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Scientific behaviour: values and epistemology

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ABSTRACT. Science as a human activity relates to different human values, and therefore it is capable of ethic valuation, both for its consequences as for its process and its action. For this reason, otherwise as the *neopositivists* and the *empirism* have suggested, ethics can not be separated from the scientific analysis. The responsibility relationship appears followed by moral responsibility, that places in its actions the exercise of freedom and personal commitment, that without any doubt are basic values in an individual's behaviour, and, therefore, in a scientist. But these characters are part of any human activity, and they must *respond responsibly* before the actions derived from it. We are no longer before ethically traditional models, but we move in dynamic ethical planes. The scientific models that currently operate compel scientists to modify that attitude, and consequently, our reflection on this issue ends with a valuation on the need of an ethics of the science, or at least, to put on page the protocols of this issue.

Keywords: science, ethics, values, responsibility.

RESUMO. Comportamento científico: valores e epistemologia. A ciência como uma atividade humana refere-se a diferentes valores humanos e, portanto, é capaz de valoração ética, tanto em relação às suas consequências quanto ao seu processo e sua ação. Por esta razão, diferentemente do que os neopositivistas e o empirismo têm sugerido, a ética não pode ser separada da análise científica. A relação de responsabilidade aparece seguida de responsabilidade moral, que coloca nas suas ações o exercício da liberdade e do compromisso pessoal, que sem dúvida são os valores básicos do comportamento de um indivíduo e, portanto, de um cientista. Mas essas características fazem parte de qualquer atividade humana e devem "responder de forma responsável" diante das ações dela derivadas. Já não estamos perante modelos tradicionais de ética, mas sim nos movendo em planos éticos dinâmicos. Os modelos científicos correntes obrigam os cientistas a alterarem tal postura. Por isso mesmo, a nossa reflexão sobre esta questão termina com uma avaliação sobre a necessidade de uma ética da ciência ou, pelo menos, põe em primeiro plano os pontos principais deste debate.

Palavras-chave: ciência, ética, valores, responsabilidade.

Introduction

Science as a human activity relates to different human values, and therefore it is subject to ethic valuation, as much for its consequences, as for its process and its action. For this reason, ethics can not be separated from scientific analysis. However, during decades it has been accepted that science consisted exclusively of knowledge and was free of values, as the *neopositivists* and *empirism* sustained. These schools made a clear difference between fact and value judgements, in which science was reserved for fact judgements, despising any value judgement in scientific activity, as Ayer wrote "science never disputes matters of value, only matters of facts" (AYER, 1971, p. 23).

Later on, Ayer attests that "moral judgements are not actual judgements; it does not mean that they are not important or that adducing arguments in their favour is impossible, but these arguments do not work as logic or scientific arguments" (AYER, 1971, p, 28). In terms of Ayer's positivism, the exclusion of values in any analysis and intervention in science is clear, escaping from unique analytic statements, capable of truthfulness or falseness, and consequently, values correspond to expressions of feelings and have no scientific meaning.

Towards the 1940's, science's mythologisation, defended by the logic positivists and empirists, started to weaken and new tendencies began to surmise, tendencies that were trying to break that separation of facts and values, giving way to a new theoretical analysis. One of the first theorists to trespass the neopositivists' theoretical threshold was R. K. Merton, opponent of the separation fact/value, defending the existence of (epistemic, methodological, institutional etc.) values in science. In his exposition he indicated that

> "science is a misleading word that refers to a variety of different things, yet related among themselves. It is usually used to show: (1) a whole set of characteristic methods through which knowledge is certified; (2) a pile of accumulated knowledge that arises from the extension of these methods; (3) a whole set of values and cultural norms that rule the so called scientific activities; (4) any combination of the previous elements"(MERTON, 1973, p. 356)[1].

It is on the third item where Merton emphasizes the significance of science's values as a valuation instrument within scientific activity. This whole range of moral imperatives will be called the *ethos of science*. Although he didn't approach epistemic matters – later on Laudan (1984) will talk about epistemic values – his analysis of science highlighted the non-separation of fact and value judgements, sustained by both the philosophical and sociological traditions (See WEBER, 1978).

The mertonian analysis provided the sociology of science with two basic matters: Firstly, science is not only knowledge, but is also norms and values just because of science has at least epistemic and institutional values; secondly, the mertonian thesis breaks with science's neutrality, as the process of investigation depends on the institutional and social context, and vice-versa, that results in a preoccupation with values in science. However, Merton's contribution, although now relegated to historic reflection, opened the door for the sociology and philosophy of science for a new reflection about science – values.

