Ethical implications of onto-epistemological pluralism in relation to entropy[1]

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Abstract

From the epistemological posture that we present in this work we sustain the following thesis:

– That as subjects we constitute the world we live in through one of the possible conceptual frameworks.

– Our cognitive and social practices construct the world in a certain manner, which makes us responsible for the way this world is constituted.

The type of scientific and technological practices that cannot be corrected force us to consider that the ends/ objectives are definitive, since in fact, once started there is no going back. This, leads us to reflect that the advance of technology and its power is too advanced in relation to the knowledge that men have and also to their moral capacity to make the correct decisions keeping in mind the conditions that future generations will live in. The risk is that human beings cannot know for certain what the bi-products/ sub-products of scientific-technological-research will be, they cannot foresee exactly what the consequences derived from it will be.

Without the perspective that time gives us, on many occasions it is not clear if the effects are negative or not. It may also be that the consequences turn out to be what was expected according to the scientific and technological objectives as envisioned. In this sense, they may be successful, but in the social, cultural and moral contexts the results may be confusing, if not harmful, and exceed the capacity for research, deliberation and decision making by the members of society.

The acquisition of knowledge has become an urgent duty, but, seeing that the products of research remain submitted to the restrictions imposed by reality, in this case, conceptualized as entropy, it is necessary to accept that far from the subjects having absolute dominion over the environment, our knowledge is partial and fallible and the second law of thermodynamics restricts our practices.

Key words

Pluralism, onto-epistemological, social practices, knowledge, entropy, fallibilism.

1. Introduction

According to the first law of thermodynamics the total energy contained in the universe is constant and, agreeing to the second law the quantity of entropy tends to increase constantly in time. Corresponding to the law of conservation of energy, energy is neither created nor destroyed, we can only transform energy from one state to another. Entropy is a measurement of the quantity of energy that cannot possibly be transformed into work. If entropy increases then the energy disposable to be transformed into

work decreases. In fact, pollution is the sum of disposable energy that has been transformed into dissipated energy.

In a closed system, the difference in the levels of energy tends to equalize. For example, when a poker is removed from the fire and left in the open air, soon we notice that it begins to cool while the surrounding air begins to heat up. This is because the heat flows from the hottest bodies to the cooler ones. After some time the air and the poker reach the same temperature. The experts call this condition a 'state of equilibrium', the state in which there are no differences in the levels of energy. The state of equilibrium is that in which entropy has reached its maximum level. That is, the level where there is no more energy available to carry out any additional work. Rudolf Clausius, the first physicist to coin the term 'entropy', concluded that this, understood as the quantity of energy not available for carrying out work, tends towards a maximum level. Many people believe that nearly everything we use can be recycled and reused if we develop the appropriate technology. But this is not so. Recycling requires additional energy to collect, transport and process the used materials, which increases the proportion of entropy in the environment. So that, materials can only be recycled thanks to the use of new resources of the available energy and at the price of increasing the entropy in the general environment. Let us not forget that entropy increases and will reach its maximum level. This is because the Earth is considered a closed system in relation to the universe, that is to say it exchanges energy but not the surrounding matter (Rifkin & Howard, 1980).

It could also be said that the maximum level of entropy in which the available energy has been dissipated is also the most disorderly state. The state of minimum entropy, in which there is the greatest amount of energy available is also the most orderly.

The state of equilibrium only concerns closed systems. Live systems cannot reach a state of equilibrium because a state like this would mean death. Live beings use the surrounding energy available, this is called a 'stationary state'. If the flow of matter and energy through a live organism stops, the stationary state is abandoned and the organism takes on the state of equilibrium.

So far we have that for an organism to exist it requires energy. The energy that a live being dissipates can only be replaced by its interaction with the environment which allows it to restore the useful energy that it lost. From now on, the term 'energy' will be understood as 'useful energy'. In general terms, energy can be used to generate work or to generate heat. The energy that is used to carry out work is called 'useful energy'. From the energy that is used to generate heat, one part is useful and the other is dissipated, that is, it is lost. The energy that is dissipated goes to produce entropy. Not even an animal in a state of lethargy can live indefinitely off itself. Energy which is restored is related to energy wasted or dissipated. "Life would be impossible without an active interaction between the living and the nature surrounding it." (p.15) If there is a surplus of energy that the living being replaces, then there is growth. If there is an energy deficit, degeneration begins, and if this is constant it leads to death.

