Verba Volant, Scripta Manent

The discontinuity effect of explicit media

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It is commonly recognized that different social configurations tend to be associated with different types of innovation. Not surprisingly, linear innovations are more likely to be produced by communities of strong and homogeneous ties; while radical innovations are more likely to originate from networks of weak and diverse connections. Yet, there is a second and subtler linkage between social patterns and innovation types: a junction which depends on the nature of the media available to different groups. The key role is played by explicitness. Communities, being relatively homogeneous, can rely on implicit forms of communication, while networks require explicit channels and languages to relate their highly diverse components. This difference in media explicitness tends to produce a difference in innovation styles. According to the main hypothesis of this paper, the more explicit are the media available to a group, the more discontinuous and radical will be the innovation generated. The discontinuity effect of explicit media will be explained with examples drawn from the history of media and technologies and some empirical ground will be provided through the analysis of a much-discussed case of biopiracy.

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A slightly subversive perspective on innovation

There are two things that bind all the papers presented here[1]: a useful simplification and a slightly subversive perspective. The first is directly suggested by the very object of this debate. Placing innovation within a *continuum* delimited by communities and networks implies condensing the infinite diversity of inventive settings into a simple and flat dichotomy. This is, evidently, a reductive operation, but it has the advantage of showing innovation from a slightly subversive perspective. Focusing on communities and networks as extremes of a variety of different social configurations, we draw attention to the influence of relational settings over innovative processes. This leads inexorably to reconsider the very origin of innovation as something that does not originate *inside somewhere*, whether inside the mind of an ingenious inventor or inside an inventive organization, but rather *through something*, that is through the links that connect different individuals and groups. In other words, innovation has less to do with the pure accumulation of knowledge, than with its, often impure, circulation.

To be sure, this is not the first time this idea is advanced in innovation studies and yet it is far from being actually accepted. Especially in the practice of knowledge management and knowledge engineering, too many projects continue to be aimed at the mere accumulation of information. Certainly, there are notable exceptions, but the majority of KM campaigns are still centered around the gathering and organizing of knowledge bases[2]. As I will try to show at the very conclusion of this paper, this obsession with knowledge stocking derives from a misunderstanding over the value of information. I will elaborate this argument later on, for the moment, I will just put forward the idea that communities and networks generate unlike types of innovations not because they differ in the *quantity* of knowledge they hold, but because of the *quality* of their knowledge flows.

The main evidence for this idea is extensively discussed by Filippo Dal Fiore (2005): different social structures, presenting dissimilar configurations for knowledge circulation, generate different types of innovation. In particular, communities, which are circuits of few, strong, thick and homogeneous social ties

[1] This paper is part of a series of articles which summarize the discussion work done within the workshop "Communities Vs Networks, as the extremes of a continuum of social containers for innovation" during the second edition of the International Conference on Communities and Technologies (13-16 June 2005, Milan)

[2] On the myths knowledge management and the idea information as unique and magical source of innovation, see the irreverent book of John Seely Brown and Paul Daguid (2000).

tend to produce linear innovation. Networks, which are dispersed constellations of many, weak, diverse social connections tend to produce radical innovation. This influence, exerted by the configuration of knowledge circuits on innovation styles, is hardly surprising. On the one hand, communities are gifted with a natural inclination towards linear innovation, as the similarity and collective-orientation of their members offer the perfect setting to rework the same problems and solutions over and over. On the other hand, networks are better fitted to generate radical innovation, since their heterogeneity and agents-orientation favor original combinations of knowledge.

This being the straightest connection between social structures and innovation styles, it is possible to reveal a second mechanism through which communities and networks are connected respectively to linear and radical innovation. This second junction between social configuration and innovation types has to do with the dissimilar communication settings offered by communities and networks and it is subtler since it operates through the media by which technical knowledge is preserved and spread[3]. As I will suggest in the following pages, there is a twofold bond that links social structures to communication media on the one hand and communication media to innovation styles on the other. Accordingly, I will elaborate my hypothesis through a twofold argument: firstly, I will illustrate why communities and networks tend to be linked to dissimilar type of media and, secondly, I will explain why this difference tend to produce different styles of innovation.

There is one last point to clarify before making my argument. Evidently, there are several dimensions in which the media available to communities and networks can be said to be different, but here we will focus on the one dimension that has the major influence on innovation. This is, as I will try to show, the degree of explicitness. Even if the notion of explicitness sounds pretty intuitive, it is not easy to provide a strict definition of it. Evidently, explicitness has something to do with the clarity of a text or a message. Generally, we say that a communicative act is highly explicit when its meaning can be understood equally in many different context. A mathematical equation, for instance, is commonly considered as a very explicit text, because its meaning is supposed to be unique no matter how it is interpreted. On the contrary, a poem is regarded as relatively more implicit text because it can be subjected to many different reading according to the framework of interpretation. We could then define explicitness as the degree of independence between

[3] In this paper, I will concentrate on the effect of different media on innovation. Yet there are other dimension of the communicative process which affect the innovation style. One of them is convincingly discussed by Nicola Cavalli (2005) in terms of discursive communities and communication genres.

meaning and context[4]. Strangely enough though, explicitness depends neither on meaning nor on context. Explicitness is a quality of the communication mean.

