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De Boeck Supérieur | *Journal of Innovation Economics & Management*

2014/3 - n°15
pages 39 à 57

ISSN 2032-5355

WHAT DOES INNOVATION STAND FOR? REVIEW OF A WATCHWORD IN RESEARCH POLICIES[1]

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Innovation is on the agenda of every research policy. To take but one example, the European Commission set the objective in 2010 of developing an "Innovation Union" by 2020. This "Europe 2020" strategy follows on from the "Lisbon Strategy", promoted in 2000 with the aim of making the European Union the "*leading knowledge-based economy*". Without dwelling on the results of the previous ten-year agenda, the reference document instantly asserts that competitiveness, employment and standard of living in Europe depend primarily on its ability to promote innovation, which is "*also our best means of successfully tackling major societal challenges, such as climate change, energy and resource scarcity, health and ageing, which are becoming more urgent by the day*" (EC, 2010, p. 2). Tasked both with stimulating the economy and protecting, if not improving, living conditions, innovation, as omnipresent as it may be in that document (there are more than 300 occurrences of the word on less than 50 pages), is not defined anywhere. Its meaning is taken for granted and evident. It is this obvious fact that we wish to question, together with the coherence of the various aims ascribed to innovation.

Other documents naturally complete and specify what "innovation" means with a view to its assessment and implementation or, at least, to fostering its emergence. The third edition of the *Oslo Manual* (OECD, 2005), developed jointly by the Organisation for Economic Cooperation and Development and a European Commission body, is devoted to "Guidelines

1. Our thanks to Bernard Bigot, François Bontems, François-Xavier Dudouet, Yves Gingras, Etienne Klein, Erwan Lamy, Yann Renisio, Thomas Valli and the evaluators for their wise input which considerably helped improve this document. We remain solely responsible for the arguments put forward herein.

for collecting and interpreting innovation data". After, in turn, insisting on the great need and expected benefits of innovation, the *Manual* proposes the following brief definition: "*An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations*" (OECD, 2005, p. 54).

The third edition of the *Manual* stresses that this definition marks a significant change from the previous version which only considered the creation or improvement of products or processes, i.e. what people call "technological innovation". This broadening of the definition of innovation to marketing and organisation is therefore presented as something new, the definition being under development and still needing a few adjustments. In fact, it is merely a turn back to the traditional economic definition, established by Joseph Aloïs Schumpeter, in 1911, in his *Theorie der wirschaftlichen Entwicklung*, the English translation of which (Schumpeter, 1934) is included in the *Manual's* bibliography. The authors subsequently explain and comment on it in detail, but without putting it back into the original conceptual framework in which it takes on meaning. Our question therefore emerges as follows: is current use of the word in research policy documents underpinned by one or more theories? Or is it a pragmatically developed conceptual framework?

In the *Manual*, an explanation of methods for measuring innovation specifies the key characteristics: the outcome of the innovation is uncertain; innovation requires investments; it produces appropriable spillovers (typically patents); it involves new knowledge or new combinations of existing knowledge; lastly, it is supposed to provide the person using it with a competitive advantage. While this conceptual network might appear evident, we must point out that it is not obviously coherent without any empirical or theoretical justification: does an organisational change inevitably induce a lead over the competition? – Does a change in marketing methods involve a new combination of knowledge? – Does every technical development secure a return on investment? – None of these standard questions can be answered without explaining, even remotely, a conceptual framework and empirical criteria for identifying innovation and assessing its aptitude to achieve the many aims it is assigned. Yet, this is never done in documents organising the governance of research. Innovation is most of the time taken to be the solution to every problem.

In a way, although it is presented as the means of achieving all sorts of (no doubt diverging) aims, innovation emerges as an end in itself. How did this situation come about? – How significant should we consider the concept

of innovation to be in the current context of reforms of research institutions? – Such are the questions that, to finish, we would like to address and which have already been raised by social science researchers (for a review of the literature, see Hanel, 2008). Above all, we shall acknowledge the considerable work done by sociologist Benoit Godin (2008a, 2008b, 2009, 2010) in unearthing sources of reflection on innovation. A philosopher of science and technology takes a completely different approach: over the length of his long-standing discipline and with the inevitable judgement inherent in a tradition that only retains "great names", he or she examines variations in the meaning of the word "innovation" to highlight certain tensions that (de)structure its use today. It is therefore both a "genealogical" investigation, within the meaning of Nietzsche, which draws on the untimeliness of prior diverging, or even conflicting, definitions (rather than an "archaeology", in the sense of Foucault, which would claim to probe the historical strata to reveal the effective evolution of the concept), and a "spectral analysis", within the meaning of Gaston Bachelard, which detects the interferences of a notion with different conceptual horizons.