Living processes are liberated by the environment and the organism; these two integrate through their interactions. The environment of a moving animal differs from a sedentary plant, the environment of a fish differs from that of a bird. The difference does not consist in the fish living in the water and the bird in the air but that the characteristic functions of these animals are what they are because of the special way that water and air form part of their respective activities, as well as the availability of the food (useful energy) needed for them to live in one en-

vironment or another according to their needs. (Dewey, 1950). Living beings survive when they are capable of re-establishing/ replacing useful energy of their environment. The struggle for existence depends on how well equipped each organism is to capture the useful energy available. (Rifkin & Howard, 1980).

A great number of living beings depend on their anatomic capabilities to obtain energy from the environment. Take plants, they live only by the sun's energy whereby they absorb the inorganic nutrients into the organic matter. Although human beings also take in inorganic nutrients, minerals, for example, we do not survive only on that. Our interaction with our environment is more complex because we need a greater variety of foods in order to exist. Also, throughout history, men and women have needed to construct tools and machinery to capture and transform the available energy. For example, men have built houses to capture heat and keep our bodies at an adequate temperature that allows us to subsist. At the same time we have developed forms of social organization related to certain meanings, languages, beliefs, knowledge, social practices, norms and values, thanks to which we have been able to survive as a species. This construct of social and cultural organisations requires useful energy "Energy is the basis of culture, in the same way as it is the basis of life." (p. 58).

We could say that energy is the basis of the constitution of different forms of life. Faced with the need for survival, different cultures have been constituted in relation to different surroundings, natural and social (tools, technology, etc.) resources that the members of respective societies and cultures have used throughout generations to replace the energy dissipated and thereby survive.

The possibility of men and women surviving depends, to a great degree, on their knowledge of the context in which they live and their use of stable resources. From an epistemological posture, the construct of societies and cultures that constitute different conditions of existence, can be explained starting from the proposal of onto-epistemological pluralism. This position is relevant to the subject of entropy and our interaction with the environment because, in the degree to which we construct the world we live in, we are also responsible for it. For example, if we consume more useful energy than the environment can provide – consider non-renewable resources – the missing difference will cause the environment to degenerate irreversibly. In addition, when our interactions with our surroundings are so intense that they start consuming more energy in a shorter time than that needed to replace it – the case of renewable energies – the process of degradation begins. The problem is, therefore, that energy resources are or become scarce in relation to the social practices we carry out.

2. Onto-epistemological pluralism and the constitution of different worlds.

Let us start from the basis that subjects structure the world or reality [1] through one of many conceptual frameworks. Conceptual frameworks are social constructs that are constructed, sustained and transformed as a result of the interactions of the subjects. These frameworks are conditions of possibility to acquire concepts, beliefs, language, knowledge, norms and values that human beings need and use in our cognitive relationship with the world (Olivé, 1999). The facts and the objects that form part of a world only exist when we structure reality from a certain conceptual framework; the world in which the members of a community live depends epistemologically and ontologi-

cally on these frameworks. So that, those subjects who structure a reality from a different conceptual framework understand the world in another way, but they also live in another world.

According to Kuhn, the conceptual frameworks provide the limits to the beliefs that it is possible to conceive (Kuhn, 2000). These frameworks are constructed and transformed by the subjects in their social practices, so that when the new generations are born they find themselves in a world with the subjects that preceded them, with their concepts, social practices, beliefs, language, knowledge and values that already form part of the historical development of the community. It is thanks to the inherited conceptual framework, that those born into that world, acquire the pre-supposed established restrictions as to what the subjects can come to believe. Among these pre-supposed concepts are the language, beliefs, knowledge, the norms and values that the subjects need to get to know their reality and interact with it. But although there is a reality that they encounter, it is also they, who as they go constructing in their social practices as members of a community, who can transform it and themselves in the process.

