Sci & Educ (2013) 22:2463–2483
DOI 10.1007/s11191-012-9455-7

On the Commodification of Science: The Programmatic Dimension

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Published online: 4 May 2012

Abstract The article is a partial result of a wider research project, in which the commodification of science is interpreted, from one point of view, as a facet of the rise of neoliberalism, and from another, as a set of processes, classified according to a three-category taxonomy. Only one of the taxonomy's categories is dealt with in this article, the one that concerns the processes that affect the programme of scientific research. First a sketch is presented of the historical background and the periodization of the most relevant epoch for the study of the commodification of science, namely, the one from the end of World War II to the present. The periodization is expressed in the notions of *Golden Years science* and *neoliberal science*. The ensuing sections have the aims: to show that, in Golden Years science, the processes shaping research programmes did not include commodification; to characterize the period of transition of the 70 s; to describe the processes of commodification that have impact on the research programmes of neoliberal science; to discuss criticisms that have been levelled against them, as well as proposals for better ways of conducting scientific practices, and their implications for science education (which are of the same nature as that of *Science & Education's* editorial line); and finally, to bring to light the differences between developed and emerging countries as far as the commodification of science is concerned.

1 Introduction

This article [1]is a partial result of a wider research project, in which the commodification of science is interpreted, from one point of view, as a facet of the rise of neoliberalism and, from another, as a set of processes, classified according to the following taxonomy:

1. Processes related to the direction, or *programme* of scientific research, i.e., to decisions about which research projects are carried out and which ones left aside.

[1] It includes passages from two Portuguese language articles (Oliveira 2011a, b).

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2. Processes of *corporatization*, understood as those which introduce principles and methods typical of capitalist private enterprises into the management of the production of scientific knowledge, at all levels.
3. Processes related to the way scientific knowledge is distributed, through education, the media and particularly through *intellectual property rights* (patents and copyrights), whose establishment is necessary for the distribution to be carried out in the way proper to commodities, i.e., by means of buying and selling.

This taxonomy derives from a principle, sometimes presented as one of the foundations of Economics, according to which every society, in order to organize its economic life, must have institutions capable of answering three questions: *what to produce?*, *how to produce*?, and *how to distribute the goods produced?* (Samuelson and Nordhaus 1992, pp. 19–20)[2] It is based on the proposition that to each of these questions there corresponds a dimension of economic life, such that each process of commodification (affecting not only scientific knowledge, but in principle any type of goods) is located in one or another of the three dimensions. At least in the case of science, the processes are independent enough to make it worthwhile to treat them separately. The processes in each of the three categories above are located in the respective dimension, i.e., those of the first category (related to the programme of scientific research) are located in the first dimension (corresponding to the question *what to produce?*), and analogously for the other two categories/dimensions.

This article deals only with the processes in the dimension corresponding to *what to produce*?—the *programmatic dimension*. I will use the abbreviations: "p-commodification" for "commodification in the programmatic dimension" and "p-commodified" for "commodified in the programmatic dimension".

2 Historical Background and Periodization

The most relevant epoch in the history of science for the study of its commodification is the one that goes from the end of World War II to the present. In general history, that epoch is normally divided into three periods. The first is the period of the *Golden Years*, during which the capitalist system performed excellently, having high growth rates and low unemployment, and affording a significant improvement in the quality of life for people in most parts of the world; it was also favored, especially in Europe, by the flourishing of the Welfare State. During the Golden Years, neoliberalism, which had emerged as system of ideas in 1944, with the publication of Friedrich von Hayek's *The Road to serfdom* (Hayek 1944), remained in a latent state; it was theoretically eclipsed by the dominant economic thought, of Keynesian extraction, and in practice devoid of political weight.

The second period begins in the early 1970s, when the economic arrangements of the Golden Years started to present problems. It had a crucial moment in 1973, with the crisis triggered by OPEC's rise in oil prices, and lasted until the end of the decade. It was essentially a period of transition during which, fostered by the crisis, neoliberal ideas began to gather strength, with an increase in the number of supporters, the creation of think tanks, etc.

[2] According to its supporters, in the capitalist system, the three questions are answered, in the best possible way, by the market (Samuelson amd Nordhaus 1992, ch. 3A).

The election of Margaret Thatcher in the UK in 1979 and Ronald Reagan in the US in 1980 mark the beginning of the third period, during which neoliberal ideas are put in practice, and its policies effectively implemented, first in those two countries, then gradually all over the world. The collapse of the communist regimes at the end of the 80 s boosted the advance of neoliberalism and helped it to become hegemonic.

Schematically, then, there are two main periods, the Golden Years and neoliberalism, separated by a period of crisis and transition in the 1970s (Hobsbawm 1994; Harvey 2007).

Many of the works mentioned below, dealing with the history of science, adopt—with varying degrees of explicitness—a periodization for the epoch in question which is structurally identical to that of general history. This is not surprising for, given the economic importance acquired by science in the postwar years, it is natural that the changes in the production and distribution of scientific knowledge go along with the changes in the economy and society as a whole. In each of the two main periods, one might put it, science assumes a determinate form, which will be designated, respectively, *Golden Years science* and *neoliberal science*. Golden Years science corresponds, with the proper qualifications, to what Stokes (1997) calls the *postwar paradigm*; neoliberal science, to what Ziman calls *steady state science (*Ziman 1994) and *post-academic science (*Ziman 2000), and Krimsky (2003) calls *science in the private interest*. Mirowski (2011) distinguishes the periods in terms *regimes of science organization*, calling the first *Cold War regime*, and the second *globalized privatization regime*—remarking however that the latter began to prevail about 10 years before the fall of the Berlin Wall, which marks the end of the Cold War (p. 115).

3 "Golden Years Science" and Its Programmatic Autonomy

A category of goods is p-commodified when the determination to produce the goods is contained in the answer given by the market to the question *what to produce?* In the domain of science, what gets produced are items of scientific knowledge, arrived at by means of research. There the question *what to produce?* Translates into *what to do research on?* Or, in other words, *which among possible research projects should be included in science's research programmes?* Science is p-commodified to the extent that its research programmes are determined by the market. The aim of this section is to show, by means of a summary account of its origin and development, that—at least to a first approximation—Golden Years science was not p-commodified. Given the limits of the article, the account is very concise; it gives more attention to the sphere of concepts than to the concrete reality of scientific practices, and is focused in the developments in the US, the country which exerted an unquestionable leadership in the field of science and technology from World War II onwards.

