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From Natural-Resource Commons to Knowledge Commons
Common Traits and Differences

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From Natural-Resource Commons to Knowledge Commons

Common Traits and Differences[1]

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[1] Paper presented at the « Rencontre des acteurs et des chercheurs de l'Economie Sociale et Solidaire avec Elinor OSTROM, Paris, 23 Juin 2011 ». The paper is based on discussions between the researchers participating in the ANR project PROPICE (which is presented in the appendix of this paper). Although some of the viewpoints expressed here are not supported by all the members of PROPICE, the aim is to present the current state of reflection within the group concerning the definition of the commons, to inform the discussion with E. Ostrom and the researchers involved in their study.

Summary:
Drawing on the works of Ostrom, the paper seeks to establish the bases on which the "traditional" commons (TC) and the "knowledge" commons (KC) can be compared and differentiated. Three criteria are proposed: the nature of the goods or systems of resources, the property regimes and the modes of governance. On this basis, the two large families of commons (traditional/informational) are distinguished as follows:

- *Nature of the goods*. While TC are composed of tangible and rival goods, KC are composed of non-rival goods;
- *Property regimes*. The essential difference (between TC and KC) lies in the fact that in TC, the basic right given the to "authorized users" is designed to guarantee the long-term reproduction of the resource, whereas in KC, beside the right to withdraw resources from the CPR, another and complementary right is defined ; namely a right of *addition*. In KC, the authorized users are allowed and encouraged to contribute new information or knowledge to the pool. It is often for this very reason that the pool has been created.
- *Mode of governance*. Whereas TC are oriented towards the *reproduction* of the shared resources, KC are oriented towards their continual enrichment (databases, open source software, wikis, etc.).

Finally, if TC are above all organizations *aiming at the orderly exploitation and long-term conservation of resources*, many KCs and the most prominent one (FLOSS, wikis, ..) are conceived primarily as tools for the *growth and enrichment of the pool of resources* through cooperative procedures aiming at promoting modes of production of innovation based on information sharing.

Key Words :
IPRs, Property regimes, Commons, Public Domain, Public goods

The aim of this note is to consider the similarities and differences between "natural-resource" commons and "knowledge" commons.

As this objective cannot be pursued without preliminary clarification of the very definition of the concept of the commons, we shall start by describing what we believe to constitute the three "entries" that can be identified in the works of Ostrom (and the other researchers associated with her approach) by which the commons can be defined and characterized. As we shall see, this investigation will also allow us to make certain distinctions and to identify different types and configurations of commons. We shall then endeavor to better define the nature and characteristics of "knowledge" commons,[2] which we believe to possess specific properties, requiring analyses that are partly original in relation to those concerning natural resource commons, the main subject of works written or inspired by Ostrom.

We conclude by recapitulating the main points established and questions raised during this investigation.

1.
Of the commons in general: the three entries/approaches

Following the works of Ostrom, one can identify three "entries" through which "commons" can be identified, characterized and finally given a status in the theory.

1. **Commons are the result of certain attributes of goods and/or systems of resources**

Here, Ostrom's takes as her point of departure the classic distinction made in public economics (as defined by Samuelson, 1954) between "collective goods" and "private goods".

[2] The concept of knowledge commons will be defined in more detail below. At this stage, let us just say that what distinguishes them is the fact that the resource (or system of resources) that constitutes the common is intangible. It is information in the broad sense of the word: digital databases with shared access, made up of collections of scientific or technological information and knowledge, digital libraries, literary works, on-line encyclopedias, etc. Madison et al. (2008) use the term "cultural commons" to refer to the same realities.

Following the analysis proposed by Samuelson, one can draw a contrast between two main types of goods:

- Goods of the first type possess the attributes of *non-excludability* (it is impossible to exclude an individual from using the good) and *non-rivalry* (consumption of the good by one individual does not subtract from its consumption by any other individual). Here, we are dealing with “pure collective goods”, of which the air and the oceans are often cited as examples.
- Goods of the second type, on the contrary, have the properties of excludability and rivalry (in their consumption): we are then dealing with “pure private goods”, including, in practice, most objects of everyday consumption.

Between these two extremes, different categories of goods can be defined according to the degree to which they display the attributes of excludability and rivalry.

Starting with this basic distinction, and reworking or rewriting some of the properties that can be attributed to goods, Ostrom formulated the hypothesis of the existence of common-pool resources (CPR). These CPR are characterized by the fact that they combine “high subtractability” (in use) and high “difficulty of excluding potential beneficiaries”. Typically, this includes fisheries, forests, grazing land, etc. Straight away, we can note that these are natural resources, generally renewable and exploited by relatively small communities. Indeed, E. Ostrom concentrated for a long time on the analysis of what we refer to here as “natural-resource” commons, to distinguish them from the “knowledge” commons that we will be dealing with in more detail in the second part of this note.
This is all expounded in many contributions, and very clearly again in Ostrom (2010).

