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Bioethics and Modern Technology: Reasons of Concern

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1. Introduction

Today's world technology, more than any other human activity, is transforming our lives, our habits and life styles, the ways human beings relate to each other; it creates our material wealth and the bases of our progress and modern civilization, that is to say, our economy. It is not improper to say, in a word, that modern technology makes our world. However, this abundant source of benefits is not free from inconveniences, some of which may seriously endanger fundamental aspects of nature and human life [Arthur, 2009; Kelly, 2010].

Thanks to the scientific and technological advance during the last 150 years, infant mortality has been enormously reduced and life expectancy of people has almost doubled. We have found effective treatments for many diseases which were before mortal, and the hygiene conditions of most of the world population have been considerably improved. This has brought at the same time a huge growth of this population, which has grown from one thousand million at the middle of the nineteen century to almost seven thousand million beginning the second decade of the XXI century, what is giving rise to serious difficulties in providing adequate living conditions for every human being. Antibiotics have saved countless lives while making it possible for new and incredibly virulent bacteria to evolve. The convenience of e-mail turns into communication overload; face to face contacts are being substituted by screen to screen communications. Even our most publicized inventions can turn on us. Contradiction seems to be the name of the game: the past century was history's deadliest, in terms of humanity's technological capacity for organized violence. And yet life expectancies in the industrialized world, as mentioned, rose to approach eighty years.

Nuclear energy developments have encountered useful applications in the generation of electric energy for many regions of the earth, as well as applications in the medical fields, but at the same time have created the possibility of massive annihilation of all kinds of creatures, including the human, and the destruction of ecology at large. Genetic manipulation is associated with our hopes for attainment of a life free of diseases and other sufferings, but it is also opening possibilities of interventions in the natural evolution processes of living organisms with unpredictable consequences. Any prediction based on the genetic determinism is nowadays strongly questioned, since there are no reasons to accept that the characteristics of a living organism are only determined by their genes [Ho, 1998].

Experience teaches us that every good outcome from the scientific-technological progress is always accompanied by reasons of concern; there is an implicit contradiction in the progress: every result can be both beneficial and harmful, without the possibility to separate these characteristics; the old dilemma of good and wrong. But in this dilemma there is some degree of relativism which makes even more difficult the decision; sometimes what is good or wrong depends on the decisions-taker point of view. A dam which is used to provide water and electricity for a city is certainly good, from the point of view of those who receive this benefit. But perhaps the same dam required the displacement of thousands of people and destroys an ecosystem, and from this point of view is bad. The important questions are then: Who chooses? Who wins? Who loses? [Lightman et al., 2003].

If we consider some other recent technological advances, like genetics engineering (genetic manipulation, cloning, assisted reproduction), neurotechnologies, etc., we have to deal with more complex situations to decide between what is more convenient to be done and what we must avoid in order to prevent severe damages to human life and values. Thus we can convince ourselves that technology, which up to now we have seen as the best instrument man has to improve his life, can be at the same time a powerful means for transforming his nature and values in a way that is unacceptable for some of us up to the point of rising the question if man will be able to survive his ingenuity and creativity.

In this work we shall be concerned with the implications that the development of modern technology has on human values, and in this respect we shall consider some specific situations which are already giving rise to ethical dilemmas requiring urgent answers. Next we review some fundamental concepts related to the problems at hand. In the last part of the work we shall discuss the topic of social responsibility and the role the whole society can play in search of solutions to the ethical problems posed by the technological advance. We end up looking for rational arguments to support an optimistic vision of our future technological development.

2. The impacts of technological development

The technological development occurred during the past 100 years has provided the infrastructure needed to revolutionize the study, the knowledge and manipulation of life, including human life itself; it has changed and accelerated communications among persons and countries; it has altered the "goods and services" production systems while creating new and threatening problems which place humanity on the brink of extinction … or happiness! Today, starting the second decade of XXI century, the topics of our times are in connection with the most advanced technologies, which open for almost everybody the possibility of creative or destructive actions surpassing our most audacious speculations about future, not imagined before.