Although the members of a community can structure a reality starting from different conceptual frameworks, the beliefs that they accept or reject, as well as the decisions and actions influenced by those beliefs, will be related to the group of elements (concepts, knowledge, beliefs, language, norms and values) that these subjects pre-suppose when making a choice (Olivé, 1999).

As Olivé explains, the importance of conceptual frameworks lies in that they can allow or prevent the identification of certain facts; they can also allow or prevent the formulation of certain problems, the recognition of certain facts as relevant to certain problems, as well as allowing or preventing the construction of theories and specific concepts about the world. So that these conceptual frameworks can also allow or pose obstacles for certain types of actions. These actions constitute the world in which we live (Olivé, 1996).

2.1. Internal Realism

One of the main thesis of internal realism by Putnam is that facts are constructs which are made based on conceptual frameworks, but also from a reality which is inferred as being independent of these frameworks.

From an opposite posture to internal realism, in metaphorical realism it is maintained that there is a realism structured by facts and objects that exist independently from our conceptual frameworks. From the posture of internal realism the facts and objects are considered not to have existed prior to the application of the conceptual frameworks that we apply to an Independent Reality (Olivé, 1996). We should understand that facts are situations in the world that certain subjects in relation to Reality have constructed, are constructing or about to construct. As 'object' we should understand an entity that, as a result of the application of one of the conceptual frameworks to Reality, really exists in the world, has existed or will exist.

Taking as a basis the interpretation made by Olivé regarding internal realism, in future we shall call reality or world (lower case) the reality or world that exists in relation to conceptual frameworks. This reality is not a mere reality of facts and objects conceived and known by the subjects. In a stronger sense, it is a reality of facts and objects that exist and are constructed in relation to one of the conceptual frameworks that divide independent Reality.

Another thing, Reality (capitalised) will be understood as independent Reality where the subjects construct the facts

and objects by applying one of the conceptual frameworks. About this Reality we cannot say anything, since our only access to this knowledge is through the conceptual frameworks.

Internal realism does not deny the existence of a Realism independent of our conceptual frameworks and the cognisant subjects, it maintains that the world does not exist independently of our conceptual frameworks. But this relationship between the reality of constructed facts within the conceptual frameworks and Reality from which facts are constructed, should not be understood as dealing with two realities. The facts and the objects are real because they are part of independent Reality, they originate from there, but they are constructed as facts and objects in relation to the conceptual frameworks. 'reality' (lower case) depends gnostic-logically and onto-logically on these frameworks. Independent Reality is inferred as a limit or restriction to our social constructs.

Therefore, according to internal realism, the facts and objects that human beings know, do not exist as of themselves, in the words of Putnam: "'objects do not exist independently of the conceptual schemes." (Putnam, 1981, p.52). So that internal realism sustains that a realist posture is not incompatible with conceptual relativity, "one can be both a realist and a conceptual relativist at the same time." (Putnam, 1994, p. 61).

So, the experience we have of Reality is contaminated by our concepts, we cannot know anything of the first apart from the second. The world exists for us and we understand it only from a human point of view , "(...) 'objects' themselves are as much constructed as discovered, as much products of our conceptual invention as the 'objective' factor in experience (...)". (Putnam,1981, p.54)

Conceptual frameworks are not absolute, nor fixed nor established definitely, but rather human constructs that can change. The subjects of a community are not irremediably constricted to one single conceptual framework but rather, the subjects can become related to other conceptual frameworks and discover that, as Sosa claims, "what exists in relation to one conceptual schema need not exist in relation to another." (Sosa, 1992, p. 79). What we call world is as much a conceptual world as a real one "(...) we are not talking now of multiple possible alternatives to a single real world, but, on the contrary, of multiple real worlds (...)" (Goodman, 1990, p.18-19).