However, we believe that this approach to and definition of the commons is just the first step. One might reasonably wonder whether, in the end, this first entry only serves to identify and characterize “candidates” for the status of commons, like the screening of molecules in medical research to find “candidates” of therapeutic potential that might (but not necessarily) lead to the development of new drug.
The problem is that this type of goods (combining high “subtractability in use” and high “difficulty of excluding beneficiaries”) can perfectly well be privately appropriated, in which case the owners may or may not grant rights of access and/or

use to third parties. Thus, forests may be bought privately, either simply for the pleasure of the owners, or for economic exploitation through the employment of workers. These candidates to become commons will never attain that status. They are private goods, over which the owner exercises full property rights.

Conversely, candidates for the status of private goods (arable land, for example), can be administered as if they were commons. This was the case for the vast number of "communal lands" that existed before the enclosures, a good number of which survived the movements of expropriation that marked the 17th and 18th centuries in Western Europe (F. Gauthier, 1977).

For all these reasons, the commons are more accurately defined on the basis of other criteria, complementary to the above. Instead of focusing on the "natural" (or quasi-natural) properties of goods, or the degree to which they possess the attributes of excludability and rivalry, these criteria concern the *legal status and regime* associated with these goods or systems of goods.

2. The commons are characterized by particular and original property regimes

In our view (and almost certainly that of Ostrom too), characterizing the commons in terms of the property regimes associated with goods or systems of resources is the central and most effective way to define them. The essential contribution of Ostrom here is to have shown that between the "exclusive right" attached to private property and the "public good" that is open to everyone, there is a wide variety of situations in which "bundles of rights" are distributed between different partners associated in the sharing of a resource.

It is here, we believe, that the commons find their true definition and characterization.

In an article of major importance on this subject, Schlager and Ostrom (1992) propose a clear distinction between the different attributes of property rights. There are five such attributes, belonging to two distinct classes of rights.

The first two, ***Access*** and ***Withdrawal***, define and guarantee the lowest levels of rights. The former guarantees the right of access to a resource. In Ostrom's works, these rights usually relate to a natural resource (lake, forest, fishery, grazing, etc.). The latter is the right to withdraw part of that resource (fish from a fishery, wood from a forest, grass from gazing land). These two rights (often, but not always combined) are the rights enjoyed by "authorized users".

Ostrom emphasizes three points here:

i) These rights of access and withdrawal may come from the law, but most often they derive from rules or customs. Moreover, customs, when they are understood and accepted, can be more effective than laws, the enforcement of which may be weak or nonexistent. Rights of access and withdrawal are often governed by a mixture of laws (issued by public authorities) and rules established among the users of the commons.[3] In other cases, it is the owners of a domain corresponding to a CPR and the residents/users who agree on the rules governing the exploitation of the CPR, rules that allow all the participants to benefit from the resource while at the same time preserving its quality over the long term.

ii) The nature and content of the "rights" granted to authorized users, in particular, are liable to evolve. The community of those who grant and/or benefit from the rights may decide to modify the nature of the right, perhaps to take into account ecological changes in the resource being shared (for example by raising or cutting the amount that can be taken by those with withdrawal rights (see the next point).[4]

iii) These rights are accompanied by obligations that the rights-holders must respect (under penalty of having the rights withdrawn from them). Thus, the right to fish in a particular fishery may be accompanied by obligations concerning the type of nets allowed, the amount of fish that can be caught, or the part of the fishery assigned to each rights-holder.

[3] Thus, in many of the fisheries off the coast of New England, some of the conditions of access and withdrawal are stipulated by law, and the rest are fixed by the local communities in charge of the administration and exploitation of the commons.

[4] It is essential to remember that the typical CPR studied by Ostrom are systems of natural resources, which, as such, each possess their own specific *ecological* characteristics. The preservation of these equilibriums is at the very heart of the rules in use that constitute the common. The common is therefore a construction of which the rules in use are largely determined by the ecological constraints on the CPR.

The three other attributes of property rights, ***management, exclusion*** and ***alienation rights***, are of a different (and in fact "superior") order to the first two attributes.

Whereas the access and withdrawal rights granted to authorized users are described as "operational-level" rights, the other three are situated at the level of "collective choices" and concern the *administration* (or management) of the common. This point is crucial. It clearly shows that the common is in no way free of hierarchy. Those who participate in the common (the "commoners") possess unequal rights.
Management concerns the right to regulate the conditions of use of the common and to make improvements to it. ***Exclusion*** is the right to decide who will benefit from the right to access and how this right to access may (or may not) be transferred. ***Alienation*** refers to the right to lease or sell one or more of the above rights.

If we consider all five of these rights as organizing a common, then several observations can be made.

- These different rights are independent from each other. A commoner may enjoy one or more of them, without there necessarily being any connection between them. Having one of these rights does not entail the possession of any of the others.