In 1976, after the discovery of the recombinant DNA techniques and the potential risks due to its use which allow, in principle, the design of new living organisms with characteristics selected at will by the experimenter, the United States National Institute of Health (NIH) established the conditions required to carry out these kind of experiments, fixing the security levels corresponding to the varying characteristics of creatures under study. Nevertheless, some local authorities rejected these rules of national security and asked for the open discussion of these issues in committees designed *ad hoc*, in order to guarantee the free participation of all interested persons and avoid any alleged manipulation; in this way they expected to dissipate fears and distrustful thinking of the people. These committees

would study all risks involved and propose recommendations about the convenience or inconvenience of authorizing experiments on recombinant DNA and, in case of approval, in what conditions. The deliberations were carried out but neither definitive answers nor compulsory measures were obtained, and much less agreement in all respects; but the proposed questions and the individually adopted answers opened the way for new approaches to the problem, based on questions like: Is it possible to separate the ethical issues associated with the experiments from those related to its applications? Is it possible to separate the creation of new forms of plants or microbes from the creation of new types of human beings? And assuming that genetic manipulation of human beings is possible in practice, what would be the prevailing ethics: that of human fraternity or the ethics based on the right to be different? Is commercial exploitation of recombinant DNA ethically different from commercial exploitation of other techniques? Does gene implantation from higher to lower level organisms represent a dangerous transgression of the barriers between biological species? Have we the right to interfere in the natural evolutive processes without knowing the possible outcomes? … etc. [Dyson, 1993].

In a different field of knowledge, the development of information technologies and social networks (Internet, Facebook, etc.) are drastically changing the political order and the traditional courses of action and modalities of citizen's participation. It is not possible to predict the future course of events, but recent cases like those of Tunisia and Egypt could be replicated and perhaps the revolutions of XXI century will be done not with arms but with cell phones and will be transmitted by Internet, since these media provide the means to express the desires for freedom and justice that sometimes official censorship restricts through public broadcasting media and printed press. These are revolutions without visible leaders but with visible technology that connects people and enables common citizens to express their dreams and desires through message texts and twits.

This sudden change in the ways people are connected comes together with another revolution that takes place within us, since cell phones enable us to be closer to distant persons and more distant of those who are near. If we observe any line of persons waiting for bus, show or restaurant, we notice that people are talking by phone with somebody far away instead of talking with their neighbors in the same cue. This occurs so frequently that answering a phone call and talking with distant persons in the middle of a social gathering is not anymore considered as impolite. Our values in this respect have changed.

These facts convince us that social values change quickly as a result of the new communication technologies, and this is because eight of every ten inhabitants of this planet have access to a cell phone, what amounts to 5,300 million according to the International Telecommunications Union belonging to the United Nations. There exist today two thousand million with access to Internet and this number is growing every day. Modern communications not only put down tyrants; they also change our habits and customs.

Our age is characterized by the success of physical technologies, in what has been termed Second Industrial Revolution: automatism, space conquest, atomic bomb, genetic medicine, cloning, etc. We can say without arrogance that human life has suffered more changes in the last decades than in any other earlier period of history [Drucker, 2011]. But at the same time, progress has brought worries and dire visions in connection with the same aspects that were improved: the threat of a thermonuclear war, the population explosion due to the increase in life expectancy, etc. This is the price we have to pay for living in a cybernetic society. Present day societies oscillates between hopes and satisfaction, on one hand, and fears on the other;

technological marvels in medicine and urban life are counterbalanced by the real possibilities of nuclear destruction. Ecology has been seriously affected by what we have called technical progress, and if we do not change our concept of good living standard to make it more sustainable our cybernetic society will be on the verge of collapse.
History has shown that whenever humanity reached any limit situation it was necessary to build new social structures and review current moral values and its hierarchy in such a way that survival could be assured. This does not imply the construction of a completely new morality, but the adaptation of what we can consider human intrinsic values to the new situation. Today we are confronted for the first time in history with situations that need special attention: some of the new artifacts emerging from the new technologies have such a destructive potential that can destroy all life in extended regions of the planet, and can be used by a single person. The only consideration of this possibility is terrifying. The problem is not that today's scientific-technological development is more advanced than before, but that the traditional role of mere mediators played by science and technology is not in correspondence with the role effectively played by them today. Modern science and technology are not only intermediaries between human life and nature. They are new ways of living and thinking; even our art and philosophy have changed in accordance. These are the main reasons to consider the issue of human values as a priority, and also the underlying arguments for the creation of the field of bioethics in connection with technology. This is the idea behind the expression "bioethics is a bridge to the future", which its founder [Potter, 1988] used as the title of one of his books, as we shall see in what follows.