To roll out this sequence of questions (the obviousness of the concept, the nature of any conceptual references, the reasons for its current hegemony), we will begin by going back over the pioneering use of the word made by two Renaissance thinkers: Machiavelli and Bacon. This will be an opportunity to highlight a contrast between innovation designed as a risky disruption and innovation designed as a gradual and well-managed change. We will then briefly examine three research traditions (in sociology, economics, and history of technologies), which developed innovation theories in the 20th century. We will see that the term encompasses diverse realities and refers to very different conceptions of historical evolution. Lastly, we will consider how models of the "innovation chain" have developed, from the "linear theory" to the "chain-linked model". Here, we will demonstrate how such evolution involves a change in the very function of a reference to innovation in discourse on relationships between research policies and the economic world. This evolution is above all marked by a reversal in priorities between institutional aims (knowledge production) and managerial organisation of scientific research. We will conclude with a few remarks on how researchers see this as a contradiction. Although this work is based on material apparently unknown to the writers of the countless official reports on innovation, we suggest that knowledge of this conceptual genealogy nonetheless clarifies certain failings, or even contradictions, concealed by non-reflective use of the concept of innovation.

THE FORGOTTEN ORIGINS OF REFLECTION ON INNOVATION: MACHIAVELLI AND BACON

The verb "innovate" was borrowed in the 14th century from the low Latin "innovare" meaning "to renew" but which previously meant "to come back to" in classical Latin (Rey, 2006, p. 1840). It was first used in legal jargon, to mean introducing something new into something established, before becoming part of the political and theological register. As Godin reminds us (2008a, p. 24), the terms "innovate" and "innovation" can then be found in the writings of two major Renaissance thinkers: Niccolò Machiavelli and Francis Bacon. In 1513, in *Il Principe*, Machiavelli does not use *innovatio* but the verb *innovare* (in chapters IV, VI and XXI) and the noun *innovatori* (chapter VI), which are used to describe how a Prince can break with habits and take initiatives. While the exact occurrences of these words are of little interest here, the conceptual framework in which Machiavelli studies the opportunity of innovating deserves to be recalled. In chapter 25, he writes on "What Fortune Can Effect in Human Affairs and How to withstand her" (Fortune naturally meaning here "luck" and not "wealth").

Machiavelli establishes a contrast between two kinds of behaviour: one is daring and consists in taking action surprisingly, by suddenly changing attitude and reforming customs; the other is cautious and consists in acting safely, after careful consideration, in a consistent manner and without upsetting habits. There are advantages and drawbacks to both; their success depends on the circumstances, and the time and place, which sometimes demand daring action, sometimes the use of caution. But a Prince who has achieved his ends by one method or the other tends to believe that it will always be the best one, so much so that he suffers a reversal of fortune when a change is necessary. The method used to gain power is very rarely the right method for retaining it. Innovation is therefore what enables a Prince to deal with crisis situations, whereas it can become counter-productive when he needs to stabilise his position. As we can see, there is no question of knowledge here, even though Machiavelli insists on the fact that one must learn to think in a certain way, i.e. with cunning (like a fox), because strength and determination are not always enough. The thing to remember about the reflective attitude advised, is that innovation is only appropriate in a crisis situation (whether active or latent) since the ordinary development thereof would lead the Prince to ruin. This danger of innovation is echoed in Montaigne's *Essais*: "*Nothing presses so hard upon a state as innovation: change only gives form to injustice and tyranny*" (Montaigne, 2002, p. 1495).

Innovation is also the topic of one of the chapters of Bacon's *Essays or Counsels, Civil and Moral*, published in 1625. Baron Verulam was one of the founding fathers of scientific modernity. Immanuel Kant devoted his *Critique of Pure Reason* to him. Aware of the resistance to progressive ideas, and keen to overcome them, he integrated the question of the reception of new ideas and techniques into the background of his thinking on innovation; even though the term also keeps the political meaning it was given by Machiavelli. He writes about innovations: "*As the births of living creatures, at first are ill shapen, so are all innovations, which are the births of time. Yet notwithstanding, as those that first bring honour into their family, are commonly more worthy than most that succeed, so the first precedent (if it be good) is seldom attained by imitation. For ill, to man's nature, as it stands perverted, hath a natural motion, strongest in continuance; but good, as a forced motion, strongest at first.*"

The text begins by establishing two analogies. The first excuses innovations for their weaknesses by comparing them with newborns: the second, however, underlines the risky nature of innovation by expounding a general tendency to deterioration: ill worsens whereas good weakens. As this tendency is not specific to innovations, but to time, innovation must be regarded as a way of withstanding it: "*Surely every medicine is an innovation; and he that will not apply new remedies, must expect new evils; for time is the greatest innovator; and if time of course alter things to the worse, and wisdom and counsel shall not alter them to the better, what shall be the end?*"