- A classification of rights-holders can be drawn up, based on the nature and quantity of rights allocated to them. This can be presented in the form of a table like the following, drawn up by Schlager and Ostrom (1992) based on the study of a fishery managed as a common.[5]

[5] More generally, among the works of Ostrom dedicated to the decomposition of property rights, see in particular Ostrom E. (1999) and (2009b).

	Owner	Proprietor	Claimant	Authorized User
Access and Withdrawal	X	X	x	x
Management	X	X	x	
Exclusion	X	X		
Alienation	X			

Bundles of Rights Associated with Positions

(Source : Schlager and Ostrom, 1992)

As the table shows, a common consists in a ***"distribution" of rights*** between the partners involved in the exploitation of a resource.

On the basis of this distribution, we can define different types of commons. Although these considerations are not expressed by Ostrom, we believe them to be important, because they allow us to distinguish between different families and different large groups of commons.

Following ***the characteristics taken on by the distribution of rights***, three main sub-groups can be distinguished. Below, we propose a very simplified representation of this idea, starting at one extreme of a spectrum.

- **The domain of private goods, cartels and pools**

At one extreme, we are in the domain of *private goods* attached to people (and/or entities) holding exclusive rights, not shared and not leased out. Here, we are at the *outer* limit of the commons. These private goods (for example exclusive rights

corresponding to patents) can, however, be “shared” between holders of exclusive rights. We are then dealing with “pools” or “cartels” of patent holders who exchange certain rights of use to each other, but exclude all the non-members of the pool or cartel. Rather than “commons” in the sense that is now attached to the concept, these are “clubs” as defined in the standard theory of public goods. But it could be argued that some derived forms of pools, distributing access and withdrawal rights among users (the owner of grazing land grants these rights to local farmers), constitute particular forms of commons in which the administration rights are concentrated in the hands of the sole owner, which is therefore owner, proprietor and claimant at the same time. For convenience, we shall refers to the commons of this domain as “type 1 commons”.

- **The public domain**

At the other extreme, we are in the domain of *public goods*, either because there is a right that guarantees universal access to and use of these goods, or because the absence of rights has the same effect. When they are covered by rights – which is not always the case - these particular commons, in the public domain, are usually administered and managed by the public authorities. The instrument of control (which determines access and withdrawal, in particular) is then the law or regulations. Another characteristic of these goods is that access is usually not limited (in the case of a nature park or a museum, for example) although users may have to pay for access (and there can be congestion problems, in the case of the museum). The difficulty n the case of museum is that access may be free, but it is access to a physically enclosed space: the building that houses the museum. Likewise, the works of art may be freely viewed, but they are the subject of commercial exploitation regulated by the law and/or museum regulations. Here we are dealing with complex forms of commons that are indeed in the public domain but require the management of problems of congestion and access fees.

One particular case calls for attention here, that of “very large commons”, or even commons with a universal dimension. They are often called “global public goods”, and the air and the oceans are typical examples. Essentially, they are resources for which access and withdrawal are unrestricted by any rights or constraints, since exclusion is practically impossible. Over time, however, with the negative externalities

that have accumulated due to the absence of any limitations on access and/or withdrawal, it has become apparent that these goods need to be administered. At present, two competing solutions have been envisaged: taxation (of the pollution emitted) or the distribution of marketable pollution permits.[6]
Similar problems need to be addressed in the sphere of built heritage, which can be considered as large commons, but with positive externalities. Examples might include the façades of Versailles or the historic centre of Venice.

Generally speaking, the question of what constitutes the "public domain", its limits and rules, has been little studied. Likewise, few works have been devoted to the conditions under which the public domain has been literally invaded, over the last two or three decades, by law and private ownership. In this field, the pioneering works of Benkler (2003) and Boyle have opened up a vast research program on the relationship between commons, open access and the public domain[7].

We shall refer to these commons in the public domain (of which there is a wide variety, as we have noted above), as "type 3 commons".

- **The domain of CPR managed by small communities**

Between these two extremes, we find the common-pool resources, which have the particularity of being run by systems of ***community-based management***. These are the archetypal commons (essentially natural resource-based) analyzed and described by Ostrom (et al.). The administration of the common is then conducted by proprietors and owners who may be private individuals or collective entities with legal status. The distribution of the bundle of rights generally defines and delimits quite strictly the rights of access and withdrawal, especially in the case of exhaustible resources and fragile ecosystems that need conserving.

This presentation, which differentiates between three "domains" of commons, differing in their extent, mode of governance and objectives, can be further

[6] On this point, see R. N. Stavins (2011), who, in an approach that is not without its critics, argues that we are still beset by the "tragedy of the commons".

[7] On the question of the boundaries of the public domain in the life sciences, see Cassier M. (2009).

elaborated and refined. In the wide interval between “exclusive private goods” and “pure public goods”, all sorts of situations can develop. For example, the software community has invented a type of commons that would correspond, in the above typology, to a particular category of “pure public good”, with universal, unrestricted access, no State presence or intervention, but which is in no way a *res nullius*: the free/libre and open source software (FLOSS) community is actually structured by a set of very precise rules (Mangolte, 2010). It is the legal innovations constituted by the creation of the GPL-GNU license and copyleft[8] that have given rise to this particularity: the formation of a public good, but one that is run along the lines of community-based management, like the “narrower” commons analyzed by Ostrom. It differs in that access is universal; in principle, it is not limited or restricted to specific categories of users. It can be noted that “wikis” (collaborative writing with an open system of contribution, of which the most successful example is Wikipedia, to which we shall return later), are based on the same approach.