The account starts by considering the most emblematic document of science in this period, namely, the report prepared by Vannevar Bush at the request of President Roosevelt, delivered to his successor Truman in July 1945, and published with the title *Science, the endless frontier* (Bush 1990/1945). Complying to Roosevelt's commission, the report outlined the science policies to be adopted in the aftermath of the war.[3]

[3] As evidence for the importance of Bush's report, in the introduction of a collection of texts produced in commemoration of its fiftieth anniversary one reads: 'Since its publication in 1945, Vannevar Bush's report *Science, the endless frontier* has come to occupy a biblical status in science policy. On the day it was issued, the report was greeted by front page headlines in the *New York Times*. Since then it has been the subject of innumerable studies, reports, analyses and interpretations, studied as if it were the word of God, invoked to legitimate a wide range of sometimes contradictory science policy models, decisions, and priorities' (Cole 1994,

According to the arrangement defended in the report, the function of providing funds for scientific research falls to the state. Scientific research is carried out by scientists motivated only by pure curiosity, by knowledge as an end in itself or, in other words, by the *intrinsic value* of science. The knowledge generated by scientific research affords technological applications, whose development is the task of technological research. In the report's terms ("basic research" and "applied research" are used in place of, respectively, "scientific research" and "technological research"),

> Basic research is performed without thought of practical ends. It results in general knowledge and an understanding of nature and its laws. This general knowledge provides the means of answering a large number of important practical problems, though it may not give a complete specific answer to any of them. The function of applied research is to provide such complete answers. The scientist doing basic research may not be at all interested in the practical applications of his work, yet the further progress of industrial development would eventually stagnate if basic scientific research were long neglected. (Bush 1990/1945, p. 18).

The granting of public funds to scientific research is justified because the technological applications that it generates are beneficial to the whole society; the report mentions explicitly the benefits for the health of the population, for national security (military applications) and for economic development. The state, as the provider of funds, differently from the scientists, is motivated by the *instrumental value* of science, i.e., in Bush's view by its capacity to generate technological applications.

According to the report, therefore, the intrinsic value of science exists only for the direct producer, the researcher, and the instrumental value only for society, represented by the state. This somewhat peculiar view is not just assumed, but expressly defended. On the one hand, it is argued that the researchers, not only need not, but also *should not* be concerned with applications. The contrary advice is justified by the thesis, held in the report, according to which applied research is detrimental to basic research.

> It is important to emphasize that there is a perverse law governing research: Under the pressure for immediate results, and unless deliberate policies are set up to guard against this, *applied research invariably drives out pure*.
>
> The moral is clear: It is pure research which deserves and requires special protection and specially assured support (p. 83).

On the other hand, the benefits deriving from the applications of its results provide the only reason to justify the allocation of public funds for research, and this means that it is only the instrumental value that matters. Although the letter of transmittal makes reference to "cultural progress" (p. 2), and Appendix 3 (Report of the Committee on Science and the Public Welfare) states that 'it is part of our democratic creed to affirm the intrinsic cultural and aesthetic worth of man's attempt to advance the frontiers of knowledge and understanding' (p. 79), it is the instrumental value that prevails. As Stokes says:

> Vannevar Bush found the appeal of knowledge for its own sake so unequal to the task of sustaining the flow of public support for basic science in peacetime that it went almost unmentioned in his report of forty pages, a document superbly tuned to the ear of his postwar audience. Bush instead centered his case on what has become the primary reason for supporting pure science – one dating from the Enlightenment – the belief that the advances in understanding achieved by pure research will later improve the human condition (Stokes 1997, p. 100).[4]

Footnote 3 continued
p. 1). According to Kitcher, 'the most important document about the place of scientific research in a twentieth-century democracy is surely Vannevar Bush's *Science, the endless frontier*' (Kitcher 2001, p.138).

[4] See also Kitcher (2001, p. 139).

It is clear therefore that, in the report's view, the intrinsic value plays a secondary role, restricted to researchers, reduced to a means for the realization of the instrumental value.[5]

Since the state is the provider of funds, it is natural to think, recalling the saying *he who pays the piper calls the tune*, that it would have the right to determine the programme of scientific research, and to allocate funds in view of society's interests. But that was not the arrangement proposed by the report, and that came to prevail to a large extent in Golden Years science. According to the report, the role of the state should be limited to providing a lump sum of resources, leaving it for the scientific community to distribute in the light of the pure curiosity of its members. In other words, the proposal was that science be granted *programmatic autonomy*—autonomy in the determination of its research programme[6]. In the report's terms:

> Scientific progress on a broad front results from the free play of free intellects, working on subjects of their own choice, in the manner dictated by their curiosity for exploration of the unknown. Freedom of inquiry must be preserved under any plan for Government support of science (Bush 1990/1945, p. 12).

The scientific community's success, at the level of politics, in its claim to programmatic autonomy—from now on, p-autonomy—owed much to the prestige acquired by science due to its contributions to the war effort, including advances in the treatment and prevention of health problems of the combatants, in the invention and improvement of military devices, specially the radar and, crowning the process, the A-bomb (dropped on Hiroshima one month after *science, the endless frontier* was delivered to Truman).

At the level of theory, the claim of p-autonomy was supported by what one may call the *Principle of Serendipity*—serendipity being the faculty of making discoveries by accident, while searching for something else.[7] In the domain of scientific research, the idea is that the aim is the advance of scientific knowledge; what is discovered later, serendipitously, are applications of the knowledge produced. There are many examples of this type of occurrence in the history of science, like the early investigations on electrical and magnetic phenomena, later unified in electromagnetic theory, with its innumerable technological applications, very far from what had been anticipated by its pioneers; the researches on the atomic and nuclear structure of matter, which led to A- and H-bombs, to the peaceful use of nuclear energy, etc. Bush's report elevates such examples to the status of a universal rule, and draws as an implication the Principle of Serendipity: one can predict neither which scientific researches will actually give rise to applications, nor, when applications do exist, the type of practical problem they will contribute to solve. Quoting once again the report:

> One of the peculiarities of basic science is the variety of paths which lead to productive advance. Many of the most important discoveries have come as a result of experiments undertaken with very different purposes in mind. Statistically it is certain that important and highly useful discoveries will result from some fraction of the undertakings in basic science; but the results of any one particular investigation cannot be predicted with accuracy (Bush 1990/1945, pp. 18–19).[8]

[5] That valuation of the instrumental to the detriment of the intrinsic, or *instrumentalization* of science, is a process more comprehensive than commodification, and was active also, in theory and practice, in the Soviet Union, and the countries which adopted its model of socialism in the twentieth century.

[6] Programmatic autonomy is one of the three forms of which, according to the analysis presented in Oliveira (2011a), the autonomy of science assumes along its history, the other two being methodological autonomy and neoliberal autonomy.

[7] On "serendipity", see Merton and Barber (2006).

[8] In another passage, the principle is held to prevail in the field of medicine: 'discoveries pertinent to medical progress have often come from remote and unexpected sources, and it is certain that this will be true in the future. It is wholly probable that progress in the treatment of cardiovascular disease, renal disease,

Such unpredictability of course makes it impossible for the state to determine the programme of scientific research in function of the applications, and thus legitimates the p-autonomy of science.