Bacon then explains that innovations are seldom conceived in this way owing to social conformism: "*It is true, that what is settled by custom, though it be not good, yet at least it is fit; and those things which have long gone together, are, as it were, confederate within themselves; whereas new things piece not so well; but though they help by their utility, yet they trouble by their inconformity. Besides, they are like strangers; more admired, and less favoured.*"

This argument, which asserts the disadvantage of innovations compared to things long established, is then reinforced by another, on people's views of change and its causes: "*For otherwise, whatsoever is new is unlooked for; and ever it mends some, and pairs others; and he that is holpen, takes it for a fortune, and thanks the time; and he that is hurt, for a wrong, and imputhed it to the author.*"

However, before that, he resumes his argument on the corrupting nature of time, insisting on the fact that innovation is not only desirable, but essential: "*All this is true, if time stood still; which contrariwise moveth so round, that a forward retention of custom, is as turbulent a thing as an innovation; and they that reverence too much old times, are but a scorn to the new. It were good, therefore, that men in their innovations would follow the example of time itself; which indeed innovateth greatly, but quietly, by degrees scarce to be perceived.*"

Here, the text gives its main piece of advice: innovative practice should be adjusted to that of time, by innovating quietly and gradually. This is a variant on the general maxim that we should conform to Nature. We then find two more specific pieces of advice, one political, enjoining us to innovate only where there is an urgent need or an obvious advantage, and the other ethical, which recommends taking time to think before moving into action.

Beyond the reference to the Aristotelian opposition between natural motion and forced motion, we could easily find Bacon's phrases, almost word for word, in current considerations on the ethical and societal risks of innovation. The introductive analogy with a newborn is a *leitmotiv* of reflection on ethical responsibility in respect of new technologies, which we must protect and supervise during their turbulent youth before they reach maturity. The whole argument about innovation's lack of conformity could be written today. The swing between recognising the uncertainty inherent in innovation and the certainty that innovating never involves an even greater risk (already pointed out by Machiavelli) is found in every text addressing the "acceptability" of new technologies. The choice of the example of medicine echoes modern-day issues of innovations in healthcare, even though, in the original text, the "remedies" are, no doubt, but an extension of the analogy with the introduction of novelties designed to withstand the corruption of time. The final reminder of the need for caution would not be out of place in a contemporary text either.

Therefore the most troubling thing in this text is that it barely seems to have aged: today, ethical thinking is still called for as a prerequisite to any informed choice between the different possibilities that innovation offers. However, despite the surprising strength of Bacon's reasoning, we must emphasise that his conclusion, recommending gradual and controlled innovation, fits into an argument which presupposes a certain conception of time. Time is, according to Bacon, "the greatest innovator"; its cycle gradually changes everything for the worse and must be countered by human effort. This metaphysics of corrupting time, with slow, steady and inexorable motion, is also Aristotelian; it is completely opposed to that of Machiavelli, to whom time is a neutral factor paced by fortune. Machiavelli therefore tended to defend risky, decisive and occasional innovation, whereas Bacon advocates gradual and ongoing innovation. Both, however, insist on the fact that it would be unwise to value innovation for the sake of it and that all recourse to innovation demands an adjustment of one's action to the evolution of time itself.

To summarise, the forgotten origins of innovation reveal an ambivalence, not to say a contradiction, in recourse to the concept of innovation, since it

can correspond to contrasting directions and metaphysical bases. Of course, if we put them back into their respective political contexts, one of crisis and the other of attrition, disruptive innovation and gradual innovation are no doubt strategically complementary. However, these writers pose the question of the propriety of innovation. And as for the connection of this notion with progress in science and technology, the question only progressively emerged from the end of the 19th century.

THREE DISTINCT RESEARCH TRADITIONS IN SOCIOLOGY, ECONOMICS AND HISTORY AND PHILOSOPHY OF TECHNOLOGY

We owe the very first definition of innovation in a contemporary context (1890), to the great rival of Emile Durkheim, the sociologist Gabriel Tarde. *The Laws of Imitation* (Tarde, 1993) sets out his theory (which actually is more a matter of collective psychology than an analysis of social factors), whereby imitation is the main mechanism of social cohesion: an individual is inclined to imitate the behaviour of others, particularly where such behaviour is regarded as specific to higher social classes. Society tends to be conformist and conservative. However, the mechanism of innovation disturbs this functioning and explains changes in habits: some individuals *innovate*, i.e. they adopt new ways of behaving, whether or not they are aware of it – "*for the individual often innovates unconsciously*" (Tarde, 1993, p. 13); and these behaviours gradually spread through society by imitation. In principle, innovation bears no relation with scientific research, but is often based on the adoption of new objects or new uses of existing objects. Within the framework of this theory, where innovation is implicitly given a very broad and therefore quite loose definition, "innovator" does not refer so much to the person who invents an object as to the one who adopts it. These material innovations give rise to new ideas. Tarde, however, stresses the fact that ideas and habits spread faster than objects, such that desires are ahead of the acquisition of the object. Without knowing it, current research on "social innovation" sometimes revives this definition of innovation as a new latent individual desire that proceeds and influences relationships with material devices (see Klein, Harrisson, 2006).

