The narrative dimension of nanotechnology

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Introduction

Basically, any technology gives individuals as well as societies the possibility to improve their lives and to free them from certain constraints. 'At its best, then, technology is nothing if not liberating' (Mesthene, 1970). Technology alleviates the tyranny of the human material constitution, its physical limitations, its spatio-temporal constraints, and its limited capacity to perform actions. Yet technology is not only for fabricating instruments: birds fabricate nests and chimpanzees use sticks for searching for food although they have not invented any technology. What turns instruments into technological objects are neither their level of complexity nor their function, but meanings. Human beings fabricate instruments that are full of meanings beyond their immediate purposes. In his essay *Power and Responsibility,* Romano Guardini (1961) presents an interesting thesis. He contends that the essence of technology lies in the human ability for establishing causal relations. This makes human artefacts not only instruments with a purpose but instruments that convey meanings. Unavoidably human beings think of the world as if any effect had a cause, though there is no way to demonstrate that the world really works in such a way.[1] When human beings turn a natural item into an instrument, or when they assemble and manipulate different natural objects to create a totally new item, they discover (or believe they discover) causal relations between objects, events and facts. Every manufacture, and every natural object used as an instrument, points at its functions, its purposes. But each object also suggests a spectrum of associated meanings. For instance a knife is a piece of metal with an edge that can be used to cut a piece of meat. Yet it also evokes the idea that there is a causal relation between being sharp and cutting. But people can be hurt by cutting, so also people are sharp (because the same causal relation works in different contexts according to our basic mental functioning), and so psychologists express this by saying that the process of symbolization entails transferring meanings from one mental representation to another, and that symbols are "over-determined", namely they convey multiple meanings.

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[1] Kant discussed this point in the third antinomy of the *Critique of Pure Reason*. The principle of sufficient reason, viz. each effect requires a cause, is the typical example of those synthetic propositions *a priori* that Kant showed to be "regulative", namely about our way to think of the world, rather than "constitutive", namely about the reality of the world.

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Technology and symbols

Manuals usually distinguish between symbols, signs and mental representations, according to their "semantic properties", that is the relations that they establish with reality (Todorov, 1977). The notion of semantic properties emphasises that mental objects need *some* bridge to reality in order to be processed and then communicated. However, I suspect that distinctions between symbols, signs and mental representations are largely immaterial, because in the last analysis all mental objects can be used—and actually are used—as symbols. All human activity originates in the use of symbols. It was the symbol that transformed our anthropoid ancestors into human beings. All human activities are symbolic: they consist of, or depend on, the use of symbols. Human beings may use—and actually do use—mental representations of every object and act to convey meanings, they can turn any object and (f)act into a symbol. There are symbols that are shared by the whole species, symbols that are specific to a culture or a community, symbols that belong only to small groups, and symbols of individuals. Society is constituted not only by material things such as the territory occupied by individuals, the objects they use, or the actions they perform, but also by the whole complex of symbols and symbolic formations, such as imageries, rituals, ceremonies, myths, narratives, which circulate in the social body.

The role of symbols in the constitution of the collective should be traced to Emile Durkheim's work *The Elementary Forms of Religious Life* and to Gustav Jung's research on the collective unconscious. More recently, the collective symbolic template has been explored in different ways by social scientists (Jameson, 1981; Maffesoli, 1993; Taylor, 1989) and psychoanalysts (Castoriadis, 1987; Mordini, 1996; Hopper, 2003). Though having different perspectives, these scholars suggest that collective action emerges from a collective imaginary, a kind of cultural conditioning that generates a sense of identity and inclusiveness between the members of a group or community. Every human being is born into a prefabricated environment that comes with a complex catalogue of messages and stimuli, which will influence him or her. Individuals belong to multiple groups through birth, assimilation or achievement, and each group influences individuals' beliefs, values, attitudes and perceptions. The collective imaginary acts as a filter for new information; it is the lens through which people perceive the world.