To understand this claim, it is very important to consider both sides of the notion of media. In this paper, using the word 'media' I will refer simultaneously to the languages *and* the channels which mediate communication[5]. In the previous example, we asserted that equations are more explicit than poems because the mathematical language is more standardized and codified than the poetic one. However, we could have compared the declamation of a poem with its written version. In this case, we would have considered less explicit the oral form because it is inevitably bind to the context of declamation, whereas the written form can be transmitted very far in space and time with minor change in its meaning.

If we consider at the same time languages and channels, we can read the history of media in terms of a progressive, even if not linear, increase in explicitness. Hand-writing, for example, is more explicit than orality: thanks to the mediation of the alphabetical code, messages can be inscribed on papyrus, parchment or paper, thereby freeing interaction from the need of a shared time-space context. Yet, if compared to printing, hand-writing turns out to be a relatively implicit medium. Hand-writing associates indissolubly a text to a specific material support, whereas, through the mediation of the movable types matrix, printing makes possible to replicate text in a potentially unlimited numbers of identical copies. Still, printing is not the most explicit medium. Broadcasting media are more explicit because they can reach simultaneously and with no additional costs a virtually boundless audience. Finally, digital networks prove to be even more explicit, since, by means of the digitalization, it becomes possible to transmit over the same connections and to the same terminals virtually every kind of message[6].

Having defined the notion of explicitness, I can now restate the twofold hypothesis of this paper: firstly, I will suggest that communities and networks tend to be linked to implicit and explicit media respectively and,

[4] The problem of the independence of meaning and context has been brilliantly analyzed by Umberto Eco (1984). In this article, Eco draws a distinction between code and encyclopedia which mirrors, though in a much more complex and refined manner, the opposition explicit/implicit that I am trying to introduce here.

[5] Unfortunately, I don't have the space to elaborate the crucial distinction between "channel" and "language". In short, this distinction is meant to distinguish between the material and the formal side of communication media. This distinction is very precisely drawn by Niklas Luhman and Raffaele De Giorgi (2000) who argues that "the communications systems constitute themselves through a distinction between *medium* and *form*. When we talk about 'communication media', we always mean the operative use of the *difference* between material substratum and form" (p. 64, my translation).

[6] A short history of this progression and of its consequences can be found in Massimo Baldini (2003).

secondly, I will argue that, because of this difference, they tend to generate linear and radical innovation respectively[7]. As I have just enunciated it, my hypothesis could refers to every type of innovation. However, as for this paper, the hypothesis will be tested only in the relatively limited field of technological innovations. As we will see, in this domain, the consequences of explicitness are especially evident and profound.

Social structures and communication media

The first part of my argument, that is showing the linkage between social structures and communication media, is by far the easiest. Communities and networks are so structurally diverse that it is not difficult to understand why they are likely to relate to media with different level of explicitness. Since we have defined explicitness as degree of independence between meaning and context, it is hardly surprising that groups with low social diversity (namely communities) tend to be associated with implicit media, while groups with high social diversity (namely networks) require more explicit media. Evidently, explicitness is a convenient strategy only when messages are expected to circulate through different context.

Simple and homogeneous by definition, communities generally offer a limited number of communicative settings. As interaction takes place in few, recurring contexts, culture lean towards implicit and situated forms of communication, typically face-to-face oral contact. Presuppositions and references tend to be embedded in the context and there is little need for explicitness. To understand how explicit forms of communication would come amiss in community interactions, think of the famous ethnomethodological experiment quoted by Harold Garfinkel (1967):

> Students were instructed to engage an acquaintance or a friend in an ordinary conversation and, without indicating that what the experimenter was asking was in any way unusual, to insist that the person clarify the sense of his commonplace remarks. Twenty-three students reported twenty-five instances of such encounters. The following are typical excerpts from their accounts…
>
> CASE 3: "On Friday night my husband and I were watching television. My husband remarked that he was tired. I asked, 'How are you tired? Physically, mentally, or just bored?'"
>
> (S) I don't know, I guess physically, mainly.
>
> (E) You mean that your muscles ache or your bones?
>
> (S) I guess so. Don't be so technical.
>
> (After more watching)
>
> (S) All these old movies have the same kind of old iron bedstead in them.
>
> (E) What do you mean? Do you mean all old movies, or some of them, or just the ones you have seen?
>
> (S) What's the matter with you? You know what I mean.

[7] As you can see, the direction of the influence is exactly the same proposed by Dal Fiore's hypothesis, but it is now mediated by the degree of explicitness of the available media. It is a subtle difference, but, as we will see, it is not without consequences.