However, the legacy of Tarde's conception of innovation must above all be looked for in the American sociologist Everett M. Rogers, a true founder of "sociology of innovation": *The Diffusion of Innovations* (Rogers, 1962) explicitly refers to the laws of imitation. Rogers statistically defines categories

of population based on the velocity with which innovation spreads out: *innovators* are those who adopt a new product the fastest (and who generally account for 2.5% of the population); they are followed by the early adopters (13.5%), the early majority (34%), the late majority (34%) and the laggards (16%). Like in Tarde, the innovator is identified, not with the inventor of an object but the adopter of that object. But sociology of innovation changes considerably, moving away from the model of traditional societies and adapting to consumer society: innovation then means the spreading out of new behaviours brought about by new objects, which itself takes places primarily through market mechanisms. So much so that the innovator is above all a pioneering consumer. Even though Rogers emphasises that his model also applies to the field of healthcare, for example to the spread of contraception, his theory is above all designed to account for the commercial success (or failure) of new products put onto the market, depending on their ability to attract innovators who will subsequently influence other consumers. At the same time, the relationship Tarde suggests between the spread of ideas and the availability of objects is reversed: "*the adoption of a new idea almost always entails the sale of a new product*" (Rogers, 1962, p. 261). Although certain counter-examples can be found, the book's fantastic success and the persistence of the research tradition it promoted make it the core theory of innovation in sociology. According to certain researchers (Fougère, Harding, 2012), current discourse on innovation, particularly the *Oslo Manual*, owe a lot to the promotion of the concept of innovation developed in this tradition in the 1960s, even though such discourse dismisses the social dimension of the innovation process in favour of a strictly economic conception.

The second research tradition in which innovation takes on specific meaning and acquires operative value is the economic theory of Schumpeter. Building on the study of economic reproduction cycles presented by Karl Marx in *Capital*, particularly the tendency of the rate of profit to fall (due to the increase in material capital compared to labour) and the capitalistic concentration processes, Schumpeter studies the conditions of the perpetuation of capitalism. He comes to the conclusion that only two processes can prevent Marx's predictions of profit erosion and the creation of monopolies (or oligopolies) from actually occurring: that of innovation, as the "*creative destruction*" of value, and that of simple destruction, i.e. war. Innovation means any new combination of production means which increase the value of production and, as a result, profit. In this respect, even though commentators generally insist primarily on technological innovation, and present scientific research and technical invention as essential conditions of innovation, in *Business Cycles: A Theoretical, Historical and Statistical Analysis of the Capitalist Process*, Schumpeter insists on the fact that "*Innovation is*

possible without anything we should identify as invention and invention does not necessarily induce innovation" (Schumpeter, 1939, p. 84). The strict economic definition of innovation is therefore "*any change that increases added value in production*".

Schumpeter identifies five possible areas of innovation: modification of products (or services); the opening of new markets (by their expansion or by creating needs); change in production processes; use of new energy resources or new raw materials; and lastly, changes to a company's organisation. As we can see, only the modification of products and processes could refer to innovation originating in science and technology. That said, Schumpeter did not ignore the existence or the importance of this kind of innovation. In *Capitalism, Socialism and Democracy*, he even stresses that technological progress is the driver of "*creative destruction*" (through what is nowadays called "*technological obsolescence*"): "*the impact of new things – new technologies for instance – on the existing structure of an industry considerably reduces the long-run scope and importance of practices that aim (…) at conserving established positions and at maximizing the profits accruing from them*" (Schumpeter, 1998, p. 97). Scientific and technological progress can therefore thwart the effects of the tendency of profits to fall and put some *metastability* back into an economic system that has an inexorable tendency to crystallize and weighed down with bureaucracy in order to secure economic rent. Some innovations induced by inventions stand out by the fact that they occur discontinuously, in a spate, and these "innovation clusters" disrupt the production cycle: some products are eliminated (destruction) while others trigger new demands (creation). Eventually, all the different areas of innovation (products, processes, markets, resources and organisation) are modified by these disruptive innovations. To Schumpeter, the key function of innovation is to prevent the capitalistic system from freezing and collapsing. Faithful to genuinely liberal ideology, he promotes disruptive innovation which completely upsets the checks and balances between economic agents, and challenges the positions and profits acquired.

