the prior art has done. At the same time, though, while paradigm shifts are necessary for any consequence outside their native scientific domain, they are not thereby sufficient to bring about much broader consequences. This is because (a), as pointed out a moment ago, paradigm shifts are an intuitive notion, thus open to interpretation, and (b) this is not an empirical theory of social change, which is to say that the three-factor model is precisely that, a model, and not a predictive, testable account with law-like statements.

1.2. Second Factor: Socioeconomic Consequences

The three examples just made illustrate the interconnectedness between the three factors making up the three-factor model being fleshed out in this discussion. This means that, while these factors can each exert their own independent force on the law, it is only in combination that they come to fruition and actually wind up calling the law into play. Thus, the first factor (paradigm shifts), may be a necessary condition for law to take notice of a new technology, but this move will not come into effect until the consequences entailed by that technology begin to work their way into the socioeconomic fabric of life and these consequences become a matter of public concern.

The biotechnological paradigm introduced in agriculture illustrates this last point, since in changing the way we grow crops and produce foods, the biotechnologies have also prompted us to ask questions we had never thought about before: Is it safe to feed chickens with chicken meat and bone meal? Are genetically modified tomatoes good or bad? Will genetically modified crops help us fight world hunger? Aren't we going against nature by genetically modifying animals for research? What all these questions have in common is that they are prompted by a deeper concern with the way the new technology in question may change our form of life, thus getting us to rethink the given.

This concern with our form of life may seem remote and philosophical, something for the speculative mind to consider, but it is more earthbound than one might at first assume. Indeed, the discussion is deeply moral—involving the practical question of what to do—and we wouldn't be relating a new technology to a form of life in the first place unless there was a question about human good and harm at stake in the new technology, thereby putting the moral question front and center.[5] And this material element (human good and harm) is by definition not trivial: it need not be abstract and far removed from where we are today.

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[5] The expression *human good and harm* is Philippa Foot's (1981). It relates to the question of how to go about specifying *moral* subject matter as distinct from what is nonmoral. On Foot's content-based approach, something becomes moral by virtue of its involving a *material* element (human good and harm), against a formal or a prescriptive element.

Thus, as we have seen, the biotechnologies—and I take this to be true of all technological advancements that come within the purview of the law—entail economic consequences as well as bringing economic opportunities. High-tech industries (such as pharmaceutics and ICT) account for 23% of the total economy worldwide, and medium-tech industries (such as chemistry and transportation) account for 39% (OECD 2009, 7). This inevitably draws the attention of investors and governments. In the United States, for example, biotechnology is both an area of research and an industry, so much so that in no other area is there a more conspicuous effort to market and exploit scientific knowledge (Etzkowitz and Webster 1995, 485), with $25 billion invested every year in the technologies (more so than anywhere else in the world). It is no surprise, then, that economists predict that the 21st century will be the century of the biotechnologies (OECD 2009, 62). The private and the public sectors are both involved, and the amount of investment is reflected in the number of patents for biotechnological inventions issued worldwide.

1.3. Third Factor: Public Debate

It was noticed in the last section that the three factors in the three-factor model are interconnected, and this holds in particular for the second factor in relation to the third: socioeconomic consequences in relation to public debate. Which is to say that we do not just sit idly by and watch these consequences as spectators; instead, we engage in the process through which they happen, and we do so by staging a public debate, not all of us together on one giant stage, of course, but in the communities through which such change is experienced. Something becomes part of the national conversation not by virtue of an overarching coordinated effort, but through the many voices that spring up at the grassroots level. On the upside, this makes for a pluralist polity whose diverse makeup and many perspectives are all brought to bear in forging a public policy or in reaching a consensus. But this is never a smooth process, as anyone can bear witness who has seen a public debate make its way forward, or otherwise get stalled, in the various forums where such debates are staged, from national television to the town-hall meeting.

There are many ingredients that factor into the process, which depends on a delicate balance of forces, and two of them that figure prominently are what I would call interests, on the one hand, and concerns, on the other: both can take imperfect or degenerative forms—as *special* interests in the former case and fear in the latter—and can thereby seize up a public debate by distracting its participants from a concern with the common good. And as much as the democratic process is designed precisely with this end in view—that of forging and maintaining a conception of the common good, or of a general welfare—we know how long this process can take (for it is an *organic* process involving many voices) and how easily it can get derailed in the attempt to achieve its purpose. So, where the biotechnologies are involved, there are interests and concerns that drive the debate on the proper use of such technologies: our interest is that the biotechnologies be used to advance human welfare; our concern, that they may be used in such a way as to instead bring about adverse effects (as would happen if human cloning were allowed). So far, so good. But as was remarked a moment ago, there are many elements that go into the process, and any number of circumstances may contribute to throwing it off balance, by causing the focus of debate to narrow down to something less comprehensive than the common good. When this happens, interests become *special* interests, and concerns are magnified into fears.

Regardless of how the public debate proceeds, however, the general rule applies whereby public awareness of a new scientific or technological development, and hence the public debate surrounding such a development, increases in parallel with the scale of the impact, or even the *perceived* impact, which the phenomenon is bound to have on society. And once a public debate is underway, law and politics are engaged in a complex multilateral process by which to forge a public policy, attempting, or at least purporting to attempt, to take everyone's interests into account with respect to the technology at issue, at which point the policy so developed is made into law (unless it has otherwise gone through the courts). So, while connected with the two accompanying factors (paradigm shift and socioeconomic consequences), public debate is what finally enables a new technology to reach critical mass, as it were, and become a subject of regulatory activity. And it can also be observed in this regard, by way of a general rule, that this point of contact is more likely to be

established where the technology in question is a novel or emergent phenomenon (as is the case with ICT and the biotechnologies), for this is more likely to spark public debate: the technology will in this case "receive much more regulatory scrutiny than old-fashioned ones" (Huber 1983, 1025).