A framework for categorizing the symbolic dimension of technology is that articulated by Feenberg, who distinguishes between social meaning and cultural horizon (Feenberg, 1992). By "social meaning", Feenberg means the social ends that justify a technology. In other words the social meaning is the explicit reason why a society develops that technology instead of another one, and why, among a batch of technically viable options, only few are chosen by social actors. Feenberg also suggests analysis of the "cultural horizon" of any technology, by which he means the general assumptions that are behind any technological choice. Cultural norms and social values shape technology and technology choices. They often lie below the threshold of conscious awareness for inhabitants of a given civilization. They are embedded in any technology in a manner that is natural and obvious. For instance, in developing mobile communications we tend to consider dialogue and communication as vital values. In a civilization in which solitude were valued more than company, mobile communication would develop rather differently, if it ever developed at all.

I propose to add a third parameter to those identified by Feenberg, derived from analysis of the narrative dimension of any technology. In this paper I shall show how this parameter can be applied to nanotechnology.

The narrative dimension

When I speak of the narrative dimension of nanotechnology I do not mean only explicit "stories"; I rather mean the inner narrative structure behind any discourse on nanotechnology. All forms of human communication are narrative at heart, according to the so-called 'narrative paradigm' as it was first presented by Walter Fisher (1984). Fisher argued that we experience and comprehend life as a series of ongoing narratives, as conflicts, characters, tropes, beginnings, middles, and ends. By this, he means not so much that we always tell stories, rather he believes that narrative provides a conceptual frame that would account for the 'stories' we tell each other—whether such 'stories' are in the form of logical argumentation, mathematical formulae, musical compositions, paintings, novels or performances (Fisher, 1992). There is a spectrum of explicit and implicit narratives in cultures, ranging from founding myths rooted in the political realm to the highly personal proto-narratives we dream. I argue that narrative is a primary meaning-making tool in culture, the mediator between individual sense-making and collective beliefs, canons and perspectives. Narrative motifs from explicit stories that circulate in public life move into people's dreams and private symbolic systems, where these motifs interact with other shared meanings. These narrative motifs are then combined in novel ways, and these combinations generate a new network of meanings. The narrative spectrum, together with this symbolic traffic, fertilized with fantasies from all forms of human discourse and narratives, establish the conditions for any human activity. Fantasies, both conscious and unconscious, influence our outlook and our acts. They are not just stories, they are a form of mental activity, which often leads to physical and concrete effects. Analysing the narrative dimension of a technology then implies a retrospective understanding, very similar to the psychoanalytic *construction* (Freud, 1937).

According to Bal (1997) narratives can be analysed at three different levels. The lowest level is the *Fabula*, the series of events that are being represented. The second level is the *Story*, this is a subset of the *Fabula* restructured into a meaningful sequence for a particular effect, for example to build tension or expectation, or to inform the user about the background of a topic. For any given *Fabula* one could derive a number of different *Stories*. At the third and highest level is the *Narrative* itself. The *Narrative* is the story given form with all the added semantics of the form itself. Any given story could be turned into many different narratives, for example a monologue, novel, film or multimedia presentation. I propose to follow now this intuitive scheme to sketch some elements of the narrative dimension of nanotechnology. Of course to carry out a full discussion would require a more in-depth analysis, which would be beyond the scope of this paper.

Fabula and story

At the lowest level, the *Fabula*, we meet the most peculiar problem raised by nanotechnology, namely the problem of its irrepresentability. Nanotechnology involves a series of events that can hardly be represented because of their scale (as I am going to argue later this is not the sole reason, but for now we can accept this easy explanation). One of the most effective means to represent the irrepresentable is by using metaphors. Most people think of metaphor as belonging exclusively to the language of poetry and imagination. Yet research in cognitive linguistics over the past twenty years has shown this commonplace idea of metaphor to be untenable. The cognitive research has revealed that metaphors permeate everyday speech and

are a major component of conceptual thinking. Lakoff and Johnson (1980) have eloquently expressed this view: '[Metaphors] are among our principal vehicles for understanding. And they play a central role in the construction of social and political reality'.