For internal realism facts and objects are constructed in relation to Reality according to the interests and conceptual frameworks with which the subjects are familiar. As Olivé points out, when one applies a conceptual framework to Reality a relevant context is established regarding which the properties of the facts and the objects are constructed, these properties will be those that determine the identity of these as the objects and facts that they are. In this sense that the objects and facts only exist in relation the conceptual frameworks. If Reality were not structured from the conceptual frameworks that allow the construction of relevant contexts, the facts and objects could not exist (Olivé, 1996). In the words of Sosa "(...) when we claim that there are certain things with certain properties, our statement should be considered as relative to a particular language and a conceptual scheme in particular." (Sosa, 1992, p.72).

From onto-epistemological pluralism as expressed here, we have no good reason to affirm that the subjects have the knowledge to guarantee absolutely that our actions are completely right. That which we consider epistemologically relevant and that we accept as knowledge, we recognise as such because its importance and sense are embedded in our social practices, our knowledge, values, norms, beliefs, cultural ideals, political

and moral practices that we have inherited from our predecessors and, partly, which have made us what we are. So, according to onto-epistemological pluralism we understand that all knowledge is generated within the framework of some way of life, so that any knowledge is partial and fallible. To acquire more precise knowledge, the cooperation between different groups of different disciplines, diverse cultures and institutions is necessary.

By drawing an analogy between cartography and scientific knowledge, Philip Kitcher notes that even if the most up-to-date maps often present a more precise spatial description and may include entities that were previously omitted, taking as example, the American continent and Australia before they were discovered, it cannot be claimed that any map is absolutely precise and it cannot be denied that a preliminary one may be more exact in its representations compared to subsequent maps. The explorers of former times who reached their destinations, had good reason to believe that the maps that guided them were correct. In retrospect, some of the features of the old maps were retained, in their later versions because part of that knowledge offered a better chance for the planned voyages to be successful. (Kitcher, 2001).

Maps are designed to meet certain different purposes and this makes them vary and also from one period to another, however, we cannot say that they are the product of our conventions and wishes. In practice we can see that if a map is drawn to follow a certain route it is sufficiently exact, and in this sense, it either serves the purpose for which it was intended or it does not. We could say that maps are designed according to wishes, beliefs, values, knowledge and the needs of the subjects.

Maps show what is relevant to one group of subjects, in this sense, cartography is designed in relation to the context in which they live. If we draw an analogy, we find that the objectives of a certain piece of scientific research are not established outside a certain way of life; they show what one group of researchers in particular consider to be of value according to the social practices in which it is carried out.[2]

Dewey is right when he says that all research takes place within a cultural context constituted by social interactions.

If we look at earlier ages, it becomes evident that certain problems could not have arisen within the context of institutions, customs, occupations and interests which did not exist at that time... There is an inalienable and indestructible fabric of concepts which is not due to us but rather it has been given to us, ready-made by society, a whole apparatus of concepts and categories within which and with which individual thought is promoted, however daring and original it may be. (Dewey, 1950, p. 534)

Stebbing adds that “no thought, not even physical, is totally independent of the context of experience provided by society within which it works.”[3] Dewey continues: “And if this is true regarding the relationship of a certain physicist in the small society of scientists with whom he works, it is also true of the activities of the group, as a whole, they are determined in their main traits by the context of experience provided by the broadest contemporary society.” (p. 535) For example, it is impossible to separate the interest there was in the 19th. Century in the exclusively mechanical concepts of Physics from the industrial needs of that time.

There is a diversity of languages from which one can conceptualize different objects, facts, processes, emotions, etc. There will be languages in which one type of knowledge can be expressed and in others it is impossible to express in the same way; including the different scientific languages and scientific knowledge.

It may also be that in certain languages knowledge can be generated with greater precision.

That there are language alternatives to explain, for example, the balance of an ecosystem, means that there are different ways of knowing and describing what that balance is. Kitcher tells us: "In the way we try to describe, predict, explain nature we are inevitably selective." (Kitcher, 2001, p. 46).

Giving an interpretation of the stability of an ecosystem in our language means describing that process in relation to the practices and purposes that are valuable in our way of life. The impact of the former constitutes and transforms our existential conditions. So that, according to the social practices of one group, will depend how its members see the world and what knowledge they will generate about it. For example, one group who consider the ecosystems to be sacred, will live in a different world, will know it and appreciate it in a different manner, and its members will develop different capacities – v.gr., capacities for survival – from those who live in a city.