(E) I wish you would be more specific.

(S) You know what I mean! Drop dead!

(pp. 38-44)

Networks, on the contrary, require explicit and formal languages to establish communication among individuals with dissimilar, if not divergent, social backgrounds. Without media capable of higher levels of definition and context-autonomy, broad and complex social networks would be organizationally unfeasible. For instance, without the invention of ideographical writing and the institution of scribes, the administration ancient Middle East empires would have been simply impossible[8]. Likewise, the rise of modern, bureaucratic nation state has been slower and more problematic within countries that could not count on a single national linguistic variety[9].

Networks foster explicitness and vice versa. This is particularly evident in the history of technology, where there are countless instances of this reciprocal amplification. One of these examples has been remarkably pointed out by Alain Gras (1993) in the history of the railroad networks. During the first half of the 19th century, the expansion of the railroad system was curbed by two "reverse salients"[10] both derived from an insufficient standardization. The first difficulty was that of standardizing the rails of different companies and countries so that trains could be switched from one line to the other. Overcoming this inconsistency required a huge effort of negotiation and cooperation and laid the foundations of the modern system of technical standards. The second reverse salient, which illustrates even better the symbiosis between networks and explicit media, had to do with the problem of coordinating the circulation of trains in order to avoid the lines overload. This problem was successfully resolved in 1844 with the experimentation of the Samuel Morse invention along the Baltimora-Washington line. From that point on, the development of the railroad networks had been indissolubly coupled with the extension of the telegraphic system.

The railroad example reveals how the implementation of a socio-technical network can induce the adoption of more explicit media, but there are examples for the opposite movement too. Often rises in knowledge explicitness, due to innovations in codification or transmission, fosters the emergence of socio-

[8] On the role of writing in the administration of ancient Middle East empires see Jack Goody (1986).

[9] See Schulze (1994).

[10] Gras borrows the notion of "reverse salient" from Thomas Hughes (1983). A "reverse salient" is an element of a technological system that, because of its resistance to change, restrains the evolution of the whole system.

technical networks[11]. The huge success of the Internet's protocols, for instance, has demonstrated how an innovation in the mediation of information can induce the development of a worldwide network. Before the introduction of TCP/IP protocol in 1983, computer networking was limited to the relatively small and isolated local area networks. By developing the TCP/IP protocol Robert E. Kahn and Vinton Gray Cerf had the revolutionary idea of developing a new codification level capable of hiding the differences between diverse local networks. With the availability of a simple and standardized transport protocol it became possible to connect almost any networks together, independently of their internal features. The Internet, namely the network of networks, was born[12].

To sum up, we may say that there is evidence of a linkage between social structure and communication means. The more complex and diverse is the relational pattern of a social group, the larger will be its employ of explicit media[13]. Obviously, this is a broad generalization: even in closest community there is a always a certain need for explicitness and, symmetrically, even in the largest network there are semantic domains which remain implicit. Still, as I have tried to show, this distinction does have some heuristic value and some empirical ground.

The discontinuity effect of explicit media

Let's move to the second and most difficult part of my argument: the influence exerted by different media on innovation styles. To broach this question, I will refer to a theory derived from the field of cultural anthropology and exposed by Jack Goody and Ian Watt, in their much-cited essay on the consequences of literacy. In this famous essay, the two British anthropologists identify the acquisition of alphabetical writing

[11] To be sure, it is only for clearness of exposition that I am distinguishing between the two directions of the networks-explicitness linkage. The relationship between networks and explicit media is always bilateral. I have showed how the railroad network promoted the adoption of the telegraph, but the opposite influence could be demonstrated too. Likewise, I will describe how the TCP/IP made possible the development of Internet, but I could also argue that it was the project of a worldwide computer network that forced the adoption of a more explicit protocol.

[12] For further information on the TCP/IP revolution see the official report available on the website of the Internet Society (http://www.isoc.org/internet/history/brief.shtml) or the one by Wikipedia (http://en.wikipedia.org/wiki/History_of_the_Internet).

[13] This linkage between social structure and communication media has been highlighted in the development of industrial firms by Bart Nooteboom (1999), who argues that: "when firms grow large, with the need and opportunity for delegation and specialisation in different activities in different departments, procedural knowledge, with its direct, face-to-face visual and oral coordination and communication, no longer suffices, and ways of doing things must be made explicit and explainable, i.e., must be turned into declarative knowledge, and must be documented to form instructions and standard operating procedures across departments or subsidiaries" (p. 139).

as a turning point in human civilization: “looked at in the perspective of time, man's biological evolution shades into prehistory when he becomes a language-using animal; add writing, and history proper begins” (p. 27). Among the numerous factors that differentiate oral communities from literal societies, Goody and Watt include a major difference in the processes of cultural innovation. According to the authors, the conservation and transmission of tradition is so deeply affected by the introduction of literacy that the evolution of oral and literal groups tends to be characterized by opposite orientations.