It is not easy to make an estimate of the degree of p-autonomy that Golden Years science actually enjoyed. It tends to be maintained in the literature that, although the institutional arrangements recommended by the report had not been implemented, its conception of science, concerning its relations to technology, became hegemonic; and science policies, not only in the US but also in many other developed and underdeveloped countries, largely conformed to it.[9] Concerning p-autonomy, Kevles says that in the US during this period,

> both the military and civilian sectors of federal science seem in general to have operated in harmony with Bush's ideas of intellectual self-determination. Academic scientists of these years remember it as a golden era, a time not only when money was freely available but when it could be freely spent primarily in accord with professional judgment (Kevles 1990, p.xix).

Other authors claim that such views are the product of nostalgic idealization, that there is no essential difference as far as p-autonomy is concerned between, in our terms, Golden Years science and neoliberal science. By and large, they are the authors who also have a favorable view of neoliberal science, rejecting criticisms leveled against it. (Mirowski 2011, pp. 87ff.) The account of neoliberal science to be presented supports the former views, i.e., that there is a qualitative difference in the degree of p-autonomy enjoyed by each form of science.

To the extent that science enjoys p-autonomy, the direction of research is dictated neither by the state, nor by the market. Hence, to a first approximation, Golden Years science was not p-commodified.

4 Intermediate Period: The Notion of Oriented Research

Following the adopted periodization, let us now consider the intermediate period of transition of the 1970s. As in the economic and social history, this was a critical time, full of turbulence, in the domain of science. Because of the complexities, it is difficult to present a concise summary of the evolution of scientific practices during this period. It is also a less important period in the context of this paper. Hence our considerations will be limited to the level of conceptual analysis. At this level, the transition from Golden Years science to neoliberal science corresponds to the introduction of a new concept, that emerges from the following line of thought.

Footnote 8 continued
cancer, and similar refractory diseases will be made as the result of fundamental discoveries in subjects unrelated to those diseases, and perhaps entirely unexpected by the investigator' (Bush 1990/1945, p. 14).

[9] Stokes, for instance, writes: 'The reception of *Science, the Endless Frontier* was filled with irony, since Bush's organizational plan was defeated while his ideology triumphed' (Stokes 1997, p. 50); 'Half a decade later (after the report's publication), the view of basic science and its relation to technological innovation set out in the Bush report became a foundation of the nation's science policy for the postwar decades' (p. 2); 'Bush's canons left a deep impression and provided the dominant paradigm for understanding science and its relation to technology in the latter part of the twentieth century. These ideas can still be heard in scientific and policy communities, the communications media, and the informal public. And Americás leadership in postwar science has given them wide circulation in the international community' (p. 4).

One need not be very perspicacious to notice that the formulation of the Principle of Serendipity in the Bush report involves overstatement that can be explained by scientific community's aspiration for p-autonomy. The exaggeration consists in the unwarranted generalization of the examples that illustrate the Principle. It can be demonstrated by observing that there are counter-examples, i.e., cases of *scientific* research that contributed to the advance of knowledge, but that were undertaken beforehand with a view to determinate applications. There is no lack of cases of this kind in the history of science. One of the most significant, used as a paradigm by Stokes in his book (Stokes 1997), is that of Pasteur's researches undertaken with the aims of improving the methods of production of vinegar, wine and beer, of devising ways to prevent various diseases, etc. Such researches also resulted in important contributions to knowledge about the existence of micro-organisms and their role in the processes of fermentation and in the etiology of infectious diseases—a type of knowledge valuable as an end in itself, apart from any practical application.

The negation of the Principle of Serendipity's universal validity makes it possible for the state, in its role of provider of funds, to take into account not only the scientific research's potential for application as a whole, but also the specific potential of each research project or field to bring about previously defined desired applications. Research undertaken in this way will be called *oriented research*. Oriented research is different from applied research, as defined in Bush's report, whose aim is to develop applications of an *already existing* knowledge; oriented research seeks *new* knowledge with specific potentials of application.

This criticism of the Principle of Serendipity had already been made in the debates about science and technology in the 1950s, but it is only in the 1970s that it gathers strength (stimulated, in the sphere of politics, by a relative decline in science's prestige). There is in those occurrences, surveyed by Stokes, an intense terminological proliferation: for what I have called "oriented research", one finds (with nuances in meaning) the terms "programmatic research", "purposive basic research", "mission-oriented basic research", "oriented basic research", "strategic research" and "use-inspired basic research" (the term adopted by Stokes) (Stokes 1997, pp. 58ff.)

5 Neoliberal Science: The Rise of Innovationism

Oriented research need not be p-commodified; it is p-commodified only when oriented *by the market*. P-commodification corresponds to the transition from the intermediate period to the neoliberal one and, once again, the change involves the emergence of a new concept: "innovation". In this case, there is no variation in the terminology used.

The concept of innovation is the core of the main neoliberal strategy to promote the p-commodification of science, namely, *innovationism*, which consists in establishing the production of innovations as the primary aim of scientific research. The English economist Christopher Freeman (1921–2010) was the author who contributed most decisively to the promotion of innovationism (Fagerberg 2005). It is odd that in the recent literature on the commodification of science, Freeman is seldom mentioned; so it is worthwhile to present briefly the most important aspects of his life and work.[10]

[10] The literature mentioned includes: Resnik (2007), Greenberg (2007), Lacey (2008), Langley and Parkinson (2009), Garcia and Martins (2009), Radder (2010), Nowotny et al. (2010), Garcia (2010) and Mirowski (2011). In contrast, in another literature, focused on questions of science and technology policies, of which the journal *Research Policy* is a good example, Freeman figures as a central reference.

Throughout his career Freeman, who belongs to the developmentalist lineage formed after the World War II, devoted himself centrally to the theme of economic development. Much influenced by Schumpeter, he attributed a crucial role to technological advances as the engine of development.[11] He exerted strong leadership through both his theoretical work and his institutional activities. In 1965 he founded the University of Sussex's *Science Policy Research Unit* (SPRU), one of the most important centers for the study of science and technology policies (STP) in the whole world, and he directed it for a long time.[12] He acted as a consultant for OECD (Organization for Economic Cooperation and Development, the most influential international agency in the field of STP), as well as for UNESCO, and he was responsible for the preparation of important documents published by those institutions, some of which are partially reproduced in the book presently to be mentioned.[13]

Freeman's book *The Economics of Industrial Innovation* (Freeman 1974; from now on, *EII*) had an enormous influence, not only concerning innovation, but also many other fundamental aspects of the organization of scientific research.[14] With the appropriate qualifications, it may be considered emblematic of neoliberal science, playing an analogous role to that of *Science, the endless frontier* for Golden Years science. Although the concept of innovation, with the meaning it has today, was not a novelty at the time (Freeman credits it to Schumpeter), it started to spread after the book's publication, in large measure due to its influence. Following a slow beginning, about 10 years later the process accelerates, with the introduction of the concept of *national innovation systems*, to whose formulation Freeman also gave a fundamental contribution (Sharif 2006, p. 750). From the second half of the 90 s, innovation gets established as the key-concept in neoliberal STP, roughly first in the rich countries, later in the emergent ones.