I conclude here by noting with Tallacchini (2009) that the reason why science and technology become political in the manner just described is that, on the one hand, they play a key role as drivers of socioeconomic change, but at the same time they tend to draw forth a sort of public scrutiny. In fact, with Kuhnian scientific revolutions and the developments that followed, we have come to be much more ambivalent toward science: no longer is science simply regarded as a cumulative, evolutionary enterprise tending toward greater and greater knowledge, and hence as a force for positive change working for the greater welfare of all, nor do we espouse any more the scientist's view that "any meaningful question can be answered by the methods of science" (Stanford 2009); instead, we have projected the fallibility of human knowledge onto science itself, so that we no longer view science indiscriminately as a force for good but as a potentially threatening or harmful activity. For this reason—that is, owing to this twofold status of science as an activity at once progressive and potentially baneful—public debate around science inevitably ensues. Science and technology necessarily invite broad discussion: they can no longer be "confined within the labs, and so they find themselves forced to make the entire world their domain of experimentation" (Tallacchini 2009, 273–4; my translation). In this way, public debate becomes part of the very process of science, so much so that Justice Brandeis found as early as 1927 (*Whitney v. People of State of California*) that such debate is actually a political *duty*, insofar as the "the path of safety [from the harm which science may cause] lies in the opportunity to discuss freely supposed grievances and proposed remedies." A continuous line can thus be traced from the lab to the law, and the medium through which the connection is established is public discussion, now viewed as an integral part of science and so as something that cannot be bypassed.

2. Law's Role in Shaping the Relationship between Scientific-Technological Development and Society

As already discussed above, the kind of scientific-technological advancements we are interested in usually come within the scope of the three-factor model, stipulating (a) a paradigm shift, (b) socioeconomic consequences, and (c) a public debate, as factors enhancing the likelihood that such an advancement will become legal subject matter. But these dynamics—describing how law comes to regulate science and technology—cannot be fully grasped without considering the larger interaction between law, science-and-technology, and society.

The law plays an important and multifaceted role in this complex relation. On the one hand it regulates the scientific and technological developments shaping their use and application to fit society's needs, calm down its concerns and stop those who want to use the advancements only for their own benefit. One such case was the attempt Hollywood studios made to stop Sony from selling the Betamax video recorder. Such a recorder made copies of copyrightable works and thus infringed the rights of the copyright owners. Nevertheless, the Supreme Court ruled that this device could also be used for purposes which did not infringe copyright and therefore the Supreme Court did not want to let copyright owners dictate the design of tools and instruments for copying or recording, as this would stop "the wheels of commerce".[6] This is only one example where the law stopped the attempt to shape technological development in a direction that led to the good of one industry but not to the benefit of the whole of society.

But on the other hand, the law also takes part in shaping society to accept a certain direction of scientific-technological advancement as the best possible one for all of us. Granick (2007, 1) suggests that legal regulation has a role to "comport with the values and desires of the public and propose a way that individual interests could be better enshrined in public policy." This is clear, for example, from the politics undertaken in the regulation of In Vitro Fertilization: an individual's wish for an offspring and technological advancements to satisfy it should not go against the common values of human dignity and human life.

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[6] Sony Corp. V. Universal City Studios, Inc., 464 U.S. 417 (1984).

In particular technology can change the law if it presents the legal system with the following premises (Bennet Moses 2006, 507):

(1) the nature of the technology requires that the legal process ban it, or limit its practice: this happened, for example, with the technologies that enable human cloning;

(2) technology creates new uncertainties, highlighting legal ambiguities: this is what happened to the requirement of "creativity" when the legislator decided to protect programs under the copyright law;

(3) technology outdates the existing technological assumptions regulated by law: this is why, for example, multimedia works are subject to legal controversies as they possess the characteristics that the copyright law is based on, but at the same time defeats its conviction that it is impossible to unite different works in one;

(4) technology presents the law with the cases that makes it over (under)–inclusive with respect to the particular technology: this is the case of the Virginia state law that prohibited the selling of not self-replicating body parts. This norm was foreseen to prevent the cases of selling kidneys, but In Vitro Fertilization expanded the domain of non-self replicating body parts by working out techniques to separate and maintain ova. Therefore, this norm also included ova, which obviously cannot be compared to kidneys. So, this law was considered to be over-inclusive and consequently amended in 1991.

The technologies are brought under the purview of law by society, by individual groups, movements and organizations through the public debate: when the mores and conventions of society are modified or created anew by new scientific and technological events, the law reflects these modifications and changes, legitimizing a particular shape of technological advancements. And vice versa, it is society that is shaped by law once those mores and conventions find judicial and statutory form, and if law legitimizes or regulates their modifications or new updates, society is forced to accept these modifications and changes, and reorganize its order correspondingly.

Granick (2007, 1) sees in the law's attention to public debate caused by technological advancement "an underlying consent: what the public wants is what the public should have, with only narrow exceptions in the case of medical safety and the rare market failure." I do not fully agree with this statement, as what the public wants is quite often not that clear to the public itself: the public wants tomatoes in December but does not agree to genetically modify them in order to make them last that much; the public wants free access to music online but whenever this access regards their own creation, the public changes its mind and asks for more complex Digital Rights Protection (DRM) systems and more severe punishments for their infringement; the public also wants to spend less time in traffic or travelling, but doesn't want to think about the pollution they produce using aircraft; the public wants a better planet for the next generation, but doesn't want to renounce the use of petroleum; the public also wants healthy babies but also questions pre-natal research on the fetus. This is why I see the public as contradictory and sometimes the law is the right tool to bring about more linearity to the public's reasoning, reminding it of the hierarchy of values our societies are committed to.

But what science does the law base its shaping of technology and society on? Or rather whether and, if yes, how, does science change when it goes through my three factor model? Does it remains the same when it goes through all of the three factors? I will try to answer these questions in the following section where I introduce the distinction between regulatory science and research science, the former being the point of reference for law and the latter the point of reference for science itself, and I will explain how research science becomes regulatory science once it goes through my three factor model.

2.1. Research vs. Regulatory Science

What I am arguing is that when the law starts to pay attention to a specific scientific-technological phenomenon, the law does not look at the phenomenon's original scientific-technological domain (research science) but looks at its socially shaped reflection (regulatory science).[7] I am arguing that

[7] The term "regulatory science" was developed by Sheila Jasanoff (1998, 76–7) where she describes it as "science used in policymaking" which purpose is to "produce 'techniques, processes and artifacts' that further the task of policy

law does not go to laboratories, it doesn't go to hospitals, research centers, doesn't introduce itself among the white-dressed chemists or nuclear physicians. Rather, it is inspired by the social dimension of science, the dimension that public debate had attributed it with: this is exactly what Tallacchini (2009, 271) brings our attention to, highlighting the tendency of law to progressively colonize new domains of social regulation, the domains which are defined by science and technology.