From philosophy, and following some of the mertonian assumptions, such as the negation of the dichotomy of facts and values, we find Bunge. This author, unlike the sociologist, carries out an important differentiation *a priori*, as he considers scientific knowledge to be ethics and axiologically neutral (BUNGE, 1988, p. 22). In principle, admitting this consideration is going back to the inherited conception, as it accepts that knowledge itself is not susceptible to ethical valuation, yet knowledge abandons that ethic neutrality, when science is applied, because it goes outside the field of scientific knowledge.

The reflection about the existence or lack of values does not stop there, it is much more prolific. It has led to the appearance of two different theoretical models in the comprehension of values in science: *internalist* and *externalist*. The internalist approach analyses the process from the inside, where it highlights the existence of a vast range of epistemic, cognitive, methodological and other values, considered typical of science. Whereas, the externalist conception elaborates on its scope, and understands scientific tasks as just another human activity, as it studies and evaluates the involvement science has in the social plane: environment, biotechnology, cybernetics etc.

The internalist perspective centres its objections on the epistemic values, the advancement of knowledge or application. It does not reject the intervention of ethical values, related to choosing the aims to be reached, and neither in the selection of proposed hypotheses with the purpose of reaching the goals. It states that there are different values that take part, however these will be conditional on cognitive values. When scientists choose a research line, it must be based on the values accepted by the scientific community.

Cognitive values are the real devices of scientific knowledge, because they will form the basis of methodological choice, as cognitive values will affect scientific rationality, and just based on this, scientists will choose the most adequate ways of achieving the aims proposed for their research. In short, for Laudan, the most favourable way to improve scientific process is, undoubtedly, the analysis from an internal perspective, and accepting an intromission of outside values, which implies straining knowledge's rational process. This is understandable if we do it from the first theoretical framework realised by Laudan (1984), *pragmatism*.

Defending this internalist approach, rejecting the intromission of external values in the valuation of acceptance or rejection of theories, facts, hypothesis, etc., we find Rescher's thesis (RESCHER, 1988). Apart from defending the justification of the internal reality of science that makes the advance of knowledge possible, he also believes that autonomy and self-sufficiency give reality to the internal value of science. For Rescher, scientific thought can not go outside of itself to compare the different hypotheses or theories, nor real life results. Internal thought has its own rules and mechanisms of internal correction, and leaving scientific knowledge to the discretion of external comparisons would mean losing science's typical freedom.

He rejects any external intromission in scientific tasks, as nothing coming from the exterior could be the apex of control of internal science's labour. So it brings up a teleological vision of knowledge, not as output but as an instrument of value. There is nothing above knowledge; knowledge itself is its own instrument of control.

[1]MERTON, R. K. The Sociology of Science: Theoretical and Empirical Investigations. Chicago: University of Chicago, 1973, p. 356. Merton had already mentioned this item in his work Science, technology e society in seventeenth century England. New York: H. Fertig, 1970 p. 221, where he wrote: "In another words, the science experience itself and scientists are supposed to hold a secure place on the scale of values, that is the final referee of prestige assigned to the different activities", although until the article published, in 1942, the existence of values in scientific activities had not been manifested.

> "The acceptability of scientific designs is something that has to be completely settled in keeping with the internal considerations of scientific tasks. A 'science' subjected to external correction a criterion simply does not make itself worthy of that name. Scientific affirmations, if corrected, must be reformed by new scientific theses. This fundamental fact is the bedrock that provides the only base on which the doctrine of science's self-sufficiency can find its firm basis" (RESCHER, 1999, p. 115-116).

Therefore, this conception limits the field of accuracy or error criterions to science's own internal structure, and the accepted values of the scientific community. They do not consider that science is part of a social construct that depends on various contexts: social, cultural, economic, etc. Although scientists fundamentally look for the satisfaction of their individual needs, they also cast their scientific interests in society, how they affect, produce and favour it. At least applied science depends on images from the outside.

The externalist perspective does not reduce the analysis of science to scientific tasks, but expands its investigative field to social values that interfere in the determination and valuation of science as a product. This interweaving of science and society implies that different externalist tendencies have appeared, that bring the reality of science close to the social view through cultural interpretations. As Nelkin and Lindee (1995) point out, these interpretations of science that come from the different ways of examining scientific behaviour, are producing an understanding of the wide cultural forces that influence both science as well as its popular appropriation. The examination of science from the externalist point of view does not consider scientific activity as autonomous and internally directed, but as an institution framed in an economic, political and juridical culture. Nelkin (1998, p. 34) describes how theoreticians that examine science from this perspective, are doing it by expanding into other contexts, such as the political, juridical, economic field, the relationships between science and other social institutions, mass-media, religion, etc.