Each metaphor suggests a spectrum of related meanings, just as a note played by a musical instrument necessarily involves its whole harmonic series, and this makes metaphors psychologically invasive. People tend to forget the metaphorical origins of many expressions, and they use metaphors as if they were objective descriptions. This has important implications for scientists. Scientists tend to believe that only the public need metaphors to conceptualize the work that nanoscience is attempting, while they themselves do not. They are wrong, any technological discourse is imbued with myths and metaphors and nanotechnology makes no exception.

Events that constitute nano *Fabulae* are very often metaphorically constructed. An instance can illustrate very well my point: the official birth of nanotechnology dates from November 1989, when scientists at IBM's Almaden Research Center in California wrote the letters of their corporate logo from 35 xenon atoms (Eigler & Schweizer, 1990). It would be difficult to think of an event more evocative and full of symbolic meanings. Not only any logo is by definition a symbol but in this case it implies a highly sophisticated metaphor. As a matter of fact, nothing of what the scientists did in order to produce a visual illusion of the IBM logo could be properly described as "writing", and this expression is definitely evocative rather than descriptive. Let us try then to decipher at least a few elements of this *Fabula*. First, consider the choice of writing the corporate logo. A corporate logo is not different in essence from the Stars and Stripes flag erected on the Moon; or the Royal Standard of Spain that Columbus planted on San Salvador in the Bahamas on October 12, 1492. The logo tells us that we are discovering a new world, but also that we are conquering it, we are planting our King's flag on it. Nanotechnology is not only a new land to discover but it also a new territory to subjugate. The IBM logo is close to the iconic photograph of the five U.S. Marines and a Navy corpsman immortalized by photographer Joe Rosenthal while raising the U.S. flag on Mt Surabachi during the Iwo Jima battle. Perhaps most current controversies surrounding "intellectual property" (IP) and nanotechnology could be better understood and tackled if one remembers that the birth of this technology was marked by an act of supremacy. Yet there are still other elements of this *Fabula* that deserve discussion. For instance, even the decision to "write" is not meaningless. The idea that something written is stable and certain is very ancient in Western culture. Undoubtedly one of its roots lies in Jewish culture, the culture of the book. However the most important tradition, which connects writing to something fixed, comes from Roman culture: "What I wrote, I wrote" (*quod scripsi, scripsi*) claimed Pontius Pilate (John, XIX, 22); writing crystallizes a will and renders it unchangeable. Actually the authors did not write anything, but positioned atoms in a way that could allow the electron microscope to produce an image that could remind us of something written. The demonstration was closer to a Chinese shadow show than a name carved in stone. And indeed another specific consequence of the nanoscale is that the nano world is in a state of continuous change. The idea of describing this world in carved stone, though paradoxical, achieves the basic result of counterpoising a feeling of instability that we may feel when we try to create mental representations of nano-events.

Dealing with nanotechnology, it is not then easy to distinguish between a mere series of events and its organization into a meaningful sequence for a particular effect, as we have

described the second narrative level, the *Story*. Because the nano *Fabula* is made up of a series of metaphors rather than events, it tends to become immediately a story. Moreover, nanotechnology encompasses a wide range of basic science, methods and engineering approaches, and looking for its unique "story" might seem unrealistic. There is no common ground between different nanotechnologies except that their productive system is based on a peculiar process of manufacturing hardware, which implies the production of new materials with high performance, unique properties and functions that traditional chemistry could not create. Nanotechnology can hardly be considered a unique field of research and technology development but for the scale on which it operates. Yet the nanometre scale is not a trivial element. The scale entails an important consequence, as at the nanoscale materials possess totally new features and their fundamental characteristics—electrical, magnetic, chemical and physical—undergo change. Though people often think of nanotechnology in terms of extreme miniaturization, size *per se* is the least interesting aspect of nano-objects. What really matters are their properties and the way in which such properties are affected by size. Eventually nanotechnology could be also described as a technology that aims to change the properties of known materials. It is not by chance that some authors have recently compared nanotechnology to alchemy:

> The claims for nanotechnology are strikingly similar to those of alchemy. Nanotechnology shows two faces in today's world. The first face matches the real results of medieval alchemy in that nanotechnology, as a method of materials science, has already produced a variety of new and improved products. The second face matches the aspirations of alchemy; boosters of nanotechnology claim that it will ultimately give us a method through which one form of matter can be changed into any other, and will lead to unprecedented wealth, restoration of the body, and even life everlasting (Herzfeld, 2006).