Oral cultures, relying on an implicit and embodied means of communication, tend to be homeostatic. As their traditional heritage is stored in individual memories and transmitted through face-to-face encounters, oral cultures are open to an incessant transformation:

> “The language is developed in intimate association with the experience of the community, and it is learned by the individual in face-to-face contact with the other members. What continues to be of social relevance is stored in the memory while the rest is usually forgotten: and language is the effective medium of this crucial process of social digestion and elimination which may be regarded as analogous to the homeostatic organization of the human body” (pp. 30, 31).

On the other hand, societies that employ explicitly and materially inscribed languages are constantly confronted with transcribed and thus fixed documentations. Cultures become therefore more rigid and self-aware of their transformation processes:

> “Instead of the unobtrusive adaptation of past tradition to present needs, a great many individuals found in the written records, where much of their traditional cultural repertoire had been given permanent form, so many inconsistencies in the beliefs and categories of understanding handed down to them that they were impelled to a much more conscious, comparative and critical attitude to the accepted world picture” (p. 48).

The distinction introduced by Goody and Watt is to be handled with the greatest care: too often the observed difference in innovation styles has been misinterpreted as a disparity in the quality or quantity of cultural development. A good example of this ethnocentric attitude can be found in some interpretations of Walter Ong’s theory (1982). Though correctly analyzing the stylistic distinction that differentiate oral from chirographic civilizations, the Jesuit scholar often seems to confuse this rhythmic distinction with a disparity in cultural dynamism. According to Ong, oral cultures tend to be additive rather than subordinative; synthetic rather than analytic, empathetic rather than objective, situational rather than abstract and, what is more important to this discussion, backward-looking rather than forward-looking; repetitive rather than inventive; static rather than dynamic.

As I will argue more extensively in the conclusion of this paper, it is characteristic of modern thought to consider itself gifted with an unprecedented dynamism. From the modern viewpoint, traditional oral

communities seem backward and stagnant if compared with the proliferation of artifacts and the extensions of networks that characterize modern technoscience. Yet, this perspective is distorted by an ideological and ethnocentric bias: we fail to acknowledge traditional creativity and cultural vitality, because we are used to conceive development in terms of succeeding revolutions[14]. Far from being static or conservative, oral communities experience a cultural evolution which is as intense as that of modern societies, although less evident[15].

As Goody and Watt suggest, oral communities, having few means to fix their cultures, tend to evolve through a process of continuous and gradual renovation. In contrast, literal societies, which have more codification tools at their disposal, tend to develop through succeeding stasis and revolutions. Comparing the quality or quantity of innovation will only confuse the actual difference between the two social regimes: while oral communities tend to be associated with linear innovations, chirographic networks are inclined to generate radical innovations. In other words, the availability of written media is likely to generate discontinuity in cultural development.

In order to be employed in my arguments about media explicitness and technical innovation, this idea needs to be generalized on one side and specified on the other. Firstly, I have to show that the dichotomy oral/literal can be expanded into a *continuum* of increasing media explicitness. Secondly, I have to show that the discontinuity effect noticed in cultural evolution can be highlighted also in the restricted field of technological development. Luckily, the first part of this work has been done by Elisabeth Eisenstein (1983), though in regard to the development of science.

In her remarkable essay on the revolution of printing, Eisenstein identifies a direct connection between the proliferation of modern scientific discourse in 17th century, the so-called Scientific Revolution, and the diffusion of movable types printing. It wasn't just the possibility of reproducing books more quickly and cheaply. It was, above all, the unprecedented capability of duplicating texts in a countless number of identical

[14] On the western conception of development see the last chapter of Serge Latouche (1994) book on the myths of modern technology.

[15] On the underestimation of the value and the vitality of traditional culture see Vandana Shiva (1988) "One knows so little about traditional beliefs, especially in the diachronic perspective, that claims about their stagnation, lack of creativity etc, can only be speculation. Thus one cannot legitimately talk of the 'open' and 'closed' predicament but merely of rapidly versus slowly changing belief systems" (p. 33).

copies. When the only available technology for replicating messages was hand-copying, it was impossible to diffuse a text without altering it. The very process of hand-duplicating entailed so many errors and variation, that there was no other way to preserve a book than secreting it. The standardization assured by printing radically transformed this situation bringing together two communicative functions that had been considered opposite till then: conservation and transmission.

This gave a double impulse to scientific system. On the one hand, through the standardization of codification means, printing favored the systematization and fixing of the existing knowledge. On the other hand, through an unprecedented diffusion of texts, printing stimulated the questioning of any previous assumption. This twofold drive accounts for the explosion of scientific discourse and explains its peculiar rhythm: the unremitting oscillation between stable paradigms and sudden revolutions that Thomas Kuhn (1962) identified as the destiny of science.