Freeman is an innovation enthusiast, he sees it as 'an essential condition of economic progress and a critical element in the competitive struggle of enterprises and of nation-states' (*EII*, p. 15). '(Innovation) is critical for the long-term conservation of resources and improvement of the environment. The prevention of most forms of pollution and the economic recycling of waste products are alike dependent on technological advance' (p. 16)[15]; 'In the most fundamental sense the winning of new knowledge is the basis of human civilization' (p. 21) Curiously, Freeman seems to value innovation as and end in itself, no matter whether the novelty is good or bad.

[11] Joseph Schumpeter (1883–1950) was an Austrian-American economist who had a special interest in the process of economic development. He saw technological revolutions as the main driving force of that process, and he attributed a crucial role to entrepreneurs in the implementation of technological advances. One his most influential works is *Capitalism, socialism and democracy* (Schumpeter 1942), which gave wide currency to the concept of creative destruction, as an aspect of the impact technological revolutions on society. The term neo-Schumpeterians is used to designate the group of his followers, in which Freeman is included.

[12] In 2009 the Unit became the Department of *Science and Technology Policy Research*, while maintaining the acronym *SPRU*.

[13] Richer accounts about Freeman's life and achievements can be found in the obituaries and testimonials by his many colleagues and disciples on the occasion of his death in August 2010. The family obituary, and links to many other ones can be found in http://www.freemanchris.org/.

[14] There are two later editions of *EII*, extensively revised: Freeman (1982) and Freeman and Soete (1997). Given the historical character of the present account, the reference is to the first edition.

[15] Freeman however does not mention the origin of environmental problems in the industrial innovations of the past.

> Innovation is of importance not only for increasing the wealth of nations in the narrow sense of increased prosperity, but also in the more fundamental sense of enabling men to do things which have never been done before at all. It enables the whole quality of life to be changed for better or for worse. It can mean not merely more of the same goods but a pattern of goods which has not previously existed, except in the imagination (pp. 15–16).

But what does innovation consists in, after all? Here is the definition put forward by Freeman:

> We owe to Schumpeter the extremely important distinction between inventions and innovations, which has since been generally incorporated into economic theory. An invention is an idea, a sketch or a model for a new or improved device, product, process or system. Such inventions may often (not always) be patented but they do not necessarily lead to technical innovations. In fact the majority do not. An innovation in the economic sense is accomplished only with the first commercial transaction involving the new product, process, system or device, although the word is used also to describe the whole process (p. 22).

The idea of innovation contrasted with that of inventions, and with emphasis on the commercial nature of the applications, pervades the whole literature on the theme, sometimes explicitly, sometimes implicitly (Fagerberg 2005; Kline and Rosenberg 1986). Now, in order to become a commercial application, an invention must be lucrative and contribute to the maximization of the profits of the firm that launches a new product, or adopts a new method of production. But the agency that determines what is and what is not profitable is the market. Thus, to the extent that the production of innovations turns into the primary aim of science, the direction of its advance comes to be dictated by the market. With the rise of innovationism, in one movement science looses its p-autonomy and becomes p-commodified.

At the conceptual level, the story ends here and, as we saw, it is quite simple. At the level of reality, innovationism is a very wide-ranging and complex movement, which mobilizes a great number of policies for science and technology, including, among others:

- Changes in the criteria adopted by funding agencies in the evaluation of the projects which give more weight to the criterion of the *innovation potential*, i.e., to each project's potential of producing lucrative applications.
- Increase, both in absolute and relative terms, of the sort of funding where the subject matter of the research, oriented towards innovation, is specified in advance;
- Encouragement for researchers working in universities or public research institutes to obtain patents;
- Creation of innovation agencies aimed, among other functions, at giving support to the scientists in that sort of enterprise;
- Gathering statistical data about the production of innovations, which are used as parameters for STP and for setting up country and University rankings;
- Promotion of campaigns, often involving contests, aiming to promote the "culture of innovation".

One of the assumptions of the movement is the thesis that its goal can only be achieved by means of an integration of the public research sector with private enterprises. Consequently, in the set of innovationist policies, there are many aimed at promoting this integration—or marriage, as it is often referred to—such as:

- Encouragement of research projects that involve collaborations of private enterprises with the public sector, utilizing such means as tax advantages, loans with subsidized interest, and favorable treatment of requests submitted to funding agencies;

- Stimulus, also by means of these kinds, to the hiring of postgraduates by private enterprises, and to the transformation, total or partial, of researchers in the public sector into entrepreneurs;
- Granting of scholarships for employees of private enterprises to follow specialization or postgraduate courses of study;
- At another level, the creation of technological parks, etc.

These policies, and their impacts, constitute the processes of p-commodification of science; all together, they promote a profound transformation of the place of science in society, inserting it much more intensely into the sphere of the market economy.

To study this transformation differences between countries need to be taken into account, investigating for each of them, which of the policies listed above are implemented and in what form; what are the legal measures and the institutional apparatus that implement them; what is the impact of their implementation, etc. Such study is of course beyond the limits of this work; for our purposes the general view presented is sufficient.

6 Freeman and Neoliberalism

In this section I discuss a problem that exists in interpreting innovationism as a facet of neoliberalism, and Freeman as the leader of the movement. The problem is due to the fact that Freeman can hardly be considered, without qualifications, a neoliberal.

For our purposes, neoliberalism can be characterized as the phase of capitalism in which the system's propensity to transform everything into commodities is exacerbated. From that characterization follows one of neoliberalism's core principles, the one according to which the role of the state in the economy must be kept at a minimum: the smaller the state, the larger the space occupied by the market. Such principle in turn unfolds into the policies of privatization, reduction of expenditure with Welfare State benefits, deregulation, etc. Freeman however is far from subscribing to the principle. Being affiliated to the current of developmentalist economists which flourished after World War II, he grants to the state a central role in the promotion of economic development.

As far as science is concerned, the principle of the minimum state may be said to imply that—as for any other kind of goods—the production of scientific knowledge should be entrusted to private enterprises, with no financing of scientific research by the state. Views of that sort were held in early 1980s by some neoliberal economists, and forcefully opposed by Freeman and his associates. In the context of that dispute Freeman's anti-neoliberal stance came clearly to the fore; according to François Chesnais, one of his closest collaborators at the time, the concept of national innovation system was deliberately devised as a weapon against such extreme neoliberal views (Sharif 2006, p. 753).