Starting from the idea that any knowledge, including scientific knowledge, is formed in the practices of the subjects. Knowledge will depend on the way we form it in the context of practices of which we have no sure bases. These practices are epistemic (generators of knowledge) but they also have an axiological structure.

The concepts we form and the knowledge we develop are directed by a certain historical context which precedes us and, to a certain degree, conditions us to select specific objectives and projects, but not others, that concern us as we consider them valuable. So that, any knowledge is contextually conditioned, is partial and is not neutral. "The possibility of a clean slate and a new start without prejudices is undermined." (Cartwright, 1996, p.131).

3. Entropy as a restriction to our actions

According to Christian Lévêque and Jean-Claude Mounolou biodiversity is not the result of a uniform process. Some species have become extinct, of some others only a few descendants have survived under particular conditions, while some others have diversified considerably. According to these authors, in geographic terms, the distribution of biological diversity is the result of, on the one hand, climatic conditions and on the other, the way these have constituted and regulated the ecosystems. The future of biological diversity largely depends on these same factors but also on the human factor.

At present, human beings constitute an invasive species that modifies the environment on an unprecedented scale and threatens the biological heritage and the survival of numerous species, either directly or because they modify the conditions of their existence. As a result, it is believed that we are experiencing a sixth period of massive extinction (Lévêque &Jean-Claude Mounolou, 2003).

While the environment is not subjected to serious impact by human activity, its change is slow, which from a human perspective, could give the impression that the world which surrounds us is stable. However, biological diversity is in a state of perpetual evolution on time and space scales that do not necessarily coincide with those of humans and that need to be understood if we want to adopt adequate measures for its conservation. For example, the Quaternary era that began less than two million years ago was marked by various ice ages and extreme climatic variations. Scientists have been able to reconstruct with relative exactness an idea of the dynamics of the ecosystems and the biological diversity of this last cycle of the ice age as a function of climate changes over time (Idem). The hope

is that knowledge of the past will allow us to anticipate the future and direct our actions accordingly. The great problem is, even if it has been demonstrated that human activity has had an impact on the environment and species over time, never has it done so to the extent that it has through its technology in our days.

Jonas would say from the ethical ambit, the previous systems were above all anthropocentric, the object of human duty centered mainly on man himself, and although this still holds true as a linking force with the vulnerability of any living thing in face of the excessive intervention by humans, according to this author, the object of our duty extends to the biosphere of the planet with all its biodiversity (Jonas, 1995). This means that now we are conscious that our conditions for existence include the biosphere.

To understand the size/dimension of the impact our actions have had on the planet let us remember what was said about the Second Law of Thermodynamics, the quantity of entropy in the universe tends to increase over time. We understand that time is irreversible, and we experience it going in only one direction. If the process of entropy were reversible, then everything that has happened could be undone. Time goes forward because energy moves from one state where it is available to another where it is not. What entropy tells us about the direction of time, it does not tell us about the speed. With every event in the world entropy increases, sometime more slowly, and sometimes faster. Entropy limits our actions, we cannot change the arrow of time, but it does depend on us how fast this process of entropy runs its course. That is to say, we decide how fast or slowly the available useful energy is dissipated. Oil, for example, is organic matter which took millions of years to form, today the consumption of this resource is so accelerated that it does not allow us to reach any stability between the consumption and its replacement. So intense is the use of oil that it becomes a non- renewable resource.

Since the survival of the human race depends on the availability of useful energy this means that every time we need more work to sustain human life. As there is not enough time in one day for human beings on their own to do the extra work necessary for survival under the difficult conditions of energy, new and complex technologies must be created to maintain human existence, and this has been so throughout History.

For example, the main source of energy in Mediaeval Europe was wood. When this resource became scarce they looked for alternatives until it was replaced by coal, which brought about a radical change in the way of organizing their lives in those days. The transition from wood to coal is considered to be one of the main factors leading to the Industrial Revolution.