This linkage between printing codification and scientific discontinuity suggests the possibility of generalizing Goody and Watt's hypothesis beyond literacy towards more explicit media. We can therefore attempt to synthesize the argument of this paper into a simple hypothesis, the *principle of the discontinuity effect of explicit media*: the more explicit are the channels and the languages that mediate the circulation of knowledge, the more discontinuous and radical will be the innovation generated.

Explicitness and discontinuity of modern technology

The discontinuity effect of explicit media is particularly evident in the field of technology as remarkably illustrated by Scott Francisco (2005). Transposing Raymond Williams's theory of cultural development into the field of architecture, Francisco analyzes the influence of explicitness in the technology of building. According to the author, architectural culture is constantly balanced between the inertia of implicit tradition and the reforming power of explicit design:

> "At one end of the spectrum is the complex realm of 'culture' and 'craft'—traditional 'ways' of making, passed down from one generation to the next, that implicitly organize patterns of thought, behaviour, inhabitation and production at all levels. At the other end of the spectrum is a tendency towards uniqueness and specificity, which language , and representation in general, relentlessly promotes: Invention made possible and encouraged by an abstract system of projective communication".
>
> "Without new values being introduced, there would be no need for specification - relevant values would be implicit and therefore have no need of articulation. Reform, then, is a design project, and design always a kind of reform".

What has been observed in the domain of architecture can be generalized to any technical field. This appears especially clear if, looking at the extremes, we oppose the technological style of traditional artisan communities with that of modern industrial networks. Of course many of the divergences between traditional and modern technologies are to be attributed primarily to social and organizational differences. Still, the importance of the discontinuity effect of explicit media must not be overlooked. Technological systems cannot be reduced to their material surface. They are much more than a mere collection of utensils and machines. Embracing a wide collection of practices, beliefs, values, notions, routines, any technological system is kept together by a correspondent technological culture. And it makes a huge difference whether this culture is preserved and circulates through implicit or explicit media.

As long as technical information is embodied in individual memory and transmitted through face-to-face contact, as long as the design of technical artifacts is reproduced mainly through use and imitation, the development of technology will always be constant and linear, since every reproduction of technology is always potentially a renovation and there is literally no way to pause the continuous reworking of the same technical problems and solutions.

On the contrary, where technical knowledge circulates in highly explicit and formalized way, where the form and function of each technical device is recorded, measured and codified to the last detail, there the rhythm of innovation takes a different shape. On the one hand, explicit media favor the dissemination of technical knowledge, thereby stimulating the creation of new ideas by combination of technical notions derived from different social setting. On the other hand, formalization and standardization produce a considerable resistance to change. This double bind generates an intermittent technical development made of discontinuous and radical innovations.

A metaphor will illuminate this point. As a river left free to flow and subside, implicit technological knowledge draws its course through gradual and continuous modification of the landscape. Codification and formal languages work as river banks which discipline and fix the stream of knowledge. Yet, the construction of artificial banks generates a consequential accumulation of dynamic energies. Cultural materials, which used to be scattered during natural inundation and used to be gradually incorporated by the landscape, begin to settle on the bottom, progressively raising the river bed over the land level. Eventually, the inevitable flood of innovation produces a transformation of the technical landscape that is much more drastic and radical than the one produced by traditional change.

Now that I have laid out my reasoning, let me recap my argument. According with Dal Fiore (2005) main hypothesis, I have maintained that communities and networks can be taken as extremes of a *continuum* of social containers for innovation. Because of their different structural configuration, communities and networks tend to generate different innovation styles, respectively linear and radical. The main intent of my paper has been to suggest that this connection is significantly mediated by the influence of the communication means available to communities and networks. The key role, I have claimed, is played by the explicitness of different media, that is to say by the independence between meaning and context assured by higher levels of codification. Firstly, I have showed that different structural configurations are likely to be associated with media characterized by dissimilar degree of standardization. Whereas communities, being relatively homogeneous, can economize in explicitness, networks must connect their diverse components through highly codified channels. Secondly, using Goody, Watt and other authors, I put forward what I called the discontinuity effect of explicit media. This effect has been track down in cultural innovation, as well as, in scientific and technological development. In all these fields, the availability of explicit media makes the melody of innovation relatively more *staccato*.

Some empirical ground: the neem controversy

The reasoning I developed was meant to be nothing more than a useful suggestion. Yet, in the concluding pages I will try to give some empirical support to my reasoning. This will be drawn from a very specific field, which recently gave rise to much debate – the emerging issue of biopiracy. Biopiracy is a relatively new term that refers to an increasing number of legal actions brought by traditional communities against the attempt by global corporations to patent technologies based on indigenous knowledge[16].