It is in the externalist conception where the ethics examination acquires a major relevance in science. In this perspective, the values of science interact with social values. Once again we see that not all the theoreticians perceive science's behaviour in its application in the same way. Following Mitcham's thesis (2000) there are three different approaches, although one of them presents a vision that is quite far from scientific practice, therefore it will not be taken into account.

We will focus the analysis on the other two theoretical perspectives that have a bigger transcendence in the examination of scientific ethics from the sociological point of view: inside and outside. The "inside" orientation analyses typical matters of scientific activity within the scientific community, as a subsystem. Once again we follow the thesis of the sociologist R.K. Merton, and the way its orientation changes: where science is analysed as subjected to values, the examination parameters are inverted, and what previously was an externalist interpretation turns into an internalist one. In this case, he centres his investigations in normative moral factors that rule scientific tasks, and that scientists internalise, as members of that system, making the advance of knowledge possible, such as: scientific honesty, universality, interchange, scepticism, originality etc. But they also analyse the criteria used by scientists when choosing purposes and methods, as they are submitted to beliefs, values, etc. In the same line we find Bunge's thesis that understands that science is a moral school, as it requires the acquisition or strengthening of a series of habits or normal attitudes: there is a corruption, according to Bunge, as it makes reference to a whole desideratum, and with the moral code of the scientific institution. This code complies with some precepts that are in part of an ethical nature – or at least to an ethical extent.

At the beginning of the 1960's the first tendencies disagreeing with the "inside" interpretations appeared. Some of these reflections state that normative models develop an important role in the scientific community, but they are neither the only ones, nor are they fundamental results, when choosing or rejecting scientific paradigms; moreover, science not only circumscribes to values proceeding from scientific institutions, but there are also other subjacent in society (BARNES; DOLBY, 1970). These will not be the ones having a major influence upon the "outside" thesis, but some public revelations, that took out some dishonest scandals, such as the Russian Lysenko's fraud. Matters like these and the different confrontations among scientists for the ownership of discoveries, such as the confrontation between Gallo and Montagnier.

These facts were casting doubt on the existence of an internal ethical code of science, and they were the main argument to disband the "inside" thesis for the "outside" ones. Then, some theoreticians started to investigate external factors that influenced scientific life, questioning the lack of interest, honesty or general interest of science, when

scientists saw themselves influenced by external values, such as recognition, economic interests, the need to have institutional or private help in order to achieve the aims of their investigations among other things.

These social aspects have a significant influence on the scientists' behaviour, but they also have repercussions in society, as their researches provoked many disasters, chemical wars, destruction of the environment etc. We should not forget that scientists are human beings and therefore as liable to be influenced as any other person. Competition and financing needs, among other causes, have made scientists become less and less disinterested, and they have fought more and more for resources and demands that come from the outside.

These matters make the scientist partly dependant on the outside, however this does not imply that we should only analyse science's secrets from an outside perspective. Any predicament can have a strong influence on the direction of scientific investigation. We are not saying that science is, in the end, a "merely social construct", nor that there isn't an important "internal logic" element in scientific development, logic that promotes some directions or subjects and holds up others. What we are saying is only that the availability of financiering resources is a very important element for the advance of science, and therefore, the history of science can not be read or reconstructed without taking into account the social, political and economic history (VALERO MATAS, 2006).

Scientists' responsibility

When talking about responsibility we perceive the reality of realness, and so it is not a matter concerning only ourselves, but it is an experience that is either born from us or comes from the outside, and whose satisfaction we are responsible for. Therefore, actions will be correct or incorrect in as for as they comply with that responsibility.

The criterions adopted when looking for responsibility are not based on the same principles, nor on the same contexts. The peculiarity of responsibility falls within the transformation of different phenomena into moral interpretations directed towards action. But that responsibility which we take as point of reflection is subject to the responsibility for something and the responsibility towards somebody. Responsibility understood in these terms is valid as a guide for science and technology, as these two subjects can not remain closed, because responsibility is an open value. It is open, as much as responsibility depends on various contexts, as for the peculiarity of human values. For example, within the juridical context, responsibility complies with some compensation criteria, in the moral domain it is on a different level, and it can be found in the rule described as supreme: *do not do unto others what you do not want them to do unto you*, responding therefore to a reciprocity criteria.