So, following my three factor model and arriving at the last of them, that is a public debate on the issues that scientific and technological developments gave rise to, the first thing the law does is to look at the science: but what it takes into consideration is not the scientific knowledge as such (which I call research science) but the science already shaped by its social implications, modeled by stakeholders (such as industry) and "masticated" during the public debates (this science I call regulatory science).

These two sciences are the two sides of the same scientific or technological advancement: when this advancement is making its way through the barriers of scientific defeasibility, testing and experimentation, it is a part of research science's domain, while at the moment in which it steps out of the lab, and faces the vast number of applications in the real world, causing the changes in our way of living both in good and in bad, and provoking in us respectively enthusiasm and disagreement, then it becomes an object of regulatory science, and consequently an object for legal scrutiny. This idea is also reflected by Karnow (1997, 89) who observes this passage and argues that "transfer of technology from the defense, research and academic settings to the commercial and consumer contexts will pose interesting and difficult issues, both technical and legal." In fact, this is what happens to technological advancement that leaves research science and enters to make part of regulatory science.

What distinguishes research science from regulatory science is that the former's focus is the search for the truth about certain possibilities or phenomena, while the latter's is the search and fight for credibility: the social group that will prove to be most credible in the eye of the legislator, will influence the legal regulation. This is why each group tries to shape and model the scientific truth (research science) on the basis of a group's framework of values and interests, working out their model of science (research science) and presenting it as the only one corresponding to the real state of things (that is the most credible).

The difference described above between regulatory and research science also presumes the difference in roles that the scientists and technologists play in each of them: if in the latter the scientists represent certain and neutral knowledge of the scientific community (Tallacchini 2009, 274), in the former their knowledge becomes a part of scientific-political decision making where there are no certainties and neutrality.

The prevailing version of regulatory science then we will find in the form of "prescriptive descriptions" (Tallacchini 2009, 274, my translation) that accompany numerous European and international legal acts under the word "whereas": these "prescriptive descriptions" then should be seen as a form of "protected truth which validity doesn't depend on the scientific consensus" or, in other words, on research science.

Bennet Moses (2006) has a similar idea: she argues that the law is not interested in the scientific-technological knowledge per se (that is research science seen as a development of "what you can know") but in the conduct that that scientific-technological knowledge enables us to do (that is, regulatory science seen as the development of "what you can do"). In other words, law is not that interested in what we can know (research science) as the knowledge as such doesn't have influence on others, but rather in what we can do with that knowledge (regulatory science) and therefore from a purely legal perspective, "how carefully the use of various technologies is monitored, is, as a rule, more important than the capabilities of the technologies themselves" (Etzioni 2007, 119).

The idea of research science versus regulatory science is also reflected in Callon's (1995) four models describing the dynamics of science: research science corresponds to his first two models, that describe science as a rational knowledge (Model 1) and as a competitive enterprise (Model 2). Both these models are governed by pure science and represented by scientists themselves, who raise the

(Contd.)

development." I use this term in a slightly different way, highlighting its importance for legal regulations (which could be seen as a sub-class of policy development).

questions, discuss and argue, but none of this trespasses on the boundaries of the scientific domain. The passage from research science to regulatory science would require passing to Callan's Model 3 and addressing scientific development as socio-cultural practice, which involves not only academic and scientific actors, but also policymakers, industry, media and others. Here the research science is fragmented into socially or economically relevant and irrelevant issues. This process is also known as "politicization of expertise" (Martin and Richards 1995, 512), which means that scientific-technological knowledge is fragmented by groups and each group selects the scientific-technological claims that support their arguments. This is how a new scientific construction would be built: this construction I present under the name of regulatory science, and this is the science that supports the law and on which legal decisions are built. These legal decisions then directly influence research science.

2.2. Translation, or Pouring New Wine into Old Bottles

We saw in the last section how law tends to regulate new technologies by relying on regulatory rather than on research science, this is an effort to balance and work together the interests of all those who stand affected by the socioeconomic changes introduced by such new technologies. We now take note of the larger aim involved here, that of promoting stable social relations. Indeed, law is widely recognized as an essentially conservative institution serving the function of ensuring stability through change. So in this section we are going to consider the way in which law plays this stabilizing or system-preserving function. Which is to say that, operating on a principle of legal inertia and economy, the law will, whenever possible, refrain from fashioning new rules and forms specifically tailored to the scientific-technological phenomenon in question, attempting to instead deal with such a phenomenon by bringing to bear its old rules and forms: borrowing a metaphor suggested by Lawrence M. Friedman (2005, xii), we might say that the law will tend to pour new wine into old bottles rather than find new bottles for the new wine.

So, we have here a case involving the broad question of how to deal with new technologies, or, more to the point, how new technologies can be brought under the purview of laws designed to regulate the older equivalents of those technologies, or again how to preserve the rationale of a law or legal doctrine when the technology in question changes, in such a way that the background assumptions about the technology are no longer what they were when the technology was older. This is an example where we can observe the law's role of ensuring stability through change, and the process is one that Lessig (2006, 160) calls "translation," for it involves identifying the *gist* of a law or doctrine, its core value or principle, and determining how it applies to the changed circumstances brought about by the new technology in question.

An example of a technology that has made it necessary to engage in this practice of translation is wiretapping. The two relevant cases here are *Olmstead v. United States* (1928) and *Katz v. United States* (1967), both of them heard by the Supreme Court.[8] In Olmstead, the defendants were bootleggers who had been running one of the nation's largest organizations of its kind, and they claimed that their right to privacy under the Fourth Amendment to the United States Constitution had been violated when the federal government tapped their telephones without a warrant (a court order giving a police officer permission to enter private property and search for evidence of a crime), arguing that the evidence so obtained could not be used in a court of law. The government objected, rebutting that no such warrant was needed, since there was no trespass involved in the wiretapping (no one entered anyone's property during the investigation), and so the Fourth Amendment simply did not apply. So the issue before the court, namely, whether wiretapping without a warrant constituted an invasion of privacy, turned on the question of whether wiretapping amounted to trespass.