Thus there seems indeed to be a difficulty for the proposed interpretation. It can however be easily overcome, the key element in the move to achieve this end being already present in the characterization of innovationism offered in the last section. It is the fact that, although innovationist policies do not exclude the financing of scientific research by the state, the distribution of funds among research projects is decided in accordance with the criterion of profitability, which is determined by the market. In the innovationist set up, the state acts thus as a middleman, who transmits the market's wishes to the scientific community. Hence, in neoliberal science, although the state is the main provider of funds for research, the determination of science's research programme is in the hands of the market.

Although the expression may seem self-contradictory, one may, on the basis of those considerations, classify Freeman a *statist neoliberal*. The self-contradictory appearance of the expression is a reflection of the fact that, as Harvey (2007) points out, neoliberalism's theoretical framework is not entirely coherent, in particular as regards the role of the state. In Harvey's words, neoliberalism's "supposed distrust of all state power" does not "fit with the need for a strong and if necessary coercive state that will defend the rights of private property, individual liberties, and the entrepreneurial freedoms." (Harvey 2007, p. 21) To the functions of the state that is needed, one may add the financing of scientific research. The reason for that need or, in other words, for the impossibility of entrusting basic research to private enterprises, is the nature of pubic good that scientific knowledge maintains, in spite of the advances in intellectual property rights.[16]

7 Questioning Innovationism

The exposition so far has an analytical-descriptive character; it is free from value judgments which would make it unacceptable to innovationism's advocates. It is worth remarking that innovationism is argued for on the basis of neoliberalism's fundamental principle, that of the excellence of the market as a system for the organization of economic life, and social life in general. Thus, from the point of view of its supporters, the claim that science is undergoing a process of commodification does not amount to a denunciation or a questioning but, on the contrary, it is something to be celebrated.

From now on the tone of the article changes; value judgments come into play, for we will be dealing with criticisms of innovationism and with some alternatives proposed as better to orient scientific practices. These criticisms are focused on the detrimental consequences of innovationism, which may be divided into three categories. The first and second categories comprise the consequences that occur in domains of investigation respectively without, and with innovation potential. The consequences of the third category are of a different nature, they occur in more specific areas, within both domains, and involve the erosion of the objective character of scientific knowledge.

7.1 Domains Devoid of Innovation Potential

As the process of p-commodification advances, the domains of investigation that inherently lack innovation potential suffer in the competition for resources with domains endowed with it. This may be put in terms of the economists' concept of *opportunity cost*, i.e., the cost of an allocation of resources corresponding to what is lost by forgoing alternative ones. The allocation of public resources to research according to the innovationist principle has a high opportunity cost inasmuch as it is detrimental to at least three domains:*public interest science*, basic science, and the humanities.

The concept of public interest science (or 'science in the public interest') is at the center of the platforms of US associations like the *Center for Science in the Public Interest* (CSPI), *The Science and Environmental Health Network* (SEHN) and the *Association for*

[16] On the thesis of science's public good nature, its use as an argument in favor of the financing of research by the state, and the critique leveled against it by a radical wing of neoliberals, see Mirowski 2011, p. 56 ff. In the light of the economic crisis started in 2008, and the governments' reactions to it, one may add to the functions of the required state that of injecting huge sums of public money into the private financial system to save it from bankruptcy.

Science in the Public Interest (ASIPI).[17] Krimsky (2003) also uses the term, contrasting public interest science with *private interest science* (or, as in the title of his book, science in the private interest):

> Public interest science addresses issues that elude a market solution"; it "asks how knowledge can contribute to ameliorating social, technological, or environmental problems. Private interest science asks how science can produce a profitable product, or defend a corporate client, whether or not it has social benefits and whether or not the product is distributed fairly and equitably (Krimsky 2003, p. 181).

Private interest science is, in our terminology, neoliberal science, driven by the market, and addressed to the production of innovations.

Public interest science may for our purposes be defined as science oriented by a concern with public welfare, especially of the disadvantaged sectors of the population, and addressed to problems not susceptible to solution by the market system. Public interest research seeks applications that generally are not lucrative, i.e., applications that are not innovations; it also plays a crucial role in detecting problems, like those of the hole in the ozone layer and of global warming. In many cases, the results of such research not only do not yield lucrative applications, but jeopardize corporations' profits, by motivating the imposition of restrictions on their practices. Public interest science's main fields of investigation pertain to many things:

- to environmental problems of all kinds
- to the risks of new technologies, particularly genetically modified organisms and nanotechnology
- to the harmful consequences of the technological model of agriculture and to the development of alternative forms, like agroecology
- to preventive medicine and, in particular, the impact on human health of the various forms of pollution, of chemicals present in foodstuffs, either coming from agrotoxics, or added in the process of industrialization
- to neglected diseases, which affect mainly the populations of poor countries that lack the purchasing power needed to make lucrative the researches aimed at their prevention or treatment; etc.

Basic science is conceived in the Bush report as non-oriented, and hence non-oriented by the market, but its *raison d'être* is the production of applications, and these applications may be lucrative, i.e., to be innovations. Basic science cannot be oriented by the market, not because it lacks innovation potential, but because for each particular project, that potential is uncertain, and tends to be realized only in the long run. The anti-basic science bias which is present in innovationism can be explained by saying that the movement seeks to establish as the primary aim of research the production of applications that are *assuredly* lucrative in the *short run*.

Reacting against this tendency, researchers in the domain of basic science defend their positions mainly by means of the argument, already present in the Bush report, that regardless of how large the innovation potential of each particular advance in basic science may be, it is limited, so that, in the absence of new advances, the flow of innovations tends to stagnate. Therefore, the argument concludes, from the point of view of innovationism itself, stifling basic science amounts to killing the goose that lays the golden eggs.

[17] See respectively: http://cspinet.org; <http://www.sehn.org/index.html>; http://www.public-science.org/index.htm.

Another argument that may be used in defense of basic science deviates from the conceptions both of the Bush report and of innovationism, inasmuch as it rejects the instrumentalist view they share, i.e., the appreciation of science exclusively for its instrumental value, as a source of technological applications. (The report, as pointed out, maintains a role for science's intrinsic value, but just as a motivation for the scientists' work; the legitimacy of allocating public funds to basic science is based only in its instrumental value.) The shared view seems to involve the presupposition that non-scientists are vulgar materialists, devoid of philosophical and spiritual interests, incapable of gaining purely intellectual satisfaction from scientific knowledge. The instrumentalist conception follows from that mistaken presupposition; moreover, as it becomes dominant, it tends to make the presupposition true, thereby promoting the spiritual impoverishment of humankind.

The revaluation of knowledge as an end in itself permits public support of basic research to be legitimized not only because of its innovation potential, but also because of its intrinsic value for interested non-specialists. Then, the number of people capable of enjoying the intellectual satisfaction provided by a contribution to basic scientific knowledge needs to be taken into account is appraising its value. In deliberations about what projects to support, intrinsic value should have greater weight in the case of knowledge understandable by laymen—like that relating to the history of life on Earth, and particularly of our species—than in the case of abstruse conceptions comprehensible only by an extremely small number of specialists, like superstring theory.