As the *Oslo Manual* broadens the definition of innovation along the lines of Schumpeter and explicitly refers to his work, it could be expected to incorporate Schumpeter's conception of economic cycles into its analyses. It is even highly likely, at a time when reflection on innovation is conjoining with the themes of energy and ecology that, after rediscovering commercialisation and organisation, the authors will not fail to reintegrate raw materials and energy resources into the next edition as essential factors in the innovation process. However, this convergence is no doubt only superficial, as it is uncertain that his economic theory serves their position as regards strategic

thinking about the governance of scientific research. Although Schumpeter is an ardent advocate of competition, he would not approve some of the obsessions of the contemporary ideology of innovation, particularly the idea that competition encourages innovation. Competition presupposes that the innovator runs the risk of paying the costs of the research alone, only to be deprived of its fruits at the end.

The writers of the *Manual* address this issue of "sunk costs" when they encourage the appropriation of the benefits generated by innovation by means of patents (OECD, 2005, p. 36). But patentability does not necessarily solve the problem. The free and non-distorted competition of a myriad of agents, in other words "the market", is merely, according to Schumpeter, an early and extremely fleeting phase in the economic cycle, which rapidly evolves towards the domination of a monopoly (or oligopoly). In these conditions, as certain researchers remark (Dudouet *et al.*, 2006), it is illusory to think that competition encourages innovation, because there are two possibilities: either the innovating entrepreneur will defend his product alone against an oligopoly capable of standing up to him (for instance by imposing technical or legal standards that deny him access to the market), or he will be forced to share his innovation with other agents to achieve standardisation that is profitable all round, but in this case, he will again have borne the full costs of the innovation alone, before sharing the profits. Economic agents capable of innovating without running this risk are either monopolies or oligopolies, as they are sure of securing a satisfactory return on their investment, or they are State-supported agents, which benefit from shared investment costs (Therrien, Hanel, 2009, p. 26). The emergence of new entrepreneurs and the re-establishment of competition stem from the disruption caused by innovation clusters. Schumpeter does not therefore regard competition as an upstream condition but as a downstream result of the innovation process.

As we have already said, the Schumpeterian definition of innovation does not necessarily tie in with scientific research. It is defined is relation to the economic world as a way of making companies more competitive, but also, and above all, as a mechanism delaying the inescapable self-destruction of capitalism. This is because, in the end, Schumpeter's theory is pessimistic about the robustness of capitalism. Not only is it threatened by external oppositions (anti-capitalistic ideology relies on strong anthropological trends), it also faces intractable internal contradictions: capitalistic concentration tends to reduce the entrepreneur's role to that of a cog in a bureaucratic organisation, while at the same time lessening shareholder responsibility, for the latter merely optimises his profit without bothering about what his capital is used for (Karslins-Marchay, 2004, p. 79). In fact, Schumpeter's innovation

could not fulfil all the functions it is given by the *Manual*: it cannot remedy all the ills of mankind. It is even doubtful that it alone could bring a continent out of economic recession if the development of continental oligopolies corresponds precisely to an accumulation and concentration of capital that trigger the investment crisis Schumpeter fears: capital no longer finds sufficient outlets in the actual economy, and innovation is thus expected to produce new ones; but these outlets are inevitably more and more risky, and investors prefer to take refuge in sterile speculation to secure profit.

At this stage in our genealogical outline, we should look at how innovation theories readjust the contradictions already stated by Machiavelli and Bacon. Tarde and Rogers retain the metaphysics of Machiavelli's fortune (notably through their insistence upon fashion), but they come down in favour of gradual (or "incremental") innovations and are wary of disruptions (the only point of convergence between Tarde and Durkheim being that they both consider rapid technical and economic changes liable to make society "anomic"). Similarly, we can consider that Schumpeter expresses a pessimistic conception of history quite in keeping with the metaphysics of Bacon's corrupting time, but he prizes disruptive innovations as the only ones capable of upsetting the economic cycle and renewing elite groups by producing as many failures as they do success.

However, current discourses on innovation probably do not fit into this analysis at all. The vaguely and implicitly underlying metaphysics is much more an optimistic conception of history, a *progressive* conception of innovation. Now, the latter is neither sociological nor economic; it comes from the history and philosophy of technologies which, paradoxically, forms a field of study in which the word "innovation" is seldom used. A philosopher of technologies like Gilbert Simondon never uses "innovation" in *Du mode d'existence des objets techniques* (1958), as he seeks above all to describe and to explain the mechanisms of "invention", a word he uses to denote creation or global reorganisation of an object or process as compared to gradual improvements. Similarly, most historians of technology claim to work on the history of *inventions*, all the more so that, when used in this context, innovation refers to another process, that of passing on an invention in time and space, which ensures its diffusion: "*For many decades now the term 'technology' has been closely linked with invention (the creation of a new idea) and innovation (the first use of a new idea). Talk about technology centres on research and development, patents and the early stages of use, for which the term* diffusion *is used*" (Edgerton, 2013, p. 15). That said, it is obvious that philosophers and historians above all study the traces of inventions that have been taken up, thus of innovations, since inventions that have failed leave few traces. Although this research tradition

is most reluctant to use the term, the history of technology definitely provides the most meaningful matrix for an up-to-date reflection on innovation.