Why does this involve translation, or pouring new wine (wiretapping technology) into old bottles (the protections afforded under the Fourth Amendment)? Because the constitutional protections in question, the Fourth Amendment protections against invasion of privacy, were framed at a time (in 1791) when the technology for invading someone's privacy was trespass. In other words, it was

[8] For a fuller account of these two cases as they pertain to translation in the sense here specified, see Lessig 2006, chap. 9 ("Translation").

assumed by the framers of the Constitution that "the right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures" (such is the language of the amendment) was something one could violate only by walking into someone's home and looking through their belongings. Wiretapping involves no such entry and so, the government argued, it could not be equated with trespass.

Clearly, the question whether wiretapping amounted to trespass had to be decided in such a way as to preserve the meaning of the constitution, for this is the whole point of having a constitution in place, especially a rigid one subject to judicial review, as is the case of the United States Constitution (on which see Ferejohn 2002, 58).[9] But how to do that? How to achieve such fidelity to the Constitution? Two competing strategies are available—one being translation and the other what Lessig (2006, 160) calls "one-step originalism"—and both can be found in *Olmstead*.

In one-step originalism, fidelity is achieved by a strict construction of the statute or constitutional provision in question, that is, by a literal reading of the relevant language. In *Olmstead,* this meant "repeating what the framers did" (Lessig 2006, 161), and since the framers intended the Fourth Amendment to apply only to trespass, it follows that only trespass amounts to an invasion of privacy. Wiretapping therefore *cannot* be equated with trespass, and the government was accordingly within its rights to obtain evidence through that method.

This is how the court wound up actually deciding the case, but there was a dissenting opinion written by Justice Brandeis, and this opinion took the view that Lessig (2006, 166) terms "fidelity as translation," the aim being to "translate the original [Fourth Amendment] protections into a context in which the technology for invading privacy had changed" (Lessig 2006, 161). Brandeis acknowledged that the Fourth Amendment as originally written applied only to trespass, but he argued that (i) there was simply no way for the amendment to have any broader application, since there was no wiretapping technology available at the time of its framing, and consequently (ii) the protections provided under the amendment were strong ones indeed, severely limiting the government's ability to carry out search and seizure, precisely because trespass was the only method by which to do so, and no trespass was deemed constitutional absent a warrant (or at least this had established itself as the Fourth Amendment doctrine by the time Brandeis was writing). So, if we wanted to keep the original protections in place, we needed to translate the original context of the amendment into its current one, and that required extending the scope of the amendment so as to cover wiretapping as well. On this view, then, fidelity to the constitution requires not *repeating* what the framers did, but finding its *current equivalent*: instead of maintaining the scope of the amendment, while diminishing its protections, you expand its scope so as to maintain its protections.

This latter view, fidelity as translation, embraces the idea of a living constitution, one "that evolves in response to changing conditions" (Balkin 2005), an idea which William J. Rehnquist has ascribed to Oliver Wendell Holmes, and which can be characterized as the logical outgrowth of the *general language* in which the Constitution was framed:

> The framers of the Constitution wisely spoke in general language and left to succeeding generations the task of applying that language to the unceasingly changing environment in which they would live. [...] *Merely because a particular activity may not have existed when the Constitution was adopted, or because the framers could not have conceived of a particular method of transacting affairs, cannot mean that general language in the Constitution may not be applied to such a course of conduct.* Where the framers of the Constitution have used general language, they have given latitude to those who would later interpret the instrument to make that language applicable to cases that the framers might not have foreseen. (Rehnquist 2006, 402; italics added)

[9] Compare Bognetti and Fellman 2006: "Constitutions, written or unwritten, must be distinguished according to whether they are 'rigid' or 'flexible.' Rigid are those constitutions at least some part of which cannot be modified in the ordinary legislative way. Flexible are those whose rules can all be modified through the simple procedure by which statutes are enacted. The United States has a rigid constitution, because proposals to amend the constitutional document adopted in 1788 must have a two-thirds majority vote in each house of Congress [...]. Great Britain has a flexible constitution because all of its constitutional institutions and rules can be abrogated or modified by an act of Parliament."

The italics in the passage just quoted serve to point out that this is where translation would have to intervene, where something develops in society which the original framers of the Constitution could not have foreseen, and which requires thinking about what they would have said had they in fact done so, in effect pouring new wine (a new socioeconomic development) into old bottles (into the general language of the Constitution), but in such a way as to remain faithful to the framers' original intent. The development in question, where we are concerned, is wiretapping technology, and though we saw a failure of translation in that regard in *Olmstead*, that is precisely the view that wound up prevailing in a case which overturned *Olmstead* almost forty years later.

In this more recent case, *Katz v. United States* (1967), the defendant, Charles Katz, had been convicted of illegal gambling on the basis of information that federal agents had obtained by planting an eavesdropping device in the phone booth he used to conduct his dealings. Katz challenged the conviction arguing that this amounted to an invasion of privacy, since the evidence used against him had been obtained without a warrant and therefore could not be used in court. So the facts of the case were analogous to those in *Olmstead*—they involved in either case a claimed invasion of privacy without physical trespass—but the rationale of the decision turned *Olmstead* on its head: it was found in *Katz* that the Fourth Amendment "protects people, not places," and privacy so conceived (as protecting people rather than places) can be violated without physical trespass. The Fourth Amendment protections against unreasonable search and seizure were thus translated into a context where new technologies made it possible to "search" people in ways the original framers could not anticipate. The effect of the ruling in *Katz* was therefore to make the Constitution context-neutral, and more specifically "technologically neutral" (Lessig 2006, 165), through an interpretive practice of translation that preserves the meaning of the Constitution by taking into account the changed circumstances of its application (rather than by sticking to the letter of the law).