For the most part, however, these commons, especially when they are natural resource-based (as are the vast majority of those studied by Ostrom), concern and are managed by relatively small communities of users and rights-holders. We shall refer to them as “type 2 commons”. They occupy an intermediate position between the commons at the boundary of private goods and exclusive rights (type 1 commons) and the large or “universal” commons at the boundary of the public domain (type 3 commons). We consider this classification to be essential, inasmuch as each category of commons requires us to address very different questions if we are to reach a full understanding of their constitution and the factors that determine their evolution.

Having said that, and to continue our characterization of commons, we must take a further step forwards, by observing that the idea that they are based on “bundles of rights” distributed among the different stake-holders immediately implies another idea. This is that commons are the result of ***collective action***, and as such they also constitute ***structures of governance*** of the shared resources.

[8] On this theme, see the works of Clément Fontaine, M. (2007) and (2009).

This is the third entry to be found in Ostrom's work for defining and characterizing commons.

3. **The existence of commons presupposes and requires the establishment of suitable "structures of governance" that guarantee their sustainability**

The existence of a *plurality of actors* (proprietors, owners, claimants, authorized users, etc.) who are themselves holders of rights that differ in their nature, extent and scope, testifies to the existence of *different interests* among the commoners. The fact that all the commoners share objectives and benefits deriving from their inclusion in the common in no way implies that the personal interests of each actor are all the same. One of the central objectives of the common's internal protocols and procedures – which control rights of access or use – is precisely to *achieve compatibility between the interests of the different actors* who participate in the commons, working on the assumption that these interests do not necessarily coincide (Ostrom, 1990).

This proposition entails several others:

- The first is that the phenomenon of free-riding (not strictly respecting the "rules in use" in order to take greater advantage of the shared resource) should not be overlooked in the constitution and design of the common. Added to which, "formal" rules cannot cover every eventuality. And yet respect of the rules in use (both formal and informal) is essential to the success of the commons. And it is hardly surprising that in practice, some commons should prove to be more "robust" than others, especially over the long term. Thus, Ostrom (1990) analyzes some commons that stand up to the test of time and are capable of collectively managing CPR in an efficient manner, and others that have failed to resolve conflicts of interest and have consequently disappeared. The need to design structures of governance capable of managing conflicts is a constant concern in her research (see for example Ostrom, E. 2009b).

- It is obvious that the quality of the structure of governance – responsible for establishing the rules in use and for arbitrating in the event of explicit conflicts

or tensions between stakeholders – plays a decisive role in ensuring the good functioning and long-term sustainability of the common. From this point of view, ***the nature and effectiveness of problem-solving devices*** incorporated into the structure of governance of the common is an essential dimension.[9] In our opinion, these problem-solving devices should include the management of *conflicts of interest* between the commoners - including, of course, economic conflicts. Depending on the effectiveness of the rules laid down, on the degree of adhesion obtained and on the quality of the problem-solving devices implemented, commons differ in their stability and durability. The coordination and transaction costs may vary in magnitude both during times of calm and in situations of explicit crisis and tension.

Ultimately, this is the yardstick by which the quality of the structure of governance can be appreciated: the effectiveness of the rules in use that it has laid down, which ensure the good functioning of the common (i.e., the proper exercising of the rights distributed among the commoners) during normal times, and the quality and effectiveness of the problem-solving devices that allow to resolve tensions and conflicts during "times of crisis". This dimension of the commons is all the more important since the commons operate in "complex and multicentric" worlds (Ostrom 2010) for which they have been specifically shaped.

- One last point should be made here, and that is that for Ostrom herself, the particularity of community-managed commons and their modes of governance is that they are original solutions to the two-way choice between State and market to which Hardin (1968) argued that the commons were confined. They provide a way out of the "all or nothing" dilemma (State ownership or exclusive private rights). For Ostrom, this is one of the key interests of the commons.

In brief - and setting aside for the moment the two extremes of the spectrum – a common can be defined as a set of resources that is collectively managed by means

[9] The concept of "problem-solving devices" is directly drawn from organization theory (see for example March and Simon 1993). We use it here to intimate that commons are organizations in the full sense of the term, and therefore constituted of actors whose skills, knowledge and interests are not necessarily immediately compatible. This is the role of the "structure of governance" of the common, to maintain cooperation with a view to achieving the shared objectives of the commoners. Problem-solving methods, using deliberation and arbitration, therefore play a vital role in the long-term viability of the common.

of a structure of governance that distributes rights between the commoners and aims to ensure the well-ordered, sustainable exploitation of the resource.