Actually, the "transhuman" debate can probably be better understood if one considers alchemy as one of the main stories that underlie nanotechnology development.

Yet there are always several and contradictory stories that run under the immediate surface of any human activity. Nanotechnology is very diverse and the implications of its applications are highly context-specific. People are not going through (and will probably never go through) dramatic revolutions. In everyday life, nanotechnology means and will increasingly mean a growing availability of customized objects produced with materials whose properties have been carefully tailored to different market segments. Nanotechnology is then part of a larger trend, which is pushing towards the production of highly tailored and customized goods and services (Pine, 1993). While industrialization was marked by mass production, post-industrial societies are characterized by technology's capacity to facilitate customization. Increasingly consumers want hardware that is unique to them, and companies, too, need new and unique configurations to fit their increasingly unique needs. For now mass customization is essentially production on demand, yet in principle it is no more than logistics or marketing, it is marrying data processes to innovative manufacturing processes. Molecular manufacturing (nanotechnology) lowering manufacturing unit cost, tailoring materials to consumers' need, and requiring less volume of

materials and energy consumption paves the way for making mass customization a leading paradigm. There is thus another story—beyond alchemy—that can help us to understand public perception of nanotechnology, that is the trope of "little people", pixies, small folk and other magic creatures living in parallel worlds or anyway hidden, who produce magic objects that serve their master—a child, a young girl or a boy. This is a trope of both myths and fairy tales and it is really curious that only little people are usually responsible for the production of magic objects. In any case those who deal with science communication should try to balance the nano fantasies of superpowers and omnipotence related to alchemy and transhumanism with more modest and decent feelings of living in a world where nice, small folk take care of good boys. Maybe it is a bit childish but it is definitely less dangerous than any appeal to *uebermenschen*.

The idea of tailored objects may recall another trope, the trope of "living objects". We have the tendency to regard inanimate objects as living and conscious (animism) and to ascribe to them human characteristics (anthropomorphism). Both tendencies are spontaneous and pervasive in early childhood, and though attenuated in adulthood they never disappear. Human beings have a continuous and silent conversation with objects, for to human minds all is animated, living, all is full of gods. In his *Le Dieu Object*, Marc Augé (1988) suggested that all people—including adults, "civilized" people—attribute human shape and qualities (such as agency) to the widest range of objects and phenomena imaginable. In the past few years, several authors, including Stewart Guthrie (1993), Nurit Bird-David (1999), Tim Ingold (2000) and Graham Harvey (2005), have shown renewed interest in animism. Their view of animism differs significantly from the traditional definition. Rather than a "primitive", "childish" superstition of attributing life to the lifeless, animism should be understood as alternative responses to universal semiotic anxieties about where or how to draw boundaries between persons and things. These very boundaries are threatened by all new technologies; Marc Pesce (2000), one of the early pioneers of Virtual Reality, speaks of 'techno-animism' to describe a world pervaded by computational objects (Aupers 2002). Blogjects (Bleecker 2005) is a neologism introduced to describe objects that blog, i.e. a network of tangible, mobile, chatty objects enabled by miniaturization, the ubiquity of consumer electronics and a pervasive Internet. Nanotechnology, by changing the inner structure of objects and materials, and by allowing an extreme miniaturization of computing technologies, can enable us to develop a true techno-animist environment. Yet the worst fate for a fantasy is to become reality before a new one takes its place, or to be thought of as reality. This is the risk with animism and nanotechnology. Narratives about self-replicating nanorobots ready to rebel against human beings seem to anticipate techno-animist fears rather than express a more obvious science fiction scenario.

This leads us to the third and highest level of analysis, namely the *Narrative*, in the sense of explicit, literary, artistic and musical forms and so stories.