The larger point of this illustration is that certain presumptions operate whenever a law or a legal doctrine or principle is framed, and that these presumptions change over time, thus making it necessary to consider the new context in which the law is to be applied. And this dynamic is not limited to wiretapping: it can be observed with respect to just about any technology across all areas of the law. Thus, (i) patents were created to protect mechanical and technical inventions for a twenty-year period, but now it protects software, which becomes obsolete as soon as five years after inception, and there is also patent protection for genes (about 20 percent of all human genes have been patented by the United States Patent and Trademark Office (USPTO)), even though patents were not conceived to cover products of nature or discoveries: there is no invention involved in isolating a gene, any more than there is in isolating the seed of a walnut from its shell.[10] Likewise, (ii) copyright protects literature and creative work generally, but now it also applies to work that cannot *essentially* be defined by virtue of its being creative, namely, software;[11] then, too, (iii) criminal procedure regulates the admission of evidence in court and is now dealing with the problem of deciding how to treat speech-recognition technologies in that respect; (iv) labor law, conceived to ensure decent working conditions and bring some stability in employer relations with trade unions, is now expanding its scope to cover new employment relationships born and carried out online, where the working conditions that trade unions have fought for are irrelevant; (v) data-protection law finds itself having

[10] An example of this is the ruling handed down in March 2010 by a New York federal district court in a case filed against the USPTO in May 2009 by the ACLU and the Public Patent Foundation, seeking to invalidate as both illegal and unconstitutional two patents which the biotech company Myriad Genetics held on two human genes associated with breast and ovarian cancer, and the ruling came down on the plaintiffs' side. Myriad Genetics is appealing the decision, but if it stands it will have significant implications for the biotech industry. The case is *Association for Molecular Pathology et al. v. U.S. Patent and Trademark Office et al*., and the opinion is available at http://thepriorart.typepad.com/files/aclu.v.myr I ad.opinion.pdf.

[11] It is not just lawyers who see parallels between software and literary works: some software engineers have argued that software "more closely resembles the temporal arts (music, literature) than the plastic arts (architecture, sculpture, painting). Software can be compared [...] to the text of a novel or poem, which has to be interpreted and performed." Another parallel is that software "comes in different versions and is distributed to the end-users in plenty of identical copies. Also from this perspective software has something in common with artworks such as books" (Northover et al 2008, 92–93).

to deal with issues emerging in connection with social networks, smart phones, and genetic research; (vi) contract law works on contractual frameworks for new types of goods and services; (vii) administrative law is devising schemes under which to set up e-democracy and e-government programs, all the while (viii) consumer-protection law is seeking ways to fight e-commerce fraud and deal with genetically modified foods; and, in an area similar to that previously discussed, (ix) the common law of trespass to chattels is being extended to cover trespass to intellectual property.

This is just a sampling of the examples illustrating how new contexts and technologies force the law to revisit its own assumptions. Then, too, there are different changes these contexts bring about, and so different assumptions that need to be revisited.[12] One such assumption is that of the boundaries between different areas of law. Take, for example, the longstanding distinction in the law of intellectual property between copyright (protecting works of authorship) and industrial property (covering inventions, trademarks, trade secrets, and industrial designs): this distinction has been losing force by a long process of attrition, and we can appreciate as much if we only consider the similarities that software bears to architecture work in this respect, in that both fall within the purview of copyright protection,[13] yet both can be patented,[14] meaning that they are at the same time treated as industrial property. This may have to do with the dual status of architectural works and software as artifacts involving both authorship (the realm of copyright) and invention (the realm of patent law). Indeed, architecture can easily be considered both a fine art and a useful art, so much so that these two sides are often thought of as closely bound up, indeed as inextricable: "Form ever follows function," said the architect Louis Sullivan in 1896 (Sullivan 1957, 205), establishing what would become the basic credo of modern architecture and industrial design, and introducing a view of architecture as an art no less concerned with the beautiful than it is with the useful, or the functional, if not more so. And software, for its part, is regarded by the law as a piece of writing, because that is what code essentially consists in: software is accordingly protected under copyright, yet it is so protected ignoring that software code does *nothing* on its own until it is coupled with a piece of hardware to make it functional, or make it *do* something, which is its intended purpose and is the reason why it would logically make more sense to protect software under patent law than under copyright.

This dual status of both software and architecture leads to all sorts of ambiguities. Thus, where architecture is concerned, we see that copyright protects (under the Berne Convention) both the building itself and its design (its plans and drawings), but it could be argued (Hooas 2006) that this defeats the essential point of copyright as protecting not the idea behind a work but its form of expression (the finished product itself). Or at least this is how we should reason if we take the building to be the concrete expression of a design idea expressed on paper (the blueprint), and if we assume that the finished product lies not in the plans for the building but in the building itself.

The same sorts of questions can also be raised with respect to software: Doesn't software code—chiefly protected under copyright, the realm of the creative—primarily serve the function of having a machine that will process data in a certain way? And isn't this the essential reason why we write code to begin with? Granted, a piece of code may be considered creative for the way it goes about solving a certain data-processing or computational problem, but isn't it primarily for this solution that we value such software? That is, do we not value code for what it *does*, or how well it *works*, rather than for its inherent beauty or elegance as a form of expression? Nor can the ambiguity of the distinction between form and content be confined to software and architecture alone: if copyright protects form, while patent law protects content, how come we can find inventions patented on the basis of their *form*? For we do have inventions based on the form of a propeller, a hull, a turbine, a lens, a container for liquids, and so on (on which see Frassi 1997, 335–68). So we have here

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[12] Cf. Bennet Moses 2006, 507, identifying four classes of problems with respect to the law's ability to keep up with technological change: under one such heading she notes how "existing rules may be based on explicit or implicit assumptions about technological feasibility that are no longer reasonable."

[13] Architecture does so under the Berne Convention for the Protection of Literary and Artistic Works (1886–1979).

[14] An example of patented architecture is US Patent 5761857, issued under the title "Lot configuration and building position and method for residential housing," which describes "a unique residential or commercial building lot configuration, building position on the lot, and method for locating buildings on adjacent lots."

a distinction on which hinges a core part of intellectual property law—since the question as to whether any creation of the mind is subject to copyright or to patent protection depends in large part on whether we are protecting its form or its content, its outward expression or its underlying idea—and yet little seems to fall neatly within this distinction outside the paradigm cases of literature, music, plays, and art, on the one hand, and inventions that *do* or *transform* something, on the other.