This is a broad, general-purpose definition, and it needs to be considerably refined for application to the case of knowledge commons.

II

From natural resource commons to knowledge commons

The three "entries/approaches" defined above can be used to characterize all types of commons, but these characterizations – which are largely based on the empirical study and analysis of natural resource commons – cannot necessarily all be applied in the same way to a new generation of commons that are currently the subject of fresh analysis: what we call "knowledge commons". These commons, of a singular kind, present totally new, original features compared with natural resource commons.

Before going any further, we should specify the perimeters of what we mean by "knowledge" commons. To put it simply, they are defined by the *nature of the resources* that are accessed and shared through the implementation of a purpose-built governance structure. Whereas the commons discussed above are constituted of tangible resources, knowledge commons involve intangible resources. The mechanisms of pooling (in the sense of shared access) therefore concern resources in the form of collections of information and knowledge, but also products developed from that informational material. One good example of the latter is shared software, which we will examine in more detail below.[10]

[10] To avoid overloading the discussion, we do not address "cultural commons" (*ie* commons based on art collections : museums, libraries,… etc.), the ubiquity of which (because they are made up of tangible *and* intangible goods at the same time) requires its own particular analysis. Likewise, we have omitted biological collections, which are also made up of both tangible and intangible material. (Research on these subjects is in progress within the PROPICE project, respectively in WP2 and WP6 presented in the appendix). "Digital libraries", on the other hand, which are available on-line with "free", shared access, do come within the category of the commons examined in this section of the text.

This form of commons has three types of salient characteristics, which we shall now seek to present in terms of the three "entries" to the definition of commons identified in the works of Ostrom.[11]

1. **Knowledge commons involve sets of resources composed of non-rival and (usually) non-exclusive goods**

.

The first characteristic of these types of commons, which clearly differentiates them from "tangible" commons, is that they are constituted of "non-rival" goods. One of the specificities of scientific information or literary works is that their consumption by a given individual does not detract from or exclude their consumption by anyone else. In principle, there is no limit to the consumption of the good. There are, therefore, no "natural" grounds for limiting the rights of access to and withdrawal from these resources, as there generally are for commons involving exhaustible and more or less non-renewable resources. In no way are these sets of resources liable to anything resembling a "tragedy of the commons" as a fishery or grazing land might be if they were subject to no rules in use and their users were unknown to each other.[12]

On the contrary – and we shall return to this point later – when the resource takes the form of information, there is every reason to believe that the more it is shared and circulated, the greater the interaction between holders of this information, and the more likely it is that the information will thus be increased and enriched.

2. **Knowledge commons have been rendered necessary by the effects of an "exclusion" that has been artificially constructed through specific *intellectual* property rights**

[11] The following paragraphs, while drawing on the analyses presented in Hess and Ostrom (2007), endeavor to propose an original characterization of knowledge commons, with the particularity of being based on the same three criteria of definition that were used to define and characterize natural-resource commons.

[12] These are, of course, the two main preconditions that may lead to the destruction of a freely-accessible resource through over-consumption. See the critique of Hardin in Ostrom's book published in 1990.

As in the case of natural-resource commons, to which most of the previous section was dedicated, one cannot come to a full understanding of knowledge commons without taking into account the analysis of the *property regimes* governing these resources.

Several points call for attention.

- The first is that the extension and general implementation of market based economies has ultimately – at the end of a long and complex process during which different and conflicting conceptions of economic development have emerged– *by the establishment of a series of specific, new rights*, known as intellectual property rights (IPR), the purpose of which is to *attach exclusive rights to goods that are in essence non-rival* (Machlup, F. and Penrose, E., 1950). These rights are allocated, under particular conditions, to people or entities that are recognized as having played a decisive role in their conception (Khan, B. Z., and K. L. Sokoloff, 2001; Lamoreaux, N. R. and Sokoloff, K. L., 1999). Whether it is a literary work or a technical invention (the two large domains covered by copyright and patents respectively), *the good is essentially non-rival*. Reading a book does not exclude any other reader, just as the use of a technical invention by a given manufacturer does not prevent anyone else from using it.

Obviously, this is not the place to describe the complex and turbulent history of the establishment of IPR.[13] The important point is that intellectual property laws (and the institutional constructions that accompanied them: patent offices, specialized courts, etc.), ***have (in many cases) transformed information into a commodity*** (Coriat B, Weinstein O., 2011), but a very particular type of commodity, since (unlike ordinary commodities) the person who has property rights over an item of information or knowledge is never obliged to sell it. ***The patent is firstly a right to prohibit*** (M. Vivant, 2005) before being a monopoly on the exploitation of the patented information. The justification given for this commodification of information and

[13] Although it is important to recall that the IP laws providing the creator of new information and knowledge with monopolies and other privileges have been constantly reworked and amended, that there has been a succession of different patent regimes, which still differ widely from one country to another ((Machlup 1958), and that exclusivity is only granted by IPR on the condition that numerous exceptions are allowed (compulsory licenses, “march in” rights, etc.).