3. The ethical dimension of development. The emergence of bioethics

In the new technology-oriented society the interactions between humanistic and scientific-technological concepts are so frequent and intense that those concepts will necessarily converge and tend towards common meanings. This understanding can be achieved through bioethics, which harmonizes the values shared by society and the challenges arising from the technical development. Some of the promises that technology offers exceed our most audacious Utopias. Newspapers daily reports on new scientific findings and new technological developments rise ideological confrontations whose base is essentially an ethical debate. Many of these confrontations are the result of ideological or economic struggles in search of power, but even in those cases there is a common background with strong bioethical implications. There was a time in which science could be considered as pure thinking and curiosity, and the phrase "thought is not delinquent" was used to separate it from any axiological consideration to avoid "inquisitions and faith acts". We cannot hold this position anymore, as has been exemplified by the famous exclamation of J. Robert Oppenheimer when he declared, as the main scientist in charge, after witnessing the first successful explosion of the newly constructed atomic bomb at Alamo Gordo, New Mexico: "In a profound sense which cannot be distorted by any malicious interpretation, we, the scientists, have known the sin" [Schweber, 2000]. The underlying meaning of this sentence was not that the scientific community had lost innocence and was thrown off paradise, but that the binomial science-technology (not necessarily in that order) leads to a new conception of man and the world. Science and technology are not axiologically neutral, they transform and determine the human experience and even the relation between human beings and the world, through the ways humans understand and handle the world itself: if

man is conceived as a programmable machine, this necessarily influences all decisions about people. These considerations lead to bioethics as a discipline constructed on the facts that have been objectively established through a dialogue between different visions of the world and man, in order to make sense of that world and the man who inhabits it.

The birth of modern bioethics is historically linked to some abuses in scientific research with human beings, carried out in the past century, especially those performed in Germany during the Second World War. Nuremberg trials exposed these facts so they were generally known the world over. Nuremberg Code, published in 1946, paved the way for the establishment of norms to protect the integrity of human subjects in biomedical experimentation. The main criteria to achieve these goals include safeguards like the previous informed consent, the subject's liberty to abandon the experiment at any time, and the experimenter's ethics. The first evaluation of a biomedical research protocol was carried out in 1953, when the NIH of the United States applied these criteria to every research with human subjects intended to be done in its Betheshda Hospital. This same spirit and normativity appear later, in 1964, as agreements of the World Medical Association (Helsinki Declaration), which recommends the integration of committees, independent of researchers and sponsors, aimed to project evaluation from the ethical point of view. It is in the field of genetics where these moral issues are more clearly perceived. Experimentation with human subjects is necessary even in those cases where genetic diagnosis and associated therapies can be tested and verified in animals, since that is the only way to guarantee that the results will be equally successful when applied to humans. Today we know that those results cannot be translated directly, without further tests, from animals to humans, because each biological entity has peculiar responses to the same conditions; the environmental conditions can affect the response too, even within the same species: the immunological response against treatments or invading agents is not the same in all human beings. This fact makes it necessary to test vaccines directly on the risk population before its general application, and this implies experimentation with human beings. Decisions in connection to these problems can only be taken after a careful analysis and discussion in a plural committee, in which human dignity, liberty and benefit can be preserved without stigmatization or discrimination. Thus, bioethics is the instrument needed to solve the problems derived from the moral dilemmas due to the new technologies, which cannot be solved by traditional ethics.

Bioethics emerges as a discipline at the beginning of the decade of 1970, and Van Rensselaer Potter [1988], who is considered its founder, states it in a rather ample sense: to discuss what it is ethically right or wrong about man's increasing capacity of intervention on nature, and the possibility that this intervention endangers life on earth [Ferrer & Álvarez, 2003]. Nevertheless, the field of bioethics is frequently restricted to the study of the moral implications and consequences arising from the medical practice. However, it is not less important that bioethical studies consider also those aspects of scientific-technological developments that have an impact on human life, both social and individually.