2.2.1. Law as an Interpretive Enterprise

What all this goes to show is that there is plenty of room for interpretation when it comes to applying the classic tests of copyright and patent protection. The originality standard in US copyright law seems pretty straightforward, requiring that a work be independently created (rather than copied from another source) and that it evince some degree of creativity; yet such creativity may simply consist of "some creative spark, no matter how crude, humble, or obvious it might be" (*Feist v. Rural,* 1991). It seems, therefore, that most *anything* counts as a creative spark, so long as we can see in it "the fruits of intellectual labor." In *Feist,* for example, creativity was recognized for the way the facts in a public phone directory had been selected and arranged, and even though this only amounts to a "thin" copyright, protecting only such aspects of a work as are original to its author, it does show that the bar for creativity is set quite low. And the same goes for the originality requirement for software in the EU: under Article 1(3) of the EU Software Copyright Directive, "a computer program shall be protected if it is original in the sense that it is the author's own intellectual creation. No other criteria shall be applied to determine its eligibility for protection."

The same sort of looseness can also be seen with respect to the machine-or-transformation requirement for patents, originally conceived for the mechanical inventions of the Industrial Revolution. This criterion applies not just to software but to a range of other technologies, too, such as pharmaceutics, the biotechnologies, and nanotechnology. One therefore has to ask, how can patent law still cover these innovations under the umbrella of its traditional concepts? For example, how does the "technical character" test used by the European Patent Office under Article 52(3) of the European Patent Convention apply to pharmaceuticals? Clearly, this can be achieved only by injecting a fair amount of interpretation into the legal requirements for something to become patentable subject matter.

One might conclude at this point that interpretation serves as a legal *expedient,* a device the law finds itself *compelled* to resort to in its striving to come to grips with new technologies and make them consistent with existing law and mores. But I would suggest that interpretation is instead connected to law on a much deeper level, or that the basic concepts in any area of the law are *deliberately* general—hence deliberately designed to invite interpretation—because that is the strategy by which the law ensures its own coherence in the face of change, considering that the alternative, namely, a set of accurately defined concepts, would quickly commit the law to irrelevance. This seems to be a pervasive feature of the law, and in fact a parallel can be drawn here between intellectual property law and constitutional law, in that just as the building blocks of intellectual property are purposely broad (as in the example of the originality standard in copyright and the industrial-use standard in patent law), so is the language of the constitution purposely general. But in either case, the basic idea seems to be to have language sufficiently specific to be meaningful, yet at the same time sufficiently general to enable interpretation of the law when the circumstances of its application change.

How *specifically* to deal with such change has been the subject of this section. We have stipulated that the law proceeds in this regard by a principle of inertia, such that when change does come about, making it necessary to interpret existing law, the tendency in law will be to pour the new wine into old bottles—this is what translation does—rather than to find new bottles for the new wine. Where intellectual property is concerned, the former strategy has been termed *accretion* (Lessig's translation) and the latter *emulation*:

> Intellectual property may be extended to new subject matter either by accretion or by emulation. Accretion involves re-defining an existing right so as to encompass the novel material; emulation requires the creation of a new and distinct right by analogy drawn more or less eclectically from the types already known. (Cornish 1993, 54–55)

To see how the wine-and-bottles metaphor applies here, we just plug in the relevant terms (in square brackets), for which purpose we can just as well use Dutfield and Suthersanen's (2008, 14) restatement of the idea: "when it comes to extending intellectual property to new types of creations [new wine], the options available to policymakers are to fit such products into existing intellectual property categories [into old bottles: accretion] or to create "new intellectual property rights [or new bottles: emulation]." In either case the process is *interpretive*, its basis being in particular one of analogy: in accretion we reason by analogy from an existing type of *creation*; in emulation, from an existing right. And even though in either case we wind up *expanding* the law, the idea is to keep the expansion consistent with existing law (that is why the reasoning proceeds by analogy), and we can thus see how this all goes back to the view (stated at the outset in this section) that while law does continually change, it seeks to do so in a *stable* way (that is, by making sure that the new is coherent with the old).

An example where law reasons by analogy from an existing technology is where the courts have treated the question whether email meets the Statute of Frauds: indeed the court in *JSO Associates, Inc., v. Price* (2008) found that emails do meet the Statute of Frauds even when they are unsigned. In an earlier case, *Rosenfeld v. Zerneck* (2004), the question whether an email satisfies the Statute of Frauds was made to depend on whether the email bears a typed-in signature or an automatic signature block.[15] And in yet another case, *Vista Developers Corp. v. VFP Realty LLC* (2007), the court emphasized that "the issue of whether an e-mail is 'signed' should turn not on the lack of a typed-in or inserted signature at the bottom, but on whether the language of the e-mail or procedures surrounding it sufficiently indicate intent. What these three cases have in common, aside from agreeing that emails can in fact satisfy the Statute of Frauds, is that they reason by analogy from what would hold for traditional writings on paper (traditional memorandums), sorting out on that basis which traits or elements of an email are relevant in deciding the issue at hand.

2.2.2. The Role of the Courts

This reasoning by analogy is just a shorthand way of saying that the law is always struggling to keep up with technological change by reinterpreting its own rules or devising new ones, all the while seeking to maintain a coherent system. There are different types of situations that might trigger such a response on the law's part, and Karnow (1997, 6–11) groups them under four headings as follows:

(1) Existing legal categories lose their force. This is what happened with the novelty requirement in patent law in the face of software-based and business method-based inventions.

(2) The boundaries between legal concepts fade. We saw this earlier with the originality standard in copyright vis-à-vis the industrial-use standard in patent law, and the same goes for the distinction between public and private, for example: "there is disagreement on whether communications between computers is like public exchanges in a town square, or like a bookstore with a thousand books, or like a newspaper. But doctrines of free speech and other rules depend on which of these metaphorical structures is thought to prevail" (Karnow 1997, 7).

(3) Existing legal concepts get eroded. An example here is liability when computer failure causes loss or injury: the more complex the computer system, and the more autonomous it becomes, the greater the difficulty in figuring out where the blame lies, or who is to be held accountable. Similarly, it becomes difficult to apply the concept of force majeure, since the boundary is no longer clear between what can be controlled (and hence with whom responsibility rests) and what cannot.

(4) There are no shared assumptions. We have seen this already with wiretapping (where it can no longer be assumed that privacy can only be infringed by trespass), and e-mail (where it can no longer be assumed that an e-mail counts as a written memorandum under the Statute of Frauds). Another case is property in a Web-based environment, where there is no longer a shared assumption as to what counts as private property.

[15] Though the court also found that even an email with a typed-in signature, while it shows intent to authenticate the writing, cannot yet demonstrate a meeting of the minds, an essential contract element, from which it followed that there was no contract.