Most legal disputes over biopiracy concern a twofold problem – what constitutes a technical novelty and what should be the form of technical knowledge. The first part of the dilemma is usually raised by traditional communities, which ask for the revocation of patents that cover innovations derived from notions embedded in their tradition. These claimed innovations, they argue, cannot be patented as they are nothing but translations into scientific terms of traditional elements cultivated and refined for centuries, though in an implicit form. The second part of the problem is then introduced by patents' defenders who assert that

[16] For an extensive description of the biopiracy issue see Vandana Shiva (1997 and 2001).

formalization does constitute a substantial (and thus patentable) progress. As long as it remains implicit, they hold, knowledge will be confined within the limits of community apprenticeship. Only by means of formal codification, can ideas be disembodied from their origin and thereby developed scientifically and industrially[17].

Resolving who's right and who's wrong in these disputes is not within the scope of this paper, as it would involve considering a much wider set of political and economic interests[18]. Yet, it is interesting to note that, in such disputes, these interests are usually pursued through arguments which are centered exactly on the same distinction drawn in this paper. Controversies over biopiracy patents[19] provide empirical ground to my arguments because they constitute the place where confrontations between community and network innovation, linear and radical development, implicit and explicit knowledge are actually and collectively debated.

The whole set of these oppositions is well illustrated in a very important case which has recently been discussed in front of the European Patent Office (E.P.O.): the dispute over patent EP 436257. Filed on December 12th 1990 and issued on August 4th 1994, this patent was meant to cover "a method for controlling fungi on plants through a preparation containing hydrophobic extracted neem oil". Despite its apparently minor object, this patent raised one of the largest controversy ever fought over biopiracy.

At least three reasons can be introduced to account for the unexpected importance of patent EP 436257. First of all, it concerns a resource which is consider vital by many traditional communities. Native to India, the neem, or *Azadirachta Indica*, is widespread and treasured throughout the South because of its extraordinary versatility and usefulness. Neem-derived products are employed for a variety of uses in medicine, toiletries, contraception, agriculture and the neem wood is appreciated for fuel and construction. Even more important, the neem is traditionally considered a free or collective resource as its Persian name suggests: *Azad-Darakth*, meaning "the free tree". Any attempt to lay claims over this precious and communal resource is therefore destined to conflict with tradition. Patent EP 436257, however, is not the sole nor the first

[17] On the importance of inscriptions and codes as means to abstraction in modern science and technology see Bruno Latour (1979 and 1999).

[18] Political and economic implications of bio-patenting are summarized in Maria Fonte (2004) especially pp. 42-61 and in Anna Meldolesi (2001) especially pp.83-124.

[19] On patents analysis as a methodological expedient for the sociological analysis of technology, see Geof Bowker (1992) and Thomas Misa (1992).

patent concerning the neem: the E.P.O. alone have released more than twenty patents for neem products and many other similar privileges have been granted by other influential patent offices, such as the American or the Japanese ones. To explain why this patent raised such an unparalleled dispute we have consider a second reason: the identity of its proponent. Patent EP 436257 was co-deposited by the Department of Agriculture of the United States and the W.R. Grace of New York, one of the most notorious multinational corporation[20]. Even before the patent was granted, W.R. Grace started a very aggressive business policy, installing industrial plants capable of processing more than 20 tons of neem seed a day and setting up a large network of neem seed suppliers. To be sure, the amount of neem seed purchased by W.R. Grace constituted only a small fraction of a very plentiful resource. Yet, because of the low elasticity of supply of neem seeds, even small purchases risked having a large effect on the price, with negative consequence on local ordinary neem supplying.

This two reasons alone would not be sufficient to account for the worldwide resonance of the neem dispute, without a third reason which transcends the specificity of the case. Because of the traditional importance of neem and because of the notoriety of W.R. Grace, the controversy over patent EP 436257 rapidly became the metaphor of a much wider controversy over the expansion of the western patent system to the South. In 1994, the same year of the promulgation of patent EP 436257, the WTO Uruguay Round released the much-discussed Agreement on TRIPS (Trade-Related Aspects of Intellectual Property Rights). Strongly wanted by western corporations and strongly opposed by traditional communities, the TRIPS Agreement is meant to extend the modern industrial patent legislation to the whole world. It would be too long to discuss the intense confrontation generated by this agreement[21], but it is interesting to note that it has much to do with the object of this paper. By extending the patent rules, western countries are seeking to extend the explicitness distinctive of modern industrial networks. On the opposite side, traditional communities all over the world are resisting this extension as it would undermine the implicit bases of their culture[22]. It is therefore not surprising that the neem controversy, which, as we will see, is organized around the opposition between implicit and explicit, has rapidly acquired such an emblematic importance.

[20] W.R. Grace had been involved in several serious scandal of environmental pollution, until in 2001 it declared bankruptcy to shield itself from hundreds of thousands of personal-injury claims connected with a severe asbestos contamination.

[21] For a detailed but critic summary of this debate see Martin Khor (2002).

[22] On the impact of intellectual property systems over traditional knowledge see Anil Gupta (2004).