Concerning the humanities, an argument in their defense would be out of place here since, by being necessarily very brief, it could hardly go beyond generalities.[18] I will say only that they play a fundamental role in the fulfillment of the critical mission of the University. In a democratic society, the critical stance is expected of every citizen, and of social institutions, especially the press and other means of communication, political parties, social movements etc. What distinguishes the mission of the University in this regard is the nature of its critique, aimed at a deeper understanding of society, to be arrived at by means of cognitively rigorous procedures. Innovationism militates against the fulfillment of the critical mission of the University, and in particular it hinders the adoption of a critical attitude towards innovationist policies themselves, giving rise thus to a vicious circle where each innovationist advance brings about a reduction in the capacity of recognizing the detrimental consequences of the process. Innovationism acts thus in the manner of an addictive drug, which undermines the cognitive faculties needed for the user to consider properly the ills caused by the drug, and accept that he has become an addict.

7.2 Domains with Innovation Potential

The topic is vast, and in order to keep the discussion within reasonable limits, I will focus on just one document, the report *Science and the Corporate Agenda: The detrimental effects of commercial influence on science and technology*, written by Chris Langley and Stuart Parkinson, and published by the movement *Scientists for Global Responsibility* (SGR), from the United Kingdom (Langley and Parkinson 2009).[19]

[18] The distinction between the humanities and other areas of investigation pertaining to the human domain is a complex issue, subject to many controversies. For my purposes here, they may be characterized as comprising the investigations whose results are not required to be free from value judgments, as it happens in the social sciences modeled on the natural sciences.

[19] http://www.sgr.org.uk/.

Although focused in the UK, much of what is said in SGR's report applies also, with due qualifications, to many other countries, given the homogenization of STP promoted by neoliberal globalization. The report's critique is internal, in the sense that it resorts to a minimum of presuppositions and values unacceptable to the interlocutors. It exposes the deleterious consequences of the commodification of science through the prism of the relations between universities and public research institutions with corporations. Five sectors are investigated: pharmaceuticals, tobacco products, military/defense, oil and gas, and biotechnology. For each sector, initially a description of the background is presented, including data about its economic dimension, lists of the main corporations involved, accounts of their operations, of their connections with universities, etc. Then comes an exposition of the detrimental effects of those connections, solidly substantiated on the basis, in the majority of cases, of articles published in peer reviewed journals—i.e., according to certification criteria of science itself. The effects are classified into four categories, those that:

1. Influence the nature of the research agenda, including narrowing its scope;
2. Have an impact on the direction of, and introduce bias into the results of, specific research studies (both intentional and unintentional);
3. Compromise the openness and transparency of research studies (for example, through commercial confidentiality restrictions); and
4. Influence the public interpretation of research results (for example, through lobby groups) and potentially compromise the public perception and acceptance of science, engineering and technology developments (Langley and Parkinson 2009, p. 22).

SGR's critique not only exposes the problems, but positively suggests alternatives, concrete measures to be taken in order to overcome the problems. From the list of sixteen recommendations, in the version of the report's executive summary, the following may be quoted, as an illustration:

Universities should adopt minimum ethical standards for the companies with which they have partnerships. These standards should include social and environmental criteria, as well as academic criteria and should be overseen by a special committee.

- Universities should openly publish comprehensive data on the nature of their business partnerships.
- All academic journals should develop and implement rigorous processes for dealing with potential conflicts of interest, including suitable sanctions for non-compliance.
- More academic research needs to be conducted into the potentially detrimental effects of the commercialization of science and technology, especially within universities (p. 8).

Other sorts of criticism may be elaborated, and be better suited, depending on the profile of the interlocutors. But when debating with innovationists, the approach of SGR's report is in my view the most adequate, given the features highlighted in this account: the internal character, the adoption of scientific criteria of certification, and the positive attitude. It is the one most likely to bring about advances in the ideological struggle by becoming—what really matters—a material force capable of changing the way science and technology are practiced. More specifically, there is no better antidote against the accusations of obscurantism and anti-science positions that representatives of the establishment make in their attempts to disqualify its critics.

7.3 Erosion of Science's Objectivity

As it was pointed out in the introduction, the processes of commodification of science studied in this article are situated in the first dimension of economic life, which corresponds to the question *what to produce?* So far the question has been interpreted as referring only to the subject matter of research. However, a broader interpretation is possible, including reference to the other features of research, like its *quality*. The quality of a research is in turn a many-sided feature, each side corresponding to a value. The deleterious consequence of innovationism to be discussed now consist in a degradation of the quality of research with respect to the value of objectivity.

From a practical point of view, scientific knowledge is expected to be reliable, i.e., to be a good guide to our actions, by providing both good predictions and effective applications. But in order to be reliable, scientific knowledge must be objective, must have a an adequate relation to the reality it is intended to represent.

Objectivity is an essential value of modern science which, throughout its history has developed—and continues to develop—methods to ensure, as far as it is possible, the preservation of objectivity, in particular by raising barriers against the influence of non-cognitive interests—religious, political, economic, etc.—which tend to deviate scientific knowledge from the path of objectivity.

As a principle aimed fundamentally at the preservation of objectivity, scientific methodology must be understood in a broad way, not restricted to the aspects studied in the modern epistemological tradition, but including also the set of norms known as the scientific *ethos* (Oliveira 2011a). Among those norms, there is the one Merton (1973) designates by the term *disinterestedness*. The norm does not stipulate that a scientist must have no interest in his work: he/she may have intellectual interests—this is of course permissible, or even required—, and he/she may also have non-cognitive interests: the imperative is only that those interests are kept at bay, so that the research do not become biased.

Given those presuppositions, it may now be said that innovationism foments violations of the scientific *ethos*, which result in loss of objectivity. (Ziman 2000; Krimsky 2003; Lacey 2008; Oliveira 2011a) Those violations occur mainly in two sectors of investigation, one without and one with innovation potential, namely, the sector of researches on climatic changes, and the sector of biomedicine, especially the drug industry.

The main tension in the field of climatic change is the conflict between the interests of the whole of humankind and the interests of oil, gas and coal corporations, which see their profitability threatened by the imperative of reducing the use of fossil fuels. Those corporations' strategy in defense of their profits consists in promoting *climate skepticism*, raising doubts about the existence of significant climatic changes, their anthropogenic character, or their impacts for human beings. This operation is made easier by the uncertainties intrinsic to the conclusions of investigations in this field—which are however grossly exaggerated. In practice, the corporations' tactics consist in the financing of think tanks, which present themselves as scientific research groups, but violate deliberately the norm of disinterestedness, distorting the evidences, or their interpretation, in ways favorable to the interests of their sponsors. (Pittock 2009).