knowledge, that it is necessary as a means to provide incentives for innovation,[14] has never enjoyed consensus among economists (Machlup, 1958), and the arguments for and against continue to rage.[15]

As far as "knowledge commons" are concerned, one of the key moments in this debate was the development of the concept of the "tragedy of the anticommons", which mirrors the earlier thesis of Hardin (1968). According to the theory proposed by Heller and Eisenberg (1990), the exclusive rights established by IPR over discoveries or inventions raise obstacles to the circulation of knowledge that lead to a reduction in innovation capacity and ultimately, a loss of welfare. In the wake of these analyses, a vast movement has sprung up to combat the private appropriation of the "scientific commons", an expression used in practice to designate the results of basic research that have, in certain cases, been rendered patentable by the combined effect of changes in legislation and jurisprudence[16].

- It is indispensable to take this context into account if we wish to understand knowledge commons. In most cases, they have been designed and established with the very purpose of fighting the risk (or effective presence) of the tragedy of the anticommons. Just as the ***history of natural-resource commons is linked to that of the enclosures,*** we can argue that ***knowledge commons are inseparable from the "second enclosure movement" represented by the considerable toughening of IP laws since the 1970s*** (Boyle, 2003).
Thus, the first and probably the most archetypical of the knowledge commons, born out of the Free/Libre and Open Source Software (FLOSS) initiative, was a response

[14] The most often-repeated and sophisticated argument provided by the economists, is the one proposed by Arrow: in a decentralized market based economy specific institutional arrangements (ie IPR) are needed to prevent the danger of permanent under-production of knowledge. However, it is often overlooked that for Arrow, IPR is only a "second best" that cannot prevent market failures, and that, also according to Arrow, the question of where the line is drawn between patentable and unpatentable is of crucial importance. Patenting "upstream" knowledge is counter-productive, because it creates obstacles to the circulation of informations and finally to innovation (Arrow, 1962).
[15] Recently, at least two works have against raised the debate to a high level: see Jaffe, A. B. and Lerner, J. (2004) and Boldrin M. and Levine D. K., (2008).
[16] A detailed presentation of these changes and the threats they pose for the scientific commons can be found in Coriat and Orsi (2002). On this point, see also Nelson (2004). More generally, on the changes that have affected American IP law, see Coriat (2002a) and (2002b).

to the commodification of software and its subjection to IP laws and an endeavor to restore to software its quality of "free good" (Stallman, 2002; Mangolte, 2010). Likewise, initiatives taken in the domain of open publishing to re-establish the rules of open science, which have been undermined both by the patentability of certain aspects of basic research and by changes in the system of scientific publishing, involving the acquisition by the publisher of the copyright and the exclusive right to reproduce the text "in all existing and future media", as most author-publisher contracts now stipulate.

To re-establish the quality of information as a non-exclusive good, knowledge commons – like natural-resource commons – proceed by means of a new distribution of rights. Like natural-resource commons, knowledge commons ***are not based on an absence of rights***, but ***on another form of use and distribution of the different types of rights attached to IP***.
This process of redistribution of rights is achieved by redefining them, and often also through legal innovation. In this perspective, as mentioned above, the creation of the GPL-GNU license and copyleft represent major innovations. But many other legal innovations have emerged in the field of licenses, creating a wide variety of types of commons that can be distinguished by the rules-in-use that ensure their functioning and therefore in the shared objectives defined by the community of commoners.

In every case, the purpose of redistributing property rights here is to *bring the common into existence*. "Knowledge-based CPR" never pre-exist in the way that natural-resource commons like forests pre-exist. The establishment and allocation of rights (and therefore also, correlatively, of the structure of governance that lays down and enforces the rules in use) are the founding and constituent acts of the knowledge common. Even before its status has been determined and the rights of access allocated, an informational database must be "produced".[17]

Nevertheless, there exists a wide variety of knowledge commons, as there was for natural-resource commons. And as we did for natural-resource commons, we can

[17] In terms of biological matter, the constitution of collections of information and databases and the definition of access rights raise particularly complex questions. On this theme, see F. Bellivier and C. Noiville (2006) and (2009).

imagine a spectrum ranging from knowledge commons that form a “public domain” to pools and clubs of private partners. Between these two extremes, there are a large number of different forms. Thus, “innovation platforms” that bring together seekers and suppliers of “solutions” to technical problems are one of these intermediate, “hybrid” forms[18] (see box 1). The contracts that govern transactions between the seekers and suppliers of solutions generally include commercial transactions and the transfer of copyrights.