The moral action of or about something in general terms does not allow for the understanding of the behaviour of responsibility built on traditional models, but we must go further, as Jonas (1979) proposes, by not interpreting the moral action in terms of compensation nor reciprocity. The development of science and technology has opened the way to much wider spaces; therefore we can no longer talk about compensation, and even less about reciprocity. In relation to compensation, it is impossible to think about a correspondence of our actions. Reciprocity requires equality of parts, and nowadays we find a strong inequality, and among them there is power. We can not possibly ask for the same responsibility of the president of the United States as of the chief of the Massai tribe. The same way, it is illogical to ask for the same responsibility of the scientist and the enterprise that commercialises CFC as of the individuals who use it, because among other things, they may not know the consequences derived from its use. Therefore, responsibility is directly proportional to the level of power and the knowledge that one has.

In other words, we can not withdraw responsibility to the simple field of actions; we must submit it to a reflection about what is to be carried out and the analysis of possible consequences[2].

Scientific responsibility – ethical responsibility

When talking about responsibility from its social dimension, we usually refer to professional responsibility, for having risen from a pile of knowledge acquired through learning, that serves a particular cause, and that generally brings a benefit for human beings. Scientists and technologists as bearers of this knowledge, and depending on the purpose of their actions, acquire a responsibility to which they must answer with facts. From this action it can be deduced that, on the one side, scientific or professional responsibility comes from the specialized knowledge someone has, and on the

[2]Where scientists' responsibility has more significance, socially occurring during the last decades, arises from the risks that scientific and technologic research suppose. *See* BECK, U. *Risk society: towards a new modernity*. London: Sage, 1992. When talking about risks, undoubtedly we can not forget responsibility (BECHMANN, 1995, p. 86). All knowledge has its risks, predictable or not predictable, any action is risky and somebody must assume that risk.

other side, that this knowledge, when serving society, must prevent producing negative effects on individuals.

Taking this matter as a basis, it is convenient from the ethical point of view to state a difference between the demonstration context and the application context, as they do not imply the same values. For example, the process and consequences of a scientist who wants to get to know and discover the cosmos does not imply social aspects, and even less does if imply a risk for human life, in principle just the opposite, that is to say, it solves the universe's mysteries. Things change when a scientist starts doing research about human nature, for example, the ones done by Wilmut and others in the Roslin institute. Research may follow the same procedures as in the previous example, but what happens when this knowledge means cloning human beings?

At this point serious reflections about responsibility come up. While in the first scientific model responsibility lies in choosing theories, spreading knowledge, i.e., demonstration of epistemic matters, and he/she must answer before the scientific community; in the second model the responsibility is towards human beings and he/she must answer before the whole society. Therefore, the effects and consequences derived from the research will not have the same repercussions nor the same effects, and this implies taking up once again the Aristotelian theories and to talk about the different responsibilities: *poietic responsibility, practical responsibility and theoretical responsibility*.

From the practical analysis and moral valuation, it is quite complicated to impute a responsibility to a scientist or technologist, as Ovejero (1996, p. 57) points out, just because of risk is not produced by only one action, but there are a great number of agents (collective or individual) – researchers, producers, consumers, institutions, organizations etc. – intervening in such a way that looking for responsibilities comes to be a complex task. On the other hand, nowadays with the ethical debate model, imputing an ethical responsibility to an individual or research collective would be unfair, as, Jonas (1997, p. 32) writes, the "modern technique has introduced actions of such a different magnitude, with such original objects and consequences, that ethic's frame can not comprise them".

We can not hide this matter by falling into the mistake of looking for responsibility in the old paradigm as we are in a new situation, that has changed the old traditional models, imbuing us with a different paradigm, consisting of new challenges and new risks. Jonas' words cast upon a new direction, however, Bechmann's (1995, p. 63) contribution is more explicit: As starting from an uncertain frame, he gets to a complex situation by looking for responsibilities, as science and particularly technology have got the better of this ethical scenario, due to the lack of predictability and the absence of individual agents. This makes him state (BECHMANN, 1995, p. 88) that "a moral founded on reciprocity and an ethic based on universality will justly fail before this social conflict situation and future expectative".

So, responsibility theory can not be based on traditional positions, neither the model of assistance of justification – anthropocentric responsibility – because it leads to the questioning of other types of life; nor the model of reciprocity, that excludes unborn children, people with mental illnesses, and non-human living things. As a consequence, the new ethics must be enlarged, i.e., not subordinating nature to human caprices, nor looking at the immediate future only, but waiting for new possible worlds. *Spheres of responsibility* are vague and they prevent us from establishing some clear rules. In order to avoid this situation it is convenient to take into account, when talking about responsibility, the proposals of action, measuring the purpose of the practice of human actions, and the negative incidences in solving problems because of omission.