In the field drug production, the profitability of corporations depends crucially on the results of investigations about the quality of the drugs produced: about the efficacy—to what degree they do have the therapeutic effects expected of them—, and about their side effects, especially the negative ones. The violations of the *ethos* in this field are aimed at distorting the results of the investigations, exaggerating the efficacy of the drugs and minimizing, or hiding their negative side effects. (Brown 2010; Resnik 2010; Musschenga 2010).

Biases in researches aimed at the assessment of drugs have been coming to light with increasing frequency, often in the form of scandals. This phenomenon provokes a reaction in the scientific community which gives rise to an intense debate on the notion of conflict of interest (obviously related to the Mertonian norm of disinterestedness). A presupposition in the debate is that if the economic interests of the researchers and sponsors of an investigation are declared, biases can more easily be detected, and thus discouraged. Krimsky (2003, Chaps. 8–10) discusses those issues extensively and rigorously, arriving to the conclusion that more stringent rules for the disclosure of interests are not sufficient to overcome the problem.

7.4 The Democratic Alternative

With respect to alternatives, at a more general level, there are various organizations—besides SGR, *Science and Democracy World Forum* (SDWF), *International Network of Engineers and Scientists for Global Responsibility* (INES), *Fondation Sciences Citoyennes*[20]—that have as a central element in their platforms the democratization of decision making processes in science, in the spirit of participatory or direct democracy. One of the strategies pursued towards that end is the carrying out of *citizens' conferences*—which also go by the names of "consensus conference", "citizens' jury", "citizen forum", etc. Very briefly, in a citizens' conference, a group of laymen and women, who have been selected according to norms designed to prevent biases, are instructed by specialists in a certain field, like GMOs or nanotechnology. Then they discuss the issues in question among themselves and elaborate a report about the conclusions reached. And finally, the report is made public, with the goal of its being taken into account in the determination of policies for the field.[21]

The democratization of science conceived along those lines presupposes scientific literacy, i.e., a citizenry sufficiently informed to be able to think critically about science and its role in society. It reinforces what may be considered the motto of *Science & Education*, the proposition that science teaching must be not only *of* science, but also *about* science, as well as its implication, the need of introducing history, philosophy and sociology of science in science curricula.

What the perspective offered in this article may provide as a contribution is a better understanding of the forces that militate against the implementation of those views, arising from the processes of commodification of science. As the considerations presented above concerning the humanities make it clear, a movement aimed at commodifying science cannot favour studies which are likely to raise questions about the soundness of its aim. A full study about such contrary forces would also include those connected with the commodification of education, which involves a move away from ample formation, as in the American liberal tradition, and towards a concentration on professional training, along lines determined by the needs of the market. In curricula resulting from that trend, there is no place for critical thinking about the role of science and technology in society.

[20] See respectively: http://fm-sciences.org; http://www.inesglobal.com/ines-home.phtml; http://sciencescitoyennes.org/.

[21] Joss (2009) provides a good historical account of the initiatives of that sort and of the context in which they originated, as well as a study of their limitations, and suggestions about how to overcome them.

The suggestion therefore is that the struggle to turn into reality the sort of scientific education advocated by *Science & Education's* editorial line must involve resistance against the commodification of science and education, and hopefully, in a second phase, the fight for their decommodification.

Although the proposal is not for returning to the programmatic autonomy enjoyed in the Golden Years, according to it scientists would of course have an essential role to play in the public debate about the orientation of research. They are the holders of specialized factual knowledge that is required in the processes of deliberation. Moreover, they have a right to defend their interests, provided they don't do it without due regard for society's interests; but in order to fulfill that condition, they must be able understand and reflect seriously about the impact of their researches on society or, in other words, they must be *socially responsible* for their work. (Ziman 1995; Kitcher 2001; Lacey 2008).

8 Innovationism in an Emerging Country

This section deals with the fortunes of innovationism in an important emerging country, namely, Brazil. A similar study dealing with the whole set of emerging countries is beyond the limits of this article. In such a study, the case of South Korea would stand out, as the prime example of an emerging country very successful from the innovationist point of view. Due to that status, in the discourse about science and technology policies that take place in Brazil, South Korea is very often used as a standard against which the Brazilian performance is assessed, and as evidence of the viability of the innovationist programme for emerging countries.

The purpose of what follows is just to show the need, in a general enquiry concerning innovationism, of taking into account the differences between developed and emerging countries. The procedure is the following. First, I present a succinct historical account of innovationism in Brazil, and use it to show that the innovationist policies introduced there, although implemented with as much vigor as in the developed countries, do not have a comparable efficacy, i.e., they contribute much less to the promotion of the p-commodification of science. Then, I discuss the implications of that deficiency, as well as the difference in significance of the SGR report for the UK and for Brazil.

With a certain delay—as usually happens when foreign ideas are imported from the developed countries—innovationism arrived in Brazil around the year 2000 (Cruz and Chaimovich 2010, pp. 103–104; Carlotto 2008, pp. 98–112), but soon its policies started to be energetically pursued. At the juridical level, the main landmarks of that process were: the creation of the first *fundos setoriais* (funds for the support of innovation-driven research, for each sector of economic activities) in 1999; the 2nd national conference on science, technology and innovation (CNCTI), held in 2001[22]; the Law of Innovation, promulgated in 2004; the so-called *Lei do Bem* (law of the good; a complement to the law of innovation specifying the fiscal and other financial advantages to be granted to innovative enterprises) in 2005; the national plan of action in science, technology and innovation for national development (PACTI), instituted in 2007. At the economic level, the funding agencies and similar organs of federal and state governments created various programs for financing innovation-driven researches, and for involving private enterprises,

[22] The conference held in 1985, the first of the series, only retrospectively was considered as such: its name was just National Conference on Science and Technology (without "innovation"). The third and fourth conferences took place in 2005 and 2010.

in the form of conventions, subsidized loans, straight grants, scholarships, etc. At the institutional level, many organs have been founded, both in the public sector (like "innovation agencies" in Universities) and in the private one (like entrepreneurial associations, consultancies, NGOs, etc.). Campaigns and contests are promoted, aiming at instilling in the public the "culture of innovation"—like University of São Paulo's *Innovation Olympics.* In January 2010 president Lula sanctioned Law n° 12.193, which designates October 19th as national innovation day, and in August 2011 the Ministry of science and technology had "innovation" added to its name; it is now Ministry of science, technology and innovation. In the *Livro Azul* (Blue Book), where the main contributions to 4th CNTCI are synthesized, one finds a passage which, in a rhetorical rapture very expressive of the enthusiasm with innovationism, affirms that "Brazil has a gigantic, urgent need to inoculate innovation in all pores of the economy" (p. 35).