Box 1
Hybrid knowledge commons
On-line innovation platforms

These platforms provide a point of contact between companies seeking solutions and large numbers of scientists registered with the website who possess expert, up-to-date knowledge. These systems have been devised to allow companies to benefit from the knowledge of experts throughout the world. As in the “traditional” commons, the access and transmission of this knowledge are governed by precise rules and mechanisms managed by the platform (conditions on the transfer of IP, filtering of solutions, etc.). So these platforms are built so as to allow forms of innovation based on distributed knowledge (that of the scientists registered with the platform) that can range from simple advice to a very elaborate (often expert) solution, obtained very fast. One key feature of the business model is that these platforms are explicitly commercial. The knowledge is not dispensed for free, as it is in a wiki: a reward is paid for the solution chosen by the firm, in return for which the firm can acquire the IP rights over that solution. As in the case of natural-resource commons, knowledge commons do not always entail the implementation of a principle of gratuitousness. Here, we are on the boundary between commons and clubs. Innovation platforms clearly borrow their protocols from the rationales underlying both of these forms.

The legal mechanisms established around the licenses and platforms of the “creative commons” are close to the public domain (and therefore belong to the category of type 3 commons in the typology defined above). In this case, authors make their works available through on-line platform and authorize their reproduction under certain conditions. Usually, these involve respecting the integrity of the work and mentioning the author’s name, as it is the case in most “creative commons” licenses.

Lastly, at the other end of the spectrum (type 1 commons) we have patent pools forms by firms who share some or all of the rights associated with their patents.

3. The governance of KC is oriented not towards the *conservation* of resources but towards their *enrichment and growth*.

[18] This point derives directly from the work conducted in the WP3 of the ANR PROPICE project by Isabelle Liotard (see the presentation of PROPICE in the appendix).

If we now turn our attention to governance, one of the key characteristics of KC is that they are not oriented towards the conservation of resources, like natural-resource commons, but towards their *enrichment and growth*.

For this reason, the rules in use in KC include a series of rules dealing specifically with the conditions of enrichment of the stock of resources already present in the common*.* Stretching things a little, we could say that in Ostrom's classification, alongside the rules governing the *withdrawal of resources,* knowledge commons differ in that they contain also a series of rules dealing with the conditions ***of the enrichment of the common*** with new information and knowledge developed from that already deposited in the commons, for which (as in the case of the natural-resource common) the authorized user has been granted rights of access and withdrawal.[19]

These rules specifying the conditions of enrichment of the common (which we can also call ***"additionality rules")*** bring together the users of the common and the persons or entities responsible for its administration, whose main task, besides maintaining the integrity of the stock of information, is to manage its enrichment. This is true for commons based on software, where the proposals for enriching/improving the software are mediated by the administrators of the common. It is also the case, for example, for the addition of new articles (or additions to existing articles) to a free-access encyclopedia like Wikipedia. But many of the more specialized "wikis" (in medicine, for example) have also emerged using the same principle. An initial knowledge base is put on-line. Its enrichment is managed by administrators who "validate" the additions proposed by users of the wiki.

Observing that KC are not oriented towards the conservation of the resources deposited and administered in the common, but towards their enrichment, is just the first step. A second characteristic of KC is that they constitute an *original and*

[19] It can be argued that since withdrawal rights are generally much simplified (because of the non-rivalry of information), it is the rules of enrichment that occupy the central place.

extremely powerful mode of production of information and knowledge. Moreover, in many cases, the new KC can be (and are) managed as instruments of innovation[20]. They are original because there are practically no limits on the size of the community of innovators. This is the case for commons based on the principle of open access, intended to entirely restore the non-rivalrous nature of information, such as software developed under the FLOSS initiative, or the on-line encyclopedia Wikipedia, to name but two highly emblematic examples.[21]

In certain cases the communities of innovators involved in KCs may be relatively small, involving only specialists. Since everything depends on how the rights of the authorized users are defined (especially the rules relating to additionality), they may also concern very large numbers. Whatever the case, this method of producing innovations marks a radical break with the traditional organization of individuals specialized in R&D: employees of public research centers or of private firms, whose activity is appropriated by the firm that pays their wages.[22] This new mode of production of knowledge, based on shared access to informational resources, has already demonstrated its force and efficiency in many different domains. And as M. Bauwens (2006) suggests, there is every reason to believe that the "P2P mode of producing innovation" is only at its beginning.[23]

Obviously, one of the chief interests of these new knowledge commons lies in this feature: their potential to revolutionize the production and circulation of information and knowledge, while at the same time protecting and guaranteeing the rights of earlier inventors as in the case for people cooperating through creative commons protocols.

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[20] We define innovation here as any activity that helps to enrich the pool of informational resources offered and managed by the common.

[21] From this point of view, it is remarkable that the innovation platforms described above (box 1) also aim to involve the largest possible number of potential contributors, even if the solution eventually chosen is then privately appropriated (by the acquiring firm) and is the subject of a commercial transaction.

[22] In Coriat and Weinstein (2011), we recount, in the case of the US, the long and complex process by which the right to register an invention (and thereby benefit from a patent) was transferred from *individuals* (for a long time the exclusive recipients of this right) to collective entities, predominantly firms.

[23] On this point, see also the pioneering and founding works of Von Hippel, E. (2005).