Inadequate behaviour of scientists: ethical valuations

Ever since the beginning of science, different cases of scientific frauds have been investigated, conscious or unconscious plagiary, errors or traps of any other kind. This has generated a certain social reticence regarding scientists' honesty, questioning the existence of an ethical code within the scientific community; and, as a consequence, made people wonder if scientists are really looking for the truth. These kinds of acts have increased society's scepticism towards science, and some theoreticians even accuse these scientists of consolidating the antiscience. Others, like Holton, state that fraud and tricks are part of the structure of scientific research itself (HOLTON, 1996, p. 35).

Going on with this line of analysis, and avoiding falling into interpretative slants about scientific activity, we must distinguish, on one hand, the analysis of epistemic and methodological representation that studies thoroughly a reflection upon the nature of truth, theory validity etc.; and on the other hand, science's social instrumentality. This does not imply the absolute differentiation of both

aspects, but rather the evaluative description of different features in the investigation about science's sense as social phenomenon. This differentiation, from an axiological perspective, makes us consider the existence of a fundamental (nuclear) axiological code, common to all contexts that will serve as reference in the development, research, analysis and reflection of the different values that intervene in the various social domains. However, we will find particular axiological codes, that will meet internal valuing estimations, and in this particular case, the development of the scientific tasks. This fragmentation of values does not mean denying the concomitance relationship between science and society; on the contrary, it means a deepening in matters that affect directly specific spaces where other values' incidence is minimal.

Merton and others have investigated this objection and have conditioned ambivalent behaviour to the psychological truth rudiment, that surrounds the desire of individual satisfaction; they state that any "extrinsic reward – fame, money or position – is morally ambiguous and potentially subversive of culturally estimated values, as when rewards are given, these may change the initial reason: the interest for recognition may oust interest in favour of promoting knowledge" (MERTON, 1973, p. 439).

The social influence from this point of view is a component that provides a base on which scientists are able to magnify their achievements, and this attitude not only produces a social disagreement, but it also generates internal disputes, making one doubt the existence of normative values, as ethical values can be adjusted to their own individual interests. In this social projection we find two quite widespread behaviours, caused by the institution itself which do not comply with the preestablished rules, such as the acceptance of theories, discoveries, etc., subject to authority principles; and secondly, the need to get into the group of noteworthy scientist. In the first case, accepting authority implies shaping values according to dominant tendencies, without justifying decisions to established principles, and drawing ethical consensus parameters, adjusted to power paradigms that irradiate negativity in science. In the second case, it is due to the wish of entering the group of notable figures of science, for the status, a matter backed up by the institution. Nevertheless, the scientific institution itself is the one that eventually detects frauds.

Dysfunctions in the domain of science can be found in scientific frauds, such as in Summerlin's case, who justified his action with the help of his feeling of failure. With the intention of avoiding frustration, he decided to paint the back of a white mouse. His fraud was discovered after some time. It wouldn't be the last farce the scientific community would have to deal with, as some years later another similar case come through: a medical researcher from Harvard, Darse, and falsified laboratory information and, as had happened with Summerlin, the falsehood was once again exposed. In some cases there is some help based on authority[3]. These researchers were working with notable scientists and in important research centres, therefore there was a goal behind it, getting fame, something that the institution itself promotes.

In this same line of improper behaviour, we find other ones manipulating information, as happens many times, when scientists choose data that does not adjust to the scientific method, so as to fulfil the wished aims, although in this case facts might or might not be made on purpose. If we consider the matter regardless of the model's typology, in these cases there has been a violation of the ethical norms, and if they were not frequent, they are clearly prejudicial for science.

From the sociology of science, we find different controversies, and nowadays we are confronting one of the most complex problems, opened by some ramifications of the sociology of science against the methods and procedures of traditional sciences. There are two essential arguments in this confrontation, that started the well-known "science wars", not so much because of the intrinsic nature of the process, but for the application context, where those "wars" take place.

On one hand, in the first argument we can notice an excessive use of scientism, i.e., appealing to the authority of science as a dogma in order to justify the veracity of the analysis. With the aim of avoiding this theoretical disagreement it is necessary to accept that science is part of society, but it is neither the only element inhabiting it, nor can many social keys be determined by science, therefore science can not be conceived as "creating". The second argument deals with the mistake of taking scientific statements out of context to give validity to other theoretical areas, formulating pseudoscientific statements, and consequently creating pseudosciences. This interpretation causes a falling into indignity, as it gives priority to individual principles, disfavouring the collective ones – and projecting it farther, it leads to the slowing down of knowledge's advance (BUNGE, 2000, p. 314).

[3] To see a detailed analysis of this character's story, check the excellent process description, written by HIXSON, J. The Patchwork Mouse. Garden City: Anchir Press, 1976. We can also find a brief note about the matter in TROCCHIO, F. Las mentiras de la ciencia. Madrid: Alianza, 2002. p. 215-218.