There is, in short, an enormous mobilization involving a considerable expenditure of public funds, as well as of the nation's intellectual and emotional energies. What is the result so far of all that effort?

In 2010, statistical data came to light that are far from auspicious for the advocates of innovationism, to say the least. Most of them are results from 4th research on technological innovation (*4ª Pesquisa de Inovação Tecnológica, PINTEC*), carried out by Brazilian Institute of Geography and Statistics (IBGE).[23] The Ministry of Science and Technology also compiles from various sources a series of statistics concerning scientific and technological activities, and publishes them in the section "Indicadores" of its site that is often updated. A non-exhaustive list of the most clearly unfavorable results includes the following:

- From the point of view of innovationism, the greater the proportion of resources invested by the private sector in science and technology, in proportion to the resources provided by the state, the better. That proportion is thus an indicator of innovationism's advance. On the average of OECD countries, private resources account for about 69 % of the total; in Brazil, 47 %. The percentage in the case of Brazil has remained more or less stable, with a slight fall in the last year for which data are available, from 47.74 % in 2008 to 45.25 % in 2009. In proportion to GDP, the investment by the public sector in Brazil is only 15 % less than the OECD average (0.59 and 0.67 %, respectively); that of the private sector is <1/3 (0.48 and 1.49 %).
- The *innovation rate*, defined as the percentage of firms which implement innovations went up from 34.4 % in the period 2003–2005 (3rd PINTEC) to 38.6 % in 2006–2008 (4th PINTEC). However, a substantial part of what counts as implemented innovation correspond to the buying of machines, equipment, software, etc., not to the true creation of innovations, resulting from internal R&D, carried out by each company's own R&D department. When only the firms that engage in internal R&D activities are computed, the percentage—which may be regarded as the real innovation rate—is not only much smaller, but fell considerably, from 6.7 % in 2005 to 4.4 % in 2008.
- The number of people working in internal R&D in private enterprises, which had been on the increase since 2000, suffered a decrease, falling from 49,354 in 2005 to 45,342 in 2008. When only researchers with a graduate degree are considered, the numbers are much smaller: 11,283 in 2005 and 10,292 in 2008.
- The number of utility patents obtained from the USPTO (*United States Patent and Trademark Office*), after a peak of 130 in 2003 fell to 98 in the average of the last

[23] Among statistical data collected by 4th PINTEC, and published in 2010, some refer to the period from 2005 to 2008, other ones to the year 2008. Analogous delays exist in previous editions, published in 2002, 2005 and 2007.

> 3 years for which data have already been computed. In the same period, the average of South Korea was 7,535. The number of patents per thousand researchers in Brazil is 1.8; in Korea, 45–25 times bigger.

Some of those figures were commented on in the section about Brazil of *UNESCO Science Report 2010* (Cruz and Chaimovich 2010). The report was launched on November 10th, the results of 4th PINTEC a little earlier, on October 29th. The repercussion in the press came soon afterwards, in editorials, interviews and other pieces with titles such as 'Brazil does not transform science into profits' (*Folha de São Paulo*: November 10, 2010), 'Stagnated innovation' (*Folha de São Paulo*: November 12, 2010); and 'Science in the private sector is still frustrating' (*O Estado de São Paulo*: November 19, 2010).

The failure so far of the innovationist mobilization is grist to the mill of critics, like Renato Dagnino, who argue that Brazilian capitalists' lack of interest in innovation does not result from a cultural deficit, as it is usually claimed, but rather from the very profit maximizing rationality, in the context of an emerging economy like that of Brazil. (Dagnino 2010) One piece of evidence for this thesis is found in the replies given by firms to questions about "problems and obstacles to innovation" in 4th PINTEC. Among the firms, which did not innovate in the period covered by the research, 55.8 % referred to "market conditions" as the reason for that lack. And among the 28.3 % which referred to "other factors", 75.3 % ascribed high or medium degree of importance to "high costs of innovation", and 68.1 % to "excessive economic risks". Since costs and risks are evaluated in comparison with expected returns, one may conclude, in simple language, that Brazilian capitalists do not invest in innovation-driven research because it is not good business.

This conclusion corroborates the criticism that, unless there occur deep changes in the structures, dimensions and insertion of the Brazilian economy in the world economy, the innovationist goal, of integrating academic research and the private sector, as a means of orienting academic research to innovations, is *unrealizable*.

Returning to the SGR report, one can say, also in a simplified manner, that its critique is of a different nature—it is the claim that the very goal of innovationism is unsatisfactory: it is worse than not worthwhile (in the sense that the return does not compensate the investment), it is *undesirable* (in the sense that the deleterious consequences are greater than the benefits of its realization). It is a situation to be avoided, not aimed at.

If the goal is undesirable, the fact that it is unrealizable may be considered a good thing. It would be, if it were not for the huge expenditure of resources with the innovationist mobilization, not just of public funds, but also of the energies of the people involved, many of them doubtless imbued with the best intentions.

The conclusion, in the light of the considerations presented, is that the meaning of SGR report for the UK has a component of denunciation—the exposure of the detrimental effects of the association between the academy and private enterprises. For Brazil, the analogous component provides a warning, a stimulus for carrying out serious reflection on the value of innovation, conceived, as it is, as a commodity, and, at a deeper level, a questioning of the efficiency of the market as the organizing principle of scientific and technological research.

9 Conclusion

As explained in the introduction, there is a dimension of economic life that corresponds to each one of the questions: *what to produce?*, *how to produce?*, and *how to distribute the* *goods produced?*. This article offers a characterization and a critique of the processes of commodification of science situated in the first dimension of economic life; and it is part of the wider research project that aims to complement it with companion articles that deal with the second and third dimensions. To the extent that studies expose deleterious consequences of commodification, they imply the need for a reform in the ways in which science and the teaching of science are conducted. The articulations between what goes on in the domain of science and what goes on in the whole of society makes it difficult to believe that a such a reform can be achieved without analogous changes taking place in other domains of social life. This suggests, for the movements engaged in the struggle for improving the ways science and science teaching are conducted, the usefulness of joining forces with other movements that share the same spirit, i.e., that oppose commodification in their domains of concern. It is typical for such movements to adopt as a motto an expression of the form "x is not a commodity", starting with the World Social Forum's "The world is not a commodity", and including many others, where "x" is education, health, water, etc.

The World Social Forum's other motto is "another is world is possible", which yields in the case in point "Another science is possible". This article's approach, centered on the concepts of commodification, Golden Years science, and neoliberal science, provides a way of giving substance to that motto, by suggesting that the other science that is possible is a decommodified, postneoliberal science.

Acknowledgments I am very grateful to Hugh Lacey, who encouraged and helped me in many ways to write this article. I also thank three of the reviewers, for their extensive and helpful comments, and FAPESP, for the support of *Projeto Temático "Gênese e significado da tecnociência"* (n° 07/53867-0), in the context of which my research work is carried out.

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