If technological innovation (induced innovation, to follow Schumpeter's terminology) serves as a paradigm for the majority of analyses, this is because it confirms the historians' definition, as lasting diffusion of an invention, and thus benefits from the belief that it fits into an irreversible cumulative history, that of technological progress – it should be noted, however, that some historians of technology, like George Basalla (1990), challenge the very notion of technological progress; and also that it is an economically and socially successful invention. This leads to the following definition: "*Innovation is the application of an invention implemented with success and thus economically viable and socially useful*" (Chabert, Vanelle, 2012, p. 89). This definition is quite debatable as it implies the equivalence of commercial success and social utility, but, for the same reason, it is also well adapted to the ideology of innovation, and this is what those who talk of innovation in connection with science are undoubtedly referring to. It has only one drawback: it does not fit into any conceptual framework that specifies the conditions of application, and that is why it promotes the innovation process absolutely, without ever questioning its relevance or limits.

Hence, innovation strategies applied to research policies rely primarily on confusion between invention, synonymous with progress, and innovation, which in this context should only mean the processes of spreading induced innovation but which ends up assuming all the functions of economic innovation. Still, this set-up is shaky: while there are many indicators, beginning with yield, for objectively measuring technical efficiency, i.e. the progress of *inventions*, it's by a sleight of hand (i.e. by the reference to patentability) that the economic criterion of profit replaces any evaluation of technical performance and establishes *innovation* as the essential factor in economic and social progress (without being capable of assessing the impact).

SYNTHESIS – FROM THE LINEAR THEORY TO THE CHAIN-LINKED MODEL

Each of the research traditions we have addressed describes a different process under the name of innovation: the history of technologies traced back the diffusion of an invention; Schumpeterian economics studied changes in production that increase its added value; and sociology of innovation considered the changes in individual behaviours. Although we have constantly stressed that these processes are neither fully superimposable, nor

totally interlinked, it transpires that it is indeed the progression of these processes to which the phrase "innovation process" refers in most modern-day discourses and reports. The question therefore remains of whether a conceptual framework can be developed in which such a synthesis can occur. In the past, hope was initially placed in the "linear theory of innovation". This is conventionally used to refer to an "innovation chain" wherein relatively autonomous scientific research produces fundamental knowledge, the source of technological applications invented by engineers, themselves developed within companies to become new products, processes and services, eventually put on the market and adopted by consumers. In this conceptual framework, the study of innovation focuses on disruptive technological innovation and innovation clusters rather than on incremental innovation. The linear theory coherently integrates invention, induced innovation and social innovation conveyed by the market.

There is some doubt that the name "linear theory" be appropriate and truly suited to the model proposed: firstly, it is questionable whether it is a real "theory"; it is more of a device for linking several different conceptual frameworks (Moldaschl, 2010); secondly, as States take their cut of business profits and consumption to finance fundamental and applied research, we can consider that, in reality, the model is already a cycle. Godin (2009) further points out that this is prefigured in Maurice Holland's research into the "research cycle". This analysis of cycles (of counter-cycles in fact) triggered by scientific research was motivated by the 1929 crisis. The linear theory however, emerged as the dominant representation after World War II, in the wake of Schumpeter's works. Rather than being a veritable theory, this model represents a consensus on the social division of labour; it forms the common representation around which political decision-makers, scientists, engineers, industrial manufacturers and consumers could agree. Retrospectively, its originality would seem to have guaranteed the independence of science by describing innovation as a one-way process: the pace of the technoscientific "push" sets the tempo of the entire cycle. This model further corresponds to the spontaneous ideology of scientists.

This unilateral conception already came under great criticism in the 1960-1970s when the emphasis was placed on stimulating consumption through advertising, reproducing demand through cultural obsolescence and creating new needs through marketing. It then became apparent that the decisive role of the market «pull» must be recognized in the synchronisation and orientation of innovation processes: marketing was capable of sparking permanent demand for new goods and services, which therefore meant that new products be incessantly put on the market; companies thus demanded

prototypes from their R&D departments, which in turn stepped up their technological intelligence and their exchanges with fundamental research in order to be the first ones to discover certain applications that could be rolled out industrially. In this schema, the analysis focuses more on incremental than disruptive innovations and it is no longer the State but «market needs» that close the loop. This revision of the «linear theory», in which two forces are henceforth exerted in opposite (and maybe contradictory) directions on each of the «links» in the innovation chain, in fact reflected the evolution of interdependency relationships between political, economic and scientific agents, at a time when the initial consensus on the division of labour was about to disintegrate.