The controversy over patent EP 436257 began officially the 14th of July 1995 when a formal opposition was filed to the E.P.O. by three women: Magda Aelvoet (then President of the Green Group in the European Parliament), Dr. Vandana Shiva (on behalf of the Research Foundation for Science, Technology, and Natural Resource Policy of New Delhi) and Linda Bullard (representing the International Federation of Organic Agriculture Movements). Right from the statement of ground which opened the opposition, the stake of the dispute was clearly identified: "this case is one of considerable public importance since it relates to the proper approach to the grant of patents for methods which have made been possible by traditional knowledge which developed over centuries in a co-production by nature and communities".

The opposition initiated a harsh legal controversy which lasted over ten years and went through two successive judgments before the Opposition Division and the Technical Board of Appeal of the E.P.O. What is more interesting, during the development of controversy, the arguments of the two parties progressively settled upon the same oppositions discussed in this paper[23].

Since the initial *Opposition Notice* (06/14/1995), the Opponents refused to recognize the patented method as a true innovation worthy of intellectual property protection. In India the fungicidal virtues of neem have been employed since time immemorial in traditional agriculture and in ayurvedic medicine. Therefore, patent EP 436257 was accused of lacking two basic statutory requirements, namely "novelty" (Article 54 of the European Patent Convention) and "inventive step" (Article 56).

In the *Response to Opposition* (04/11/1996), the patent's Defender tried to question opponents' arguments, by introducing a distinction between the baseline of traditional knowledge and the formal innovations of science and industry: "the existing knowledge will remain the common heritage of mankind and will not be affected by this or any other patent. On the other hand it is European tradition that publication of advances in the technical art shall be rewarded by a short term monopoly".

Answering to this distinction (08/11/1996), the Opponents produced several affidavits by a number of experts of Indian traditional wisdom as well as extract from ancient Indian texts. In addition, the Opponents provide the affidavit of Mr. Abhay D. Phadke, the director of a small Indian firm who employed the tradition knowledge to produce and commercialize a fungicidal product based on neem oil, long before the European patent. Through to this evidence the opponents tried to demonstrate that the knowledge cultivated in Indian

[23] All the quoted documents are publicly available at the website of the E.P.O. in the "epoline" section under the publication number 0436257.

tradition was by no means less comprehensive or refined than the one covered by the patent. This argument seemed to convince the Opposition Division, which released a Communication (30/09/1997) acknowledging the opponents' reasons.

In order to circumvent this objection, the patent's Defenders tried to shift the discussion to a higher level of explicitness (31/07/1998). Though admitting the existence of some relevant previous knowledge, they claimed that no scientific study of neem fungicidal properties had been accomplished before their own. To deny scientific status to Mr. Phadke experiments, the Defenders noted that they were not documented by any written records: "Mr. Phadke without relying on written documentation might be somewhat uncertain as to specific processes and components used. A scientific or field tester must have some records for such experiments and tests which might give further information and prove the alleged events". In the absence of scientific documentation, the extraction method coded by W.R. Grace was then to be considered inventive and thus patentable.

This attempt to rise in the level of codification required, however, was not accepted by the Opposition Division. During the *Oral Proceeding* (13/02/2001), the Opposite Division considered satisfactory the testimony of Mr. Phadke and refused to take into consideration the further documentations he submitted.

Knowing that the acceptance of Mr. Phadke's testimony meant the definitive refutation of any claim of novelty, the lawyers for USA/Grace submitted an *Auxiliary Request* which restricted the original claims of the patent: the concentration of Neem oil contained in the preparation was now specified precisely as 0.25%, no more, no less. Obviously, this extreme specification would have made the patent completely useless, since it would have made very easy for any competitor to produce a similar product without infringing the patent. Nonetheless, the patent owners hoped that, amending the formulation, so that it fell just outside the recipe described by Mr. Phadke, they could have at least avoided losing the patent.

Not even this ultimate attempt to introduce further explicitness saved patent EP 436257. The Opposition Division, though accepting the novelty of the amended claims, refused to acknowledge the new formulation as inventive. Being only a mere specification of a well-known technical knowledge, patent EP 436257 was then revoked because lacking in inventive step.

Few months later, W.R. Grace declared bankruptcy and its share of patent EP 436257 was took over by Thermo Trilogy Corporation. The new owner appealed to Technical Appeals Board of the EPO (12/06/2001),

more or less repeating the same arguments. Eventually, after three more years of controversy, the 8 March 2005, the patent on neem fungicide was entirely and definitively revoked.

Conclusions: away from knowledge society

To conclude this paper, there is an important lesson that can be drawn from the neem controversy. In the last few years, it has become very fashionable to define the advanced modernity of social systems through the notion of "knowledge society". This label is generally used with the implication that contemporary societies can be described as knowledge landscapes, whereas past societies were characterized by other strategic resources such as power or wealth. However, the example provided by the neem dispute and, in general, all the arguments developed in this paper suggest at least two reasons to reject this definition: knowledge is not sufficient or necessary to define modernity.