The reader may be aware from the discussion in the last section that it is not necessarily through statutory enactment that the law responds in its attempt to cope with these types of situations: the response may well go through the courts before reaching a legislature. In fact, there are reasons to suggest that this is actually a *tendency* of the law, more so than a matter of happenstance. That is consistent with the principle of inertia I have postulated for the law, or the law's essentially *conservative* tendency, which I have explained by pointing out its inherent need to maintain a coherent system—stability through change, as the idea was previously expressed. But there are other reasons, too, that might explain this tendency, and one such reason has to do with an oft-cited virtue of common law, namely, its flexibility. Mann and Roberts (2010) attribute this quality to the basic working principle of common law, that of *stare decisis* (to stand by the decisions), "the requirement that courts follow their own precedents" (Emerson and Hardwicke 1987, 7). To be sure, this suggests not so much the idea of living law as that of law stuck in a groove by virtue of its own dead hand. But then

> *Stare decisis* does not [...] preclude courts from correcting erroneous decisions or from choosing among conflicting precedents. Thus, the doctrine allows sufficient flexibility for the common law to change. The strength of the common law is its ability to adapt to change without losing its sense of direction (Mann and Roberts 2010, 8).[16]

This explanation of flexibility has also been pointed out by Bennet Moses (2006), who casts the argument in terms of what the best strategy might be when it comes to removing the uncertainty of law in the effort to "facilitate the law's adaptation to technological change" (ibid., 508).

This is an argument she supplements by noting in addition that what the courts find often goes hand in hand with what a legislature would enact: "if the common law solution is similar to that what have been enacted in any event, the flexibility of the common law is retained. In particular, the rule is likely to be more adaptable to future technological change" (ibid., 617). For this reason, among others, she advocates a "wait and see" approach in this regard, "observing the common law resolution of uncertainty and enacting a statute only if the resolution is undesirable or any residual uncertainty has undesirable consequences" (ibid., 616).

The courts thus seem to have a useful role to play in enabling law to deal with the changes that develop as technologies advance: the courts' ability to maintain the flexibility of law, all the while enabling the law to "hang together" and not lose its sense of direction, means that we can use the courts to test a solution before committing to legislative enactment. In other words, the courts' interpretive activity makes it possible to test whether existing laws and legal concepts (our old bottles) can be used as containers within which to suitably accommodate the practices and forms of life arising in connection with a new technology (the new wine) or whether the challenge so posed makes it necessary to stretch our legal concepts and solutions to such an extent that they can no longer be recognized for what they are, at which point we know we may need to turn to legislation. Indeed, as Karnow (1997, 144) argues, "good solutions to problems of advancing technology are those that do not need repeated access to the courts."

So the idea here is to harness the law's power as an interpretive enterprise—a power enabling us to see what works in the face of change—and it is for this reason that we turn to the courts. As Karnow (1997, 224) comments, "courts that concede the power of the past to judge the present will help us understand that present and to put it into a context." The courts, in other words, help us understand the meaning the past has for us today. This is the stuff of translation as previously discussed: we are dealing here with an interpretive practice at once *conservative,* because the effort is to "preserve context and meaning" (ibid.), and *transformational,* because we want to do so in such a way as to welcome and make sense of the new.

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[16] A statement very much in the same vein can be found in the decision that Justice McCardie rendered in the English case *Prager v. Blatspiel, Stamp and Heacock Ltd*. (1924): "The object of the common law is to solve difficulties and adjust relations in social and commercial life. It must meet, in so far as it can, sets of fact abnormal as well as usual. It must grow with the development of the nation. It must face and deal with changing or novel circumstances. Unless it can do that, it fails in its function and declines in its dignity. An expanding society demands an expanding common law."

These two facets of law as an interpretive practice (the conservative and the transformational) can both be rendered through the old-bottles metaphor because, even when a new technology is brought within the scope of old legal categories, the latter will nonetheless have to be *stretched* to that end, at least most of the time. For this reason I would distinguish a *transformational* interpretive practice (where we are still reasoning within the bounds of existing categories) from a *transformative* one, where we need to introduce new forms and categories, the overall stipulation being, as before, that law tends to pour new wine into *old* bottles (new technology into old legal categories) but will find *new* bottles for such new wine when the old bottles no longer do. The law's way of dealing with change, in other words, is to take a conservative attitude, so far as that proves feasible, after which point (when the change in question can no longer be accommodated within existing concepts) a transformative or category-changing (and hence creative) move will be triggered. Although there is no way to predict *when* that will happen, or under what specific circumstances,—the three-factor model attempts to frame the *setting* where that happens but is not intended as a predictive account—there is no denying that this is *generally* what happens, or that these are the basic mechanics of the law's response to technology.

The conservative mode of response can be observed in two cases involving the patentability of life forms. The first of these cases is *Diamond v. Chakrabarty* (1980), where the United States Supreme Court found that a bacterium capable of breaking down crude oil (for use in treating oil spills) is patentable subject matter under Title 35 of the United States Code, Section 101 ("Inventions Patentable"): No legal significance attaches to the fact that the thing for which a patent is sought happens to be alive; what does instead have to be established as legally relevant is that we are dealing with "a nonnaturally occurring manufacture or composition of matter—a product of human ingenuity." This is an example of what was earlier referred to as accretion, namely, expanding a legal concept (here, patentable subject matter) so as to make it more inclusive, and what makes such accretion possible is the general language of the statute in question: "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 therefore, subject to the conditions and requirements of this title" (35 U.S.C. § 101).

This generality is something that makes for *flexibility*, a characteristic earlier discussed as a virtue of common law and of the language framing the United States Constitution: that is, precisely the background condition enabling the courts to adapt existing law to changing circumstances. The Court in this case used such flexibility to effect the accretion just mentioned, and the solution can be described as conservative (albeit transformational) in two ways, the first being that no new concepts or categories were devised for that purpose, and the second that the Court, in seizing on the flexibility in question, was careful to distinguish its own role as *interpreter* of law from the legislature's as its maker and designer, and as the source to look to when offering an interpretation of law: "Congress contemplated that the patent laws should be given wide scope, and the relevant legislative history also supports a broad construction."