Then, the analyses of Stephen Kline and Nathan Rosenberg (1986) marked a notable reorientation in the modelling of innovation. These two researchers noted that the linear theory overlooked a number of feedback loops between agents and demonstrated that, even though R&D is at the heart of the technical innovation process (invention), scientific research was not the only source of high-performance innovation: customer feedback, supplier suggestions, competition watch, consultants, etc., can induce innovation. Their study examines the respective merits of types of organisation depending on the type of innovation (incremental or disruptive) to be produced. Their "chain-linked model" endeavours to better describe the effective process by broadening the concept of innovation, more or less in line with the Schumpeterian definition, but it thus loses, although this was not immediately noticed, the singular aspect of the previous model: the asserted interdependence of innovation processes and scientific and technological progress. This is all the more arresting as the reorientation occurred just as the scientific sphere was about to be requisitioned in the name of economic imperatives. With the liberalisation of financial markets in the 1980-1990s (and the ensuing significant increase in money creation by banks), the financial *pull* stole a lead over the technoscientific *push*. The crazy overabundance of financial capital triggered a reckless pursuit of outlets guaranteeing higher returns, and the once obvious idea that science should be as independent as possible to secure optimal knowledge production, whereof inventions and, *a fortiori*, innovations were but sub-products, gave way to the idea that scientific research should generate applications capable of fuelling the innovation process. However, this radical change of macroeconomic balances has not always been adequately reflected in a rational cybernetic analysis of the financial feedback loops regulating all the agents (including the State) in the innovation process.

The explanation no doubt lies in the fact that, in order to occur, this transformation of the social division of labour was less in need of conceptual analysis than normative language: at the turn of the 1990s, innovation became the "watchword" in governance of scientific research. In 1974, as Godin says (2008a, p. 36), an official report by the *National Science Foundation* still considered that "*use of the word innovation is counterproductive*" (Roberts, Romine, 1974, p. 4) as it is too ambiguous. Yet, it is no doubt that precisely the plasticity and ambiguity of the concept explain its compelling ascendency as a management tool "*justified in the name of scientific credibility*" (Fougère, Harding, 2012, p. 30). The gradual recognition of this category by "experts" (most often from an economic background) is the result of a complete reversal of the dynamics which, in the 20th century, enabled the institutionalisation of scientific research as an autonomous sphere on which the economy was dependent; henceforth, the need for return on capital expanded its hold to every field and economic rationality becomes the yardstick by which the productivity of research activity is measured. Thus, the "scientific policies" of the 1960s were followed by the "scientific and technology policies" of the 1980s to become "innovation policies" in the new century. It is certainly not a totally new "mode» knowledge production (Gibbons *et al.*, 1994), as it would be ridiculous to compare the "pure" science of the past with its researcher shut away in his ivory tower, and current research, deemed open and market-oriented, at last aware of its context of application; these are two extreme cases that have never dominated outright; the autonomy of science has always been relative and the profile of researchers ranging across a spectrum from disinterested research to entrepreneurial activities via various combinations of the two. However, we must admit that, in two generations, science underwent a process of *heteronomisation* by the financial sphere in the form of a managerial reorganisation and, as Schumpeter predicted, this came with the development of a bureaucracy that stifles the researcher, for the latter spends an ever greater amount of time accounting for what he is going to do and has done rather than actually doing it. So much so that, if we counted, for example, the time (and therefore money) that researchers spend, and often in vain, submitting proposals to various funding agencies, we would obtain a totally different measurement of the yield of these incentive schemes that researchers now sometimes liken to a Mark Gable Foundation[2].

2. In his science-fiction novel *The Voice of the Dolphins* (Szilard, 1962), the physicist Leo Szilard imagined a system for slowing down scientific progress: it consisted in taking up the time of the most renowned researchers with assessments of requests made by the least well-known researchers and drawing up lists of interesting research to eliminate all forms of creativeness.

CONCLUSION

Let us go back to the initial question: what does Innovation stand for? – We believe we have shown that it is certainly not the marker of a well-formed theory. There is, indeed, a great deal of research that make pertinent and operative use of certain concepts going by the name of innovation (or a sub-category like, for instance "knowledge-based innovation"), but there is no common framework wherein the general concept of innovation would take on meaning and the different meanings could link up. Not only is the combinatorial very vast, but most of the time general discourses on innovation make no effort to define it. It therefore appears to constantly fluctuate between a limited meaning, that of technological innovation (ambiguous already), and a broader definition, economic, that is closer to Schumpeter's (but without all the conceptual implications), or even much more vague, social innovation, which harks back to the problem of Tarde.