To understand the magnitude of the energy crisis of those days it is important to understand the crucial role that wood played in everyday life at that time. Like the fossil fuels of today, wood was used for nearly everything. A carpenter's tools were made of wood, so were the pipes in the bathroom, the bucket, the broom and, in some parts of Europe, a poor man's shoes were made of wood. Wood was used by farmers in agriculture and by textile workers; it was used for looms, spindles, oil presses, wine presses and, still a hundred years later, upon the invention of the printing press which was made of wood. The pipes which took water to the cities were usually tree trunks; ships and the principal machines for industry were also made of wood. As raw material, tool, machinery, utensil, fuel and final product, wood was the dominant resource of that time.

While cutting down the forests for agriculture greatly reduced the amount of wood available for supply, it was the ac-

celeration of commercial activities that led to a crisis in this industry. For example, the new industries of glass and soap needed large quantities of wood ash. It was the production of iron (to smelt iron it is necessary to burn wood) and the construction of ships that made the greatest demands. At the end of the 16th century and the beginning of the 17th century the felling of trees was regulated, but this measure was not effective. In 1630 the price of wood increased two and a half times compared to what it cost in the 15th century.

The response to the wood crisis was coal. But, as was foreseeable, it was not just replacing one fuel resource with another. The European cultures had constituted their ways of life closely related to wood. The change required a radical upheaval of a whole way of life, the way people dressed, behaved, and were governed (Rifkin & Howard, 1980). The world was constituted from other pre-suppositions, from other conceptual frameworks in relation to which there would be new and different facts and objects that did not exist previously.

Coal was treated as an inferior source of energy, it was dirty and it generated a lot of pollution. Also, it was more difficult to extract and process as energy than wood. According to Rifkin, the easier sources of energy are used first. Then, each subsequent context was developed from a type of energy that was less easy to use than the one preceding it. It is more difficult to extract coal than it is to fell trees, more difficult to extract and process oil than coal and still more difficult to make nuclear energy available. Richard Wilkinson in his book Poverty and Progress says:

> "During the course of economic development man has been forced again and again to change the resources he depends on and the methods for exploiting them ... gradually he has been involved in more and more complicated processing and production techniques .... Economic development, understood in its broadest sense, is the development of ever more intense (and complicated) forms of exploiting the environment." (p. 75)

In this close relationship with the changes in our surroundings and the energy resources available, technological changes occur. For instance, the steam engine was designed as a technological and scientific response to the problems for extracting coal; the steam pump drained water from the mines. This was only one of the various innovations coming directly from the new energy context. The problem of extracting coal was solved and then there was the problem of how to transport it to the markets throughout England. Because of its volume, coal could not be moved easily by horse drawn wagons. Most of the roads in England were not paved, with the crisis of farm land, using horses, who had to be fed, for transport was too expensive. The answer to this problem was the steam locomotive and the railways. Just like the steam pump, the steam locomotive was a direct response to the needs that arose from the use of coal as the main source of energy, and this in turn set the bases for the industrial era, increasing the complexity of the interactions between human beings and their environment.

It is common to believe that the idea of cultural progress corresponds to the increased use of new technologies; it is often considered that the more advanced the technology, the more advanced will be the progress of a civilization. However, the use of new technologies does not necessarily mean a reduction in work, a reduction in the use of available energy, on the contrary, on many occasions the new technologies increase the speed with which energy is extracted, also increasing the flow and therefore dissipating more energy.

Throughout history there have been cultures that have survived long periods of time adapting themselves to the

environment and they have managed to live in a stationary state in which the production of entropy was minimum. If we continue with the idea that technological innovation is necessary without considering the availability of resources, we will reach a moment in which we will find ourselves at a critical point when those resources have run out. Another thing, history shows that each technological innovation, since the first, presents certain secondary unforeseeable effects that turn out to be more damaging than those that would have been caused by the lack of energy (Ellul, 1964).

At present, the scientific process develops in an interrelation with technology. In order to reach its objectives science needs technology to be ever more powerful and precise. These scientific-technological processes take place in a context which is social, cultural, economic and political; these constitute our lives and they transform them. The idea that scientific-technological research and the products derived from it are separate from our existential conditions is a fallacy which encourages the irresponsibility of those involved, regarding the consequences of their actions.