Knowledge is not sufficient to define modernity, as knowledge is by no means an exclusive privilege of modern societies. In its own peculiar way, every society is a "knowledge society". The idea that, through the process of modernization, western culture would have acquired a wider or superior knowledge estate is deeply ethnocentric. It is only because we measure with the rule of our specific culture, that we can pretend to be more experienced or sophisticated than other populations. Societies cannot be ranked according to the quantity or quality of their culture. To be sure, this is not a relativistic statement. Cultures are not born equal: each one has its own specificities and some of these specificities turn out to be *more adaptive* under specific circumstances. Modern western culture, for example, has repeatedly demonstrated its dominance when confronted with other cultures. Still we must not confuse supremacy with superiority. Modern civilization has prevailed not because it is gifted with a wider or superior knowledge, but because it has elaborated a cultural mechanism that proved to be dominant. This mechanism is media explicitness.

The uniqueness of modernity and the cultural imperialism which derives from it has been brilliantly analyzed by Bruno Latour (1991). In his "essay of symmetric anthropology", Latour convincingly confutes all the distinctions that have been drawn to set apart modernity from the preceding eras. Only one difference stands at the end of his reasoning, the tendency of modern society to organize larger and larger ensemble of people and things, or "collectives" in Latour's terminology[24]. I don't have the space to report the details of

[24] In Latour's works, the notion of 'collective' is preferred to the notion of 'social system" to stress the indissoluble tangle of people and things, institutions and machines, culture and technology that characterized any human group.

Latour analysis, but the conclusion is that modern groups can be discriminated only because of their size: "all collectives are comparable, except for their size, as successive coils of the same spiral… Many more objects require more subjects. Much more subjectivity require more objectivity" (my translation).

Latour gives no explanations for the gigantism that seems to affect contemporary societies, but I believe that modern expansion of collectives can be traced back to the discontinuity effect of explicit media. The availability of explicit media encourages the proliferation of collectives in three different ways. Firstly, the lack of the omission resources typical of implicit transmission tends to produce cumulative rather than substitutive processes. Secondly, because of the inertia generated by codification institutions, every succeeding innovation has to be upheld by an increasing mobilization of resources. Thirdly, the availability of codification tools maximizes the transmissibility and combinability of innovations, facilitating the creation of larger and larger apparatus. Together these three processes account for the exponential escalation of the collectives that characterizes modernity.

Even if Latour denies any qualitative difference between modern and traditional societies, he does not deny that the quantitative disparity between them does have its consequences. The most important of them is the aggressive attitude of modern western culture. According to the French anthropologist, the escalation of collectives that characterize modernity generates a natural drive for expansion and, at the same time, it provides modern culture with an uncontainable expansionistic momentum. Mobilizing and organizing an increasing number of people and things, modern collectives become stronger and stronger[25]. It is the process of codification itself that makes modern culture so overwhelming. Oral communities have few ways to shield their culture. There are, of course, rituals, myths, totems and the whole set of the so-called 'material culture', but generally oral traditions are not much stronger than the memory of their members. If individual memories are erased or transformed, not much will survive of communal traditions, no matter how rich or refined they are. On the contrary, insofar as cultures are made explicit and mediated by institutions and material supports, they assume the same strength of their media. If modern western culture proved to be dominant when confronted with less explicit traditions it is not because it possess more knowledge, but because its knowledge is supported by the strength of huge collectives made of libraries, newspapers, broadcasting stations, digital networks as well as other economical, political and even military institutions.

[25] See also the analysis of the role of "calculation centres" developed in Latour (1987).

Knowledge, then, is not sufficient to define modernity, but it is neither necessary. As what makes the difference is not knowledge, but the way knowledge is codified, it would be preferable to define modern social system as "information societies". The notion of "information" is here used in its most precise sense, as defined by Claude Shannon (1948) in his metric theory of communication. This theory, which consists in a set of mathematical transformations too complex to be discussed here, defines information in a way that is relatively close to my notion of "explicitness"[26]. What is most important, in Shannon definition of information there is absolutely no mention to the notion of knowledge. The sense of messages, the very value which humans attach to their communication is totally irrelevant to his theory. Separating information from knowledge constitutes Shannon greatest achievement. It is only by means of this separation, that today most explicit and most powerful medium, namely digital networks, could have been developed.

Understanding that nowadays information is definitely disengaged from knowledge helps us to reveal which forces are really driving our societies. As I have said at the very beginning of this paper, if we are obsessed with the accumulation of information, it is too often because we misunderstand the value of explicitness. It is indubitable, that explicit media brought great rewards to our societies: without explicitness there would not be modern science, modern technology and all the advantages that go with them. Yet, explicitness has its disadvantages, especially when it gets disconnected from knowledge. To replace the notion of "knowledge society" with that of "information society" may be the first step to look critically at the limits of our modernity.

[26] In the simplest of Shannon's formulation, in the case of a code consisting of N symbols independent and equally probable, the information carried by any message composed of n symbols can be defined as $n * \log_2 N$

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