In fact, it would be wrong to take innovation for a concept that is valid by its referential capacity; the performativity of the innovation discourse is quite other. As we have suggested by employing the word "watchword", expressing views in the name of innovation amounts to justifying a series of adjustments in the organisation of research to various agents who no doubt disagree both on the realities and the purposes it encompasses. Some sociologists thus describe it as a "password": the vagueness of innovation means that various agents can be addressed without revealing the divergences that would be plain for all to see if the vocabulary were more precise. It is therefore likely that scientists understand innovation to be an application of their research; industrialists no doubt have a broader conception encompassing both technological innovation and other forms; economists immediately think of an abstract notion, with no distinction between disruptive and incremental innovations; and political decision-makers are no doubt, above all, sensitive to this economic dimension, but also take social innovation into consideration within the meaning of behavioural changes. In short, instead of a coherent perception, the innovation process gives rise to a diffraction of the meaning and results in a kaleidoscope of interpretations, the misunderstandings of which are never cleared up, and which confusedly accompanies, like a halo, the global perception of transformations. While we will not pass moral judgement on this confusion, we can doubt that it be suitable for the development of a coherent framework for assessing research policies.

It would nonetheless be just as illusory to see a cunning mind in all those who refer to innovation to legitimise these transformations. We believe, on the contrary, that a certain "blindness" (Delavan, 2006, p. 18) reigns among various agents, including those who appear to orchestrate

the implementation of innovation policies, as regards their implications in theory and practice. Discourses on innovation can be likened to what psychoanalysts call a "transaction language", i.e. a shift in vocabulary rendering expression possible even though the subconscious is caught up in insoluble impulsive contradictions. The biggest contradiction, which has endured since the distant origins of the concept, lies in the irreducible polarization between two meanings of innovation which coexist and cannot be reconciled: have we in mind, when we talk of innovations, radical changes and disruptions that significantly modify economic and social balance, or have we in mind the gradual integration of new things that help to prolong this dynamic balance and its quiet renewal? – As a watchword, innovation legitimizes a revolutionary and conservative injunction: "everything must change so that everything can stay the same". This contradiction can be seen at every level in the "innovation chain": in science, researchers are almost all forced to report "decisive breakthroughs" and beneficial developments even though they are often endeavouring to obtain funding simply to quietly persevere in the "normal" functioning of science; in communication on the societal issues of innovation, the discourse combines sensationalist rhetoric ("hype") and the assurance that the acceptability of new technologies will result, without encountering any opposition, from their gradual insertion into society; in economics, the same ambiguity exists between the quite mad hopes placed in innovation and the obsession with speeding up technology transfers and promoting short return-on-investment cycles, which can but correspond to technical obsolescence forced by incremental innovations.

But it is no doubt in the regulatory implementation of research governance that this contradiction is most blatant to researchers and engineers. On the one hand, all the changes to the research profession and the organisation of research seek officially to foster innovation, synergy and serendipity, i.e. the ability to unexpectedly turn current research to advantage to generate applications; on the other hand, bureaucratic control requires researchers to define, with growing precision, the tasks and results in advance, with the threat of being penalised in the event that the work actually done strays from the programme. Bureaucratic organisation therefore tends to rigidify planning at the same time as it reorients the aims of institutions in the name of innovation which it defines as an uncertain and exploratory process! As Vincent de Gaulejac stresses (2012), the new management of research heightens tensions between the aims of scientific organisation and institution. Researchers find themselves in a typical situation of alienation and, unable to withstand these changes, they adapt by adopting a double language: the way they "sell" their research to obtain funding is contradictory with the way they communicate with peers. They adapt by preparing young

researchers for the managerial environment or by taking on managerial roles, but they do not, for all that, find their balance and particularly fear that they will be unable to pass on the "craftsmanship" to younger generations.

Lastly, the efficiency of these changes is not subject to any serious evaluation. An organisation like the French Alternative Energies and Atomic Energy Commission (*Commissariat à l'Énergie Atomique et aux Énergies Alternatives* – CEA), whose mission has never been pure science and which has always focused on the development of new technologies, does not experience "innovation policy" in the same way as the French National Scientific Research Centre (*Centre National de la Recherche Scientifique* – CNRS), which on the contrary is involved in fundamental research. CEA was already prepared to adopt new practices, like finding external funds, conducting research in partnership with private companies, systematically patenting discoveries (whose priority over articles was nonetheless a real culture shock in the years 2000) or finalising research in general. But while it conforms to these changes, this explains all the more why its researchers question the legitimacy of policies that forever increase the burden of bureaucratic procedures whose efficiency is yet to be proved.

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