It must be taken into account that ethics is not a set of simple and clearly defined norms that have no exceptions and apply automatically to any concrete situation; if this were the case, it would be useless in complex or uncertain situations. Ethics is neither a set of ideals, admirable but unrealistic, that can never be reached. Instead, ethics is composed by norms and principles that have to be harmonized and conjugated with other norms and principles, and with the data from reality, giving rise to objective axiological conflicts which must be solved to distinguish the right actions and to justify them. It cannot be completely objective,

due to its relation with culture, so moral absolutism must be discarded; it cannot be either totally subjective (moral relativism). But the survival of any society needs at least a set of minimum moral agreements, and then we are led to the question: is there an intermediate way between moral absolutism and moral relativism? If the objective-relative structure of moral life is admitted, then this would be the answer; there are moral values which are not created by the moral subject, but exist in the things themselves.

Humankind is not only interested in assuring its future survival and welfare, but wants to be ruled with criteria based on rights and justice, preserving his dignity and avoiding the rule of those who have only the power. This needs the establishment of a living-together culture. It is very important to understand that technology can help human beings not only in the construction of their future material world but also to transform human reality. In this historical moment, science and technology are not only means to provide goods and services but are also very effective instruments to modulate the people´s substrate which we call culture. More than the economic relationships, science and technology transform the nature of the relationships among the peoples by transforming their vision of reality as a consequence of the use of new knowledge and techniques.

The factors that define a culture, like historical identity and connections with neighbors and other cultures, will be transformed as a consequence of the technological advance. Globalization, a phenomenon partially due to technical progress, is making almost impossible for a civilization to remain isolated from the rest of the world. Even in the most isolated places, people's culture is affected by technological change, and that includes also the field of people's values.

There exist two factors that make our civilization unique in comparison of those already disappeared: one is the technological development, which makes possible to control nature to an extend never before attained, opening possibilities to alleviate hunger, diseases, and super population; the other one, which can be considered a consequence of the first, is the global character of our civilization.

Modern technological civilization is not the privilege of groups or particular nations; is open to every human being belonging to any culture, race or religious affiliation. The values and creativity in this civilization are being transformed and adapted to the material changes, in such a way than if the fights for power in this critical phase of world situation (which confront us with serious risks of a universal atomic devastation) are finally overcome, the differences between East and West could become insignificant due to the similarities of material cultures, that in the long term will prove to be stronger than ideological differences.

The strong attraction that comes out the technological progress, and its possibilities for attaining rapid results, lead us to consider the discussion about values as a time loss, as well as the debates about possible catastrophic results. Reason is left apart, as a measure of moral value and norm to choose between right and wrong, just or unfair, and it is replaced by a risk-benefit assessment, which gives rise to disagreements and difficulties leading to unending debates in bioethics committees, which will be analyzed later.

In order to establish a social compromise with bioethical characteristics to face the challenges posed by techno-scientific innovations and impacts due to globalization processes, we need to carry out a careful discussion about the limits of science and technology and our possibilities and constraints as a human group, contrasting the empirical and/or phenomenological reality with theoretical or operational positions that involve ethical demands. Thus, theoretical studies cannot be restricted to the construction of interpretative systems, but must also include the ways to face them: aside of interpreting

and understanding the structure and dynamics of the techno-scientific innovation processes, their stabilization and transformation, we need to assess the impact, consequences and ways of intervention in those processes. Otherwise our task will remain unaccomplished. Then, in order to fully understand the ethical dimension of technological progress, we need to know how technology emerges, the mechanisms by which it evolves and how it is connected to innovation. These are topics not completely explored, but there are some interesting works that have initiated this journey [Arthur, 2009; Kelly, 2010]] that eventually will produce a theory of technology.