Conclusions

To conclude, three points call for particular attention

1. ***The variety and diversity of forms of commons, but also the existence of "large families" of commons***

The first conclusion is that commons come in a very wide variety and diversity of forms, but that they can be divided into large "families" sharing certain constituent features.

We have represented this dimension figuratively, in the form of a spectrum, and we have suggested that three large domains exist along this spectrum, ranging from commons involving different forms of public goods at one end to highly restrictive forms of shared property and use resembling "clubs" at the other. The large domain in between comprises commons involving some form of community-based management, which are, we believe, typical of the commons studied by Ostrom and on which she bases most of her theorization.

2. ***Natural-resource commons vs. knowledge commons***

Concerning the differences between natural-resource commons and knowledge commons - the question at the center of this paper – we believe that the distinction revolves essentially around two pairs of "opposites" in the form of *conservation vs. enrichment* and *withdrawal vs. additionality*.

As regards the first pair, it is striking that the central feature allowing to distinguish between the two types of commons is the property of rivalry (rival goods[24] in the case of natural-resource commons, non-rival goods in the case of KC). Thus, in the case of "traditional" commons, the purpose of the institutional constructs (distribution of property rights, modes of governance) is to manage the property of rivalry in order to maintain shared access and ensure the long-term conservation of the resource. In the case of knowledge commons, the aim is to restore the property of non-rivalry to the resource in order to allow its continual enrichment on a large scale by an extended community of innovators.

However, as we have pointed out, hybrid and intermediate forms exist in each of these cases.

[24] And, we might add, goods that are more or less easy to renew.

3. Commons, open access and freeness

Another point only lightly touched on in this text, but which it is very important to develop further, concerns the commercial and pecuniary relations defined in and around the common.

Here, as above, a spectrum can be drawn ranging from commons in which freeness is a founding principle of the rules in use binding all the commoners through to commons designed entirely for and around commercial and marked based transactions (the case of cartels and pools).

Once again, between these two extremes, the large majority of commons adopt rules in use dictated by non-commercial considerations (preserving an exhaustible resource, bringing or restoring a resource to the status of common to provide access for communities who risk being excluded by newly-established property regimes, etc.), but which may be combined with rules of monetary exchange to settle specific transactions[25]. Thus, for example, the price of admission to museums, etc.

More generally, this question raises another of very wide scope: that of the business models underpinning the commons, allowing them to come into existence and ensuring their long-term viability.

[25] An idea of the diversity of the rules governing access and withdrawal rights can be obtained by considering fisheries. In some cases, the allocation of fishing spots to the fishing boats is done by drawing lots (bearing in mind that some spots are well-known to be more productive than others). In other cases, the allocation is done by auction. Here we have a clear example of two rules, one of which is non-commercial and the other commercial.

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Appendix
PRESENTATION OF THE ANR PROPICE PROJECT
(Scientific Director: B. Coriat)

Composition
The ANR PROPICE project brings together three partners

- The CEPN (UMR CNRS 7234) of University Paris 13; PROPICE team directed by B. Coriat
- The CDST (Centre de Droit des Sciences et des Techniques) of University Paris 1; PROPICE team directed by C. Noiville and Florence Bellivier
- UMR 912 (University of the Mediterranean); PROPICE team directed by F. Orsi

Scientific objectives
Crossing historical and empirical studies in numerous fields (ICT, biotech and pharmaceuticals, cultural goods) the objectives of the project are defined as follows:

i) To propose a state-of-the-art concerning the tensions between IPR and commons in the two major contemporary expressions of IPR: *copyright* and *patents*;
ii) To show how and in what the new "knowledge commons" differ from more classic forms of property rights (notably the exclusivity associated with intellectual property), while at the same time using some of the resources provided by these rights;
iii) To work on the differences and similarities between "commons" and the different meanings and expressions of the "public domain"; to define the boundaries and intersections between these different domains;
iii) To identify recent trends in the strategies used by different protagonists, and use this as a basis to propose one or more typologies of commons and reveal the types of institutional arrangements on which they are based;
iv) To bring to light the business models capable of ensuring the sustainability of different types of commons;
v) To suggest ways to establish an institutional context more favorable to the activities of creation and innovation.

Organization chart of tasks and work packages
The work is divided into 6 WPs (Work Packages)
WP1: The rise of exclusivism in intellectual property rights and its aporia. Leader: P.A Mangolte (CEPN)
WP2: - From tangible to immaterial patrimony: the stakes involved in the dividing lines between public domain, commons and private domain. Leader: F. Benhamou (CEPN)
WP3: Commons-based production: commons and shared innovation. Leader: I. Liotard (CEPN)
WP4: Property, intellectual property and markets. Leaders: C. Carpentier, H. Tordjman (CEPN)
WP 5: Public domain and patents in North/South relations: the case of access to treatment for pandemics. Leader: F. Orsi, UMR 912, University of the Mediterranean
WP6: Commons and public domain: the new issues in access. Leader: F. Bellivier (CDST, University Paris 1)