The narrative

Scholars' interest in narrative and nanotechnology has been growing and several good papers have been published in the last five years (Fogelberg and Glimell, 2003; Macnaghten et al., 2005; Kaiser, 2006; Kurzweil, 2006). The current agenda includes popular literature, music, arts, films, both diachronically (e.g., history of 'nano' themes in popular literature and

science fiction) and synchronically (e.g., comparison of the way in which the same themes are considered by different expressive means). In their largely quoted paper, Jim Gimzewski and Victoria Vesna (2003) give a clear, and largely accepted, explanation for this interest:

> In both the philosophical and visual sense, "seeing is believing" does not apply to nanotechnology, for there is nothing even remotely visible to create proof of existence. On the atomic and molecular scale, data is recorded by sensing and probing in a very abstract manner which requires complex and approximate interpretations. More than in any other science, visualization and creation of a narrative becomes necessary to describe what is sensed, not seen […] The scale becomes too abstract in relation to human experience.

Eventually Gimzewski and Vesna advocate 'developing narrative in the construction of a new science and industry […] is not necessarily negative, and has a potential to connect media arts, literature, and science in many new and interesting ways'. Their argument is also echoed by David Rejeski (2005), Project Director at the Woodrow Wilson International Center for Scholars:

> Narrative is one of the most fundamental and powerful elements of human cognition. We are, as a species, storytellers, and the stories we tell—either personal ones that shape our perception of ourselves, or collective ones that shape social interactions—are an enduring part of human behavior. People trying to make sense of an emerging technology will fall back on narratives long before they pick up a physics or biology book and try to understand the science […] The key to understanding public response to nanotechnology is not to be found in the latest peer-reviewed journal or yesterday's headlines but in decades of collective narratives mixed with new storylines, often from mediated sources.

Other students have discussed narrative as a form of symbolic coping with nanotechnology (Wagner et al., 2002), the role of science fiction in shaping public understanding of nanotechnology (López, 2004), and nanotechnology and myth-telling (Toumey, 2005). Tourney's paper is particularly intriguing because it enlightens the puzzling fact that until now the general public has shown little appreciation of nanotechnology. This observation is confirmed by almost all recent surveys (see for example, EUROBAROMETER, 2005; Macoubrie, 2005; TA-SWISS, 2006). A possible explanation could be in what Rejeski (2005) notes, that 'a sphere of public interest around technology tends to emerge in response to threat more than promise'. It would imply the discouraging consequence that people will appreciate nanotechnology only when they fear it. Though it could be partly true, I would like to suggest that a certain lack of public attention towards nanotechnology is also due to a lack of 'mentalization', that is, a lack of imagery concerning nanotechnology. It does not depend only on the scale at which nanotechnology operates, as Vesna and Gimzewski seem to believe, but is probably due to a more radical incapacity to represent events that happen in a world ruled by different physical laws (Schummer, 2005).

One of the most influential philosophical papers of the last decades concluded that 'there are facts that do not consist in the truth of propositions expressible in a human language. We can be compelled to recognize the existence of such facts without being able to state or comprehend them' (Nagel, 1974). Nagel points out that the essence of any experience is subjective, and mental phenomena do not admit explanations in objective terms. However his argument can be easily enlarged to comprehend the crisis of representation of modern science that limits our ability to express the insights we achieve in scientific research. We are accustomed to thinking of scientific models that refer to an independently existing reality outside them. On the other hand, modern sciences typically study unobservable and unspeakable entities that cannot be categorized in terms of any human experience, but only in pure mathematical terms. We can translate bits of them into art, poetry, drama and novels but basically we cannot process them with our mind. This is the case also with nanotechnology.

Concluding remarks

We have provided an introduction to some of the basic themes related to the public perception of nanotechnology as they emerge from interpreting various elements of its narrative dimension. There are at least three major research lines that we would like to propose for a future agenda:

1. Research on nano-metaphors, that is research on metaphors used to express events at the nanoscale and which are unthinkable and irrepresentable for us.
2. Research on the tension between paranoid narratives (e.g., alchemy, techno-animism) and nano-fairy tales (e.g., small folk and little people).
3. Research on actual, explicit narratives based on nanotechnology.

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