3.1 The case of genetically manipulated varieties. Transgenics

The use of recombining DNA in agriculture for farming improvement or plague elimination must be done through experimentation in the natural environment, in order to produce those genetically modified varieties and leave them free. But this kind of experiments is strongly opposed by irrational groups that monopolize the right of defending the planet. This is the real problem with transgenics. The groups opposing experiments on genetically modified varieties are frequently aggressive and stubbornly closed to arguments presented by other groups in favor of experimentation; the dialogue is almost impossible. Prudence is good but not extreme positions opposing any testimony. According to Matt Ridley, British zoologist, "After consuming more than a trillion meals prepared with transgenic food there are no reports about any diseases caused by genetically manipulated plants" [Ridley, 2010]. A similar statement was published by the United Nations: there is no evidence, up to now, about harmful effects due to the genetically modified varieties present in human food supplies. The gene transfer between different species, crossing the barriers which separate them, is not a natural process; in consequence, wheat, the most cultivated plant in the world is an unnatural polyploid mixture of at least three wild wheat plants. Transgenics could be a solution to the problem of increasing agriculture production to meet the continuous population growth.

However, it is very important to proceed cautiously, because according to genetics engineering specialist Mae-Wan Ho [1998]: techniques for genetic recombination are designed specifically for gene transfer horizontally between species that do not cross reproduce, and can destroy the defensive mechanisms of mixed species. If we eliminate the natural biological diversity, which is the result of a very long evolutive process, any plague could destroy in a very short time all members of given species. These techniques are also used by an industry that sells illusions for the people (cancer medicines, baby design, cloning, and other means to reach immortality). This industry is patenting almost everything and converting in merchandise the parts of every living creature, including man itself. When experiments respond to market's interest we have to proceed carefully.

It is now possible for a child to have up to five parents: the egg donor, the sperm donor, the surrogate mother who carries the baby and the couple who raises the child. Cloning is also becoming just another form of assisted reproduction; then, on the other hand, a child might have just one parent. Consequently, the notion of family is changing and even concepts like "normality" have to be adjusted to the new possibilities. It is possible to generate a genetic profile of a child before birth; twelve percent of potential parents say they would abort a fetus with a genetic propensity toward obesity. The designing of children is occurring subtly, as a result of individual choices in an open market. There is a strong controversy over human embryonic stem-cell research. Although the applications of stem cells remain on a speculative base, a marked debate has taken place in connection with the morality of destroying embryos for research. To portray the struggle as one of rationality versus the

forces of darkness seems to be very simplistic. This is why we need additional research, avoid radical positions, and invite people to participate in all decisions that affect society.

3.2 Neurosciences

The development of new technologies for studying the human brain has open countless possibilities for understanding consciousness and mental functions, but at the same time this techniques are giving rise to problems and questionings for which it is important to take into account the moral common sense, the values, and all ethical considerations.

The ethical issues raised by advances in neuroscience are with us already. These issues overlap and even outflank the ones raised by genetic engineering. Changing the brain, with or without gene alteration, speaks of what it means to be human. Drugs or magnetic fields that modulate the cognition may bend the very definition of what we are.

What kinds of safeguards are needed if a machine can read your thoughts? Will cognition enhancers exacerbate differences between rich and poor? Or will social diversity become a status of historical artifact? Is technology a means for reducing marginality of poor people or on the contrary, is contributing to increase the gap between the very rich and the very poor?

The technologies of mind and brain are different from those related to genomics and other biomedical fields in an important respect: as most scientists and ethicists acknowledge, the essence of what we are is not all in our genes.

Can neurosciences provide some answers to the ethical issues raised by its advances? In this respect it is of interest for our purposes to bring about the psychobiological studies done in Harvard University under the directorship of Dr. Marc D. Hauser. In his book *Moral Minds* [2006], Dr. Hauser establishes the existence of a basic moral sentiment or feeling, resulting from human evolution, which acts as a survival mechanism: the fact that human societies share almost universally some basic norms or guidelines for action, suggests that there is a general moral structure emerging from the human neural constitution that is still evolving, not yet in its final form. Then, the resulting human intelligence is also in a changing process, what makes it different from artificial intelligence, which up to now only evolves by external influence or innovations.

The power of these new "neurotechnologies" associated with neurosciences and psychobiology is astonishing; almost daily one can learn about new gadgets able to read face expressions of people, watching and correcting their movements, etc. It would seem that human autonomy is now in danger. Nevertheless, we must be prudent in the handling of these achievements and use them for improving our life and live together. Or, as Winner [