The lack of internal coherence within these theoreticians of social science's thesis has worsened the eternal problem of confrontation between social and natural sciences, to the point that some of the theoreticians of hard or semi-hard sciences have started to take severe dialectic measures against sociological discourse. This fact has provoked an exchange of accusations in scientific magazines and books concerning the matter.

The first important polemic appeared, when Gross and Levitt (1994), in their work *Higher Superstitions: The Academic Left and Its Quarrels with Science*, promoted a campaign against the social studies of science. Among their multiple accusations, they emphasized the indiscriminate use of metaphors of science in social studies, as a means of giving validity to theories or social models. However, these were not the only studies that have regretted the appearance of writings against the social studies of science, for using scientific epistemology as a device for defending theories, without validity.

The most virulent accusations came from Sokal and Bricmont (1998), in *Intelectual impostures*, that spilled their reprobation against certain social theoreticians, for their disproportioned use of scientific terminology and for building and using a dark and indecipherable language in some cases, and errors in the interpretation of theorems of physical-natural sciences, in others. One of the first people to be criticized was Lacan, whom they have censured for using, in a confused and inexact way imaginary numbers, and for conferring scientific validity to psychoanalysis (SOKAL; BRICMONT, 1998, p. 41-42), producing darkness in his reasoning. The texts of the writers Deleuze and Guttari are even more incomprehensible. About these, Sokal and Bricmont state having "found a dozen scientific terms used without any apparent logic, and the discourse oscillates among absurdities (a function is a slow motion) and platitudes (science does not cease to foment accelerations)" (SOKAL; BRICMONT, 1998, p. 159-160). This text is followed by a wide use of scientific terminology taken out of context and brought to a field that does not give any practical utility to social reflection.

Without any doubt, most of the criticism comes in a chapter referring to epistemic relativism, where hard recriminations against Quine, Khun, Feyerabend and the Strong Programme in the sociology of knowledge appear. I humbly consider that, although most of their accusations have enough reason, the dialectic violence against these ways of thinking has been disproportioned, in spite of the vehemence in the elaboration of these theoretic models.

Accepting as valid such reflections means transforming into rational something *a priori* not rational, as epistemologically speaking, theories, aims, etc., must follow an internal logic, connected with some rational values, avoiding the emission of judgements that could be damaged to knowledge. With the purpose of avoiding this kind of report, Laudan (1996, p. 133-134) suggests the need for rules confirmed by empiric observation, that, in turn, will serve as a confirmation or rejection instrument for other theories, although criticism should not be exclusively centred on the epistemological perspective, as this type of discourse also affects methodological and educative fields.

The inclusion of reasoning defended by sociology, especially by methodological relativism or constructivism, does not develop a method appropriate to a reasoned argumentation, adequate and consistent, apart from the fact that its analysis transgresses the ethical value. And the fact is that this theoretical-methodological arrangement, instead of contravening strategies, finally establishes a discourse based on absurdity as a method; as C. López (1999, p. 50) points out, these confusions have devastating effects on the reasoning's rigour and the intellectual honesty of professors and researchers in various subjects. And the point is that the radical scepticism that is underlying in these theories, always contains, as Bertrand Russel says, a frivolous insincerity element. (RUSSEL, 1976, p. 41-42).

Rereading López, and moving to the Kuhnian pedagogical context, we can observe that the thesis defended by these theories not only deny any normative imposition (mertonian or any other), but they also generate an important ethical problem, leaving out one of the basic principles of science and other branches of knowledge – intellectual honesty – , and this will significantly affect the analysis of science. Kuhn was stating that "people who study science are discouragingly prone to receiving their teachers' and the texts' statements without questioning them" (KUHN, 1996, p. 351).

We can deduce from here the importance ethics acquires in teaching science; and the fact is that the argumentation and spreading of wrong theories, or theories in which the searching for the truth is not implicit in their discourse, incur serious ethical problems for defending an abstract or external analysis of science. In spite of not admitting that their theoretical approach does not have any scientific justification, in the design of this kind of conjecture there is a lack of ethical valuation, and

they solve the problem by resorting to Feyerabend's axiom "Everything is allowed", and describing science as a social construction.

Moreover, theories that found their thesis on mere descriptions of politic or social interests lead to the spreading of theoretically authoritarian models, and they won't accept critical theories nor will they learn from experience, but they will introduce a new scientific culture founded on the *doxia* and rejecting *praxis* (POPPER, 1993). Therefore, we find ourselves faced with a fraud and ethical damage, both in scientific activity and in scientific action.