According to William James, the notion of truth is linked to the concrete consequences that take place in our lives. For James, truth means accordance with reality and falseness is when it does not agree, which means that our beliefs and practices far from posing obstacles, are exact, they should flow with that reality while being restricted by it. Something is true if it functions, and this 'functionality' is understood in relation to a context where concrete men and women live the effects of decisions taken by others. For example, let us think of trans-genic maize. How a product of techno-scientific research brought about a genetically modified plant is a fact. In this narrow sense the proposition "The creation of transgenic maize is a success" is true, certainly the project of creating genetically modified maize plants has been a success. Even if the proposition is true, it is not functional in the broader sense that James and Dewey defend, because of the concrete consequences in life, transgenic maize is far from being a success. The error is to think that the techno-scientific achievement of transgenic maize is a success that is under control by the researches apart from the consequences in specific contexts. The idea of modernity according to which man controls nature is a fallacy and the paradox is exposed through bio-technological research. Researchers carry out this type of process directly on living beings, and they depend on the complexity of these organisms but they are unable to control the effects that follow after their manipulation, which announces the end of modernity.

These days, one of the principal risks is that man, by using his technology on nature, transforms the conditions of existence irreversibly, so that there is no possible way to re-evaluate nor to reverse completed actions.

Hans Jonas (Jonas, 1995) explains that up to now technology had used inanimate matter with which he created auxiliaries for human use. The division seemed clear: man was the subject and 'nature' the object of technical dominion. This has been, by definition the pretension to modernity. With the arrival of bio-technology, whose objectives are to transform structures which continue to be original creations of nature, the central idea of modernity according to which man dominates nature, paradoxically is undermined. When scientists insert a new determinant in a live organism, they collaborate with the organism's own activity, its biological system that functions according to its specific nature. The integration of the determinant depends on the system itself, which can accept or reject what it has been given. This is of great relevance for a possible prediction

of the consequences because not all the results possible that can ensue can be envisioned or controlled by the researcher. Scientists aim at controlling the live organisms they work with, but they really cannot foresee all the possible effects that might ensue. The developments in biotechnology require that the researchers control the overwhelming complexity of the elements and processes belonging to the organisms they experiment with, which is evidently impossible. To a certain degree the plan becomes a wager where the transformation of an organism is no more than an experiment that takes so long to develop that the final result is further away than the researcher can foresee. These experiments (let us take genetic manipulation) cannot be carried out with representative models; so that the attempt can be valid it has necessarily to be done on a live organism. When the effects of this experiment become visible it is too late to correct what has already been done.

Conclusions

From the epistemological posture / perspective that we have presented, in this work we have sustained the following thesis:

– That as subjects we constitute the world we live in through one of the possible conceptual frameworks.

– Our cognitive and social practices construct the world in a certain manner, which makes us responsible for the way this world is constituted.

The type of scientific and technological practices that cannot be corrected force us to consider that the ends/ objectives are definitive, since in fact, once started there is no going back. This, leads us to reflect that the advance of technology and its power is too advanced in relation to the knowledge that men have and also to their moral capacity to make the correct decisions keeping in mind the conditions that future generations will live in. The risk is that human beings cannot know for certain what the bi-products/ sub-products of scientific-technological-research will be, they cannot foresee exactly what the consequences derived from it will be.

Without the perspective that time gives us, on many occasions it is not clear if the effects are negative or not. It may also be that the consequences turn out to be what was expected according to the scientific and technological objectives as envisioned. In this sense, they may be successful, but in the social, cultural and moral contexts the results may be confusing, if not harmful, and exceed the capacity for research, deliberation and decision making by the members of society.

Therefore, the acquisition of knowledge has become an urgent duty, but, seeing that the products of research remain submitted to the restrictions imposed by reality, in this case, conceptualized as entropy, it is necessary to accept that far from the subjects having absolute dominion over the environment, the second law of thermodynamics restricts our practices.

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