The second of the two cases mentioned involving the patentability of life forms is *Harvard College v. Canada* (2002), involving the so-called OncoMouse, or Harvard Mouse, a lab mouse genetically modified to carry a cancer-promoting gene that makes the mouse suitable for cancer research by making it significantly more susceptible to cancer than an ordinary mouse. The Court acknowledged a "distinction between lower and higher life forms," a distinction it described as "defensible on the basis of [...] common sense" (the OncoMouse belonging with the higher forms), and found that a "higher life form is not patentable because it is not a 'manufacture' or 'composition of matter' within the meaning of 'invention'" in Section 2 of the Canadian Patent Act. The decision differs from *Diamond* in that there is no accretion (no expansion of patentable subject matter, and hence no use of any statutory flexibility with regard to patentability) but is similar to that earlier case because it, too, can be described as conservative (conservative through and through, for I would not also count it as transformational, in the sense of its acting to *accrete* existing law). Indeed, for one thing, what brought the case on appeal to the Supreme Court of Canada was the Commissioner of Patents' refusal to grant a patent, and even though the Court agreed with the Commissioner that the OncoMouse was not patentable, it found that "the *Patent Act* does not give the Commissioner

discretion to refuse a patent on the basis of public policy considerations independent of any express provision in the Act."[17] And, for another thing, in very much the same way as in *Diamond*, the Court distinguished its own role from that of the legislature: "Since patenting higher life forms would involve a radical departure from the traditional patent regime, and since the patentability of such life forms is a highly contentious matter that raises a number of extremely complex issues, clear and unequivocal legislation is required for higher life forms to be patentable." For the same reason, even though the Court denied patentability in the case before it, it also found that "neither the Commissioner of Patents nor the courts have the authority to declare a moratorium on 'higher' life patents until Parliament chooses to act."[18]

Diamond and *Harvard College* both exemplify law's conservative attitude, its use of old bottles to deal with new technologies, whether it be by making extra room for such technologies (in *Diamond*) or by finding that they cannot be fit into existing forms (in *Harvard College*). This is something we can do in these cases because, even though the technology is new, the problem it presents can still be framed within the rule. The new technologies can be likened in this respect to "traditional subject matter such as novels, movies, and so forth" (Davis et al. 1996, 22), for here, too, one should expect issues to arise when it comes to applying intellectual property law. But in all these cases "the issue is typically one of fine tuning the rules at the margins, not making the sort of fundamental decisions that routinely arise in software cases" (ibid.). Which is to say that where new technologies are concerned, we may well face changes so consequential as to make it necessary to change the rules themselves (rather than stretch their boundaries), this through what I previously called law's *transformative* interpretive practice (as distinguished from its transformational practice, which still retains a marked conservative pull).

Conclusions

The framing idea of this paper is that the relation between law, science and technology cannot be understood just by looking at law, science and technology themselves: there is nothing inherent in law or in science that may be invoked to explain how these two terms of the relation should interact. This framing idea is not anything I arrived at by a process of research and discovery: it is rather something like a postulate, a view I take to be self-evident. And so it might be asked, given that background: Is this entire discussion not pointless and sterile, because we set out to prove what we already knew to be the case?

I respond to this concern by noting that the point of the discussion was not to prove what is self-evident but to flesh out in full detail a view that might otherwise be somewhat abstract and uninteresting. We all know, for example, that ethics deals with the notions of good and bad (Moore 1993, 54–55), and that law deals with the rules we all agree to enforce and live by for the sake of our own coexistence (Mann and Roberts 2010, 2–3). These basic definitions and ideas we pretty much take as givens. But we equally know that they will not mean much until we explore them in depth and make them come alive by considering the specific problems they apply to, and that in part explains why so much writing has been devoted to these subjects throughout the course of history.

That is precisely the kind of endeavor I embarked on in this present inquiry. And that is why the relation between law, science and technology needed to be set in a wider context, inclusive of elements other than law and science themselves narrowly construed as a system of rules, on the one hand, and a system of principles, on the other. In other words, we needed to set this relation in the context of society, where we move from the abstract to the concrete, and where nothing can be studied in isolation, no matter how amenable it may be to formalization, for this is a context where anything

[17] Similarly, in a restatement of the same idea: "The Commissioner of Patents was given no discretion to refuse a patent on the grounds of morality, public interest, public order, or any other ground if the statutory criteria are met."

[18] A court assuming such authority, in other words, would be engaging in so-called judicial activism, a practice that has been analyzed as consisting in any of at least five core activities as follows on the part of a court: (1) invalidating what would otherwise appear to be constitutional action by another branch of government; (2) departing from precedent or (3) from accepted interpretive usage; (4) legislating from the bench; or (5) judging with a view to achieving certain results forming part of an agenda (Kmiec 2004).

we study, no matter how abstract, inevitably finds itself pulled into the full complexity of human affairs, with its web of constantly changing relations. It is this web of relations that we needed to take into account in studying the "simpler" relation between law, science and technology, and in doing so we need to selectively bring to light only those relations that matter, or only those factors that pertain to the reason why we are studying it to begin with.

This gives the rationale involved in the three-factor model, but while this rationale provides a justification for the model, it also brings out its limitations. Indeed, on the one hand, as we saw a moment ago, it would have been an impossible and pointless task to explain the relation between law, science and technology by taking into account everything that goes into this relation, but at the same time the very selection (the editing) by which to make sense of this relation forces one to leave out consideration important factors without which the account itself winds up losing some of its explanatory power.

Thus, while paradigm shifts, socioeconomic consequences, and public debate have been selected as the most obvious factors explaining how a technology develops, takes root, and becomes the focus of regulation, there is a lot of ground that has not been covered in this account: there are factors and relations not considered, and the factors themselves have not been discussed in a fully rounded way.

The reason for these shortcomings is twofold: on the one hand, as was just noted, any attempt to take everything into consideration in striving for completeness and objectivity is bound to yield a formless, meaningless account; but at the same time, on a more practical note, if I may point the finger at the usual culprits, a fuller discussion of the kind I wanted to offer is yet to come because it requires more research, research which I plan to do in the future. However, for all these shortcomings, I nevertheless hope to have shown a way to discuss a legal question from a cross-disciplinary approach capable of affording a broader yet reasoned view of the problem than what a strictly legal investigation would have afforded.

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