The criticism of this kind of conceptualisation does not mean in any way reducing the whole analysis of social and natural science to a mere epistemic or ethical determinism, because, as has already been said, none of them excludes other values that interact with science, but they plead for the establishing of a flexible norm. Leaving out any type of rationality in science, far from the established models of scientific validity, means allowing non-rational conceptions to settle in the scientific world, without any kind of criticism or rejection, and it represents the acceptance of the idea that all design and validity of theories withdraws from private or collective interests built on power.

For instance, if a professor or researcher in physics thinks that the best solution for fighting against the deterioration of the ozone layer is firing an atomic bomb, and to this opinion some scientists and public powers subscribe, then – accepting the constructivist' point of view, who does not care about the criterion of truthfulness or falsity – as the controversy would be solved in favour of the bomb launching, the next step would be spreading, showing and applying this solution, even though it is completely absurd. So, delimiting scientists' action starting from some institutional imperatives does not mean falling into a normative determinism, as the perceptive side does not obstruct making coherent, adequate and precise decisions. Let us not forget Merton's words: "The authority borrowed from science turns into a powerful symbol of prestige for antiscientific theories" (MERTON, 1968, p. 613).

The need for an ethics of scientific activity

Science is the product of a pile of knowledge that is a consequence of collective actions. Although many scientists developed their activity individually, they needed their predecessors' theoretical-practical studies in order to achieve their aims in their researches or discoveries; therefore, science could and can advance in knowledge thanks to interchange and spreading. If Gauss hadn't had information about his predecessors' discoveries and theoretical developments, he could have hardly formalized the curve, law, theorem and approximation that have his name. This interchange of knowledge has not only contributed to making it easy for scientists to enter into a communication and collective collaboration process, but it has also affected other research spheres and it has produced changes in social and scientific behaviour.

From the sociological analysis, we can not leave out the relationship between science and power, either economical, political or military; and in the last decades of the 20th century, these connections reached unthinkable levels (BARNES, 1977; BARNES, 1985). Throughout history, knowledge has been coveted by politicians, businessmen and governors, as it was an instrument of power, like it happened with the discovery of gunpowder, firearms, atomic bombs, missiles etc.

Scientists and researchers have not stayed far from these private ambitions; their abilities and skills were important for businessmen and industrialists as it brought a stronger control capacity, and also very big economic benefits. After some time, scientists understood that the economic and social registers could bring them excellent profits; so some of them decided to abandon the academic field. In the second half of the last century, important groups of scientists, seduced by money, fame and business, abandoned the academy in favour of turning into businessmen or managers of knowledge, transforming it from a cultural value into a material value.

Science, scientists and technoscientists have an obligation, because of their involvement in fields of knowledge, to start the search for the truth; and, as individuals, they must control science so that it does not destabilize society, and that their knowledge is not used with damaging purposes. This mission is problematic for the scientific community, because it is formed by individuals whose actions and decisions will be conditioned by social values; but, as they are supported, favouring their researches, they have the responsibility not only to favour progress, but also to teach, spread and evaluate all the beneficial and pernicious effects of their research.

The cloning case has great transcendence because of the consequences of its application upon the human race. When Wilmut and his partners created Dolly the sheep, a Pandora's Box was opened: with it, a new scientific research field was opening, but it also generated a new socio-scientific problem. Wilmut himself wrote that "human cloning is now in the spectre of future possibilities,

and we, more than anybody else, contribute to place it there. We wish it wouldn't be this way, but there it is and it will go on as long as cloning lasts" (WILMUT et al., 2000, p. 315).

Regarding this fact, the scientific community is facing a new challenge: if animal cloning leads to human cloning. Cloning must not be seen as something pernicious; in many cases it is an excellent instrument to solve some human problems, and improve the quality of life. However, everything that seems to be socially perceived about cloning is its possible inadequate use in the field of the human race; nevertheless, nobody speaks about its benefits when used therapeutically. It can not be forgotten that in science, as in other knowledge spheres, we will encounter problems and uncertainty, and with it, risks. Medical research is perhaps the one where there has been the most consensus, but it does not mean that there haven't been confrontations.

Since some time ago there have been protests against experimenting with animals, or xerotransplants, with limited repercussions, due to a favourable internationalisation of society. However, there isn't the same mood in genomic research and cloning, where we find more difficulties and important controversies, both among scientists and in society. Cloning with therapeutic purposes is defended by a large percentage of scientists, intellectuals and society. As the theologist Küng (2002, p. 117) points out: "I'm seriously worried that people would try to build a new human being, without meaning to help somebody, but out of the mere greed of artificially creating a better human being".

However, it shelters the Frankenstein phenomenon. Somehow, the way he superfluously analyses the value of cloning, or that of genetic research, it could be that we are not only faced with the Frankenstein syndrome, but, as Haraway (1991) says, we are getting closer to the *Cyborg* model. This matter is not unfeasible at all, as we are already seeing the possible election of individuals *à la carte*, the product of evolution and biotechnology, and because of the economic interests it may give to the medical and pharmaceutical industries.

The appearance of ethical reflections is indispensable for scientific knowledge; however it must not stop science's (technoscience's) aim, *i.e.* searching for the truth, discover and get to know the unknown. In all this process, one must not forget that in the advance of science there is a commitment of responsibility that prevents us from trespassing some ethical limits.

Another matter that represents great expectations for human beings is the research with trunk cellules[4]; however, its practice has also set off alarm bells for its possible inadequate use. The problem lies in not respecting various moral rules, and that some researchers could start projects not at all positive for society, or that the economic need could end up controlling these and lead to it being the only one dictating future decisions. With these referents, we need to solve this matter from the view of ethics, as in fact it is built upon moral values.

The problem lies in how to present the ethical norms as to create order, without bypassing the limits of undesirability, although we are submitted to knowledge's advance. Regarding this matter, Wilmut stated: "As scientists, closer to action than any other people, we feel obliged to expose facts just as we see them and as clearly as we can, because facts can not be allowed to determine ethics (not equivalent to duty), they have a lot in common with moral arguments, in many different points of view" (WILMUT et al., 2000, p. 315-316).

This does not mean rejecting advances in knowledge or scientific research, but in fact the contrary. From here research is helped, but not at any price, the scientific community, political and economic forces among others must establish some limits. These frontiers go on to establish an ethical model that regulates scientific activities, that must be respected by all the parties involved, and the ones controlling power and economy should not skip this model when it goes against their private interests. So, a global ethical model is not the one that is promoted, as Küng (1998) proposed, but entering a reflexive and open ethical debate, however limiting those improper and undesirable activities.

Küng's proposal has been formulated in other terms by Apel (1980). This philosopher's proposals have alerted various political, scientific, religious, etc sectors that were considering it unfeasible and even heretic. However, Apel didn't mean it to be so; he was only calling people's attention to the abuses of science and technology, and that beneath the discourse about technological advance there were perverse effects.

Apel's contributions, subscribed to some time later by social and natural theoreticians, have opened the debate again – if it was ever closed –, proposing that if science and technoscience have a global scope, why should not be possible a global ethics? Apel's proposal, far from seeking happiness, was trying to make the process of global model of ethics take into account the interests of all the individuals, and not

[4]The moral debate is quite different if it deals with embryonic trunk cellules or adult trunk cellules. See the report of The Advising Committee of Ethics in Scientific and Technical Research, Ministry of Science and Technology.

only those of a few of them, and of course, those of science and technology. Küng's proposal follows other paths, but they all have the same final point, "a common fundament of values and rules, rights and duties, i.e., a common ethical attitude" (KÜNG, 1998, p. 78).

Conclusion

From the axiological point of view, ethics are just another value, although from the social parameters it is a dominant value, as society estimates its development as a principle that protects individuals from external abuses or threats (be they juridical, military, etc). In this situation, we are facing two contexts, the social and the scientific one that are also influenced by sub-contexts. The complexity lies in implementing these contexts without transgressing any internal rules of either of them, but also without breaking general norms.

Going on with this idea, and knowing that we are moving among systems and subsystems – each of them with plural normative parameters –, we consider adequate the developing of a model without any specific dominant value, but with many values. The combination of these values will respond to the needs of some cellular values that lead to creating a nuclear normative model, based on a general ethical norm, and leaving space for an adjacent normative *ethos*, adapted to each context. This way we can direct peripheral values toward nuclear values, without reacting to an omission of principles ordered in favour of a social balance. This does not mean that ethics are founded as the dominant value, nor is it implied; its function will have the appearance of a *horizontal value*, to which values will appeal for advice, but not because they have to. This hopes to avoid the facts determining ethics, but also that ethics determines facts.

These social, cultural, economic, etc alterations have also brought with them a transformation of human beings that are more and more at the mercy of scientific experimentation. People talk nowadays about scientific and technological dehumanisation, the consequence of the obsession to get eternal longevity, and the human perfection that lies in it. It does not seem very far away now when we can choose biologically perfect human beings, and some scientists say that some day we will be able to connect to the human minds. Before this probable reality, we should ask ourselves until which point should man and science continue. If we continue with the Greek sin of arrogance, we will be able to state that mankind will reach absolute knowledge and therefore they will control nature, as Greeks and some contemporary scientists wished, but… that is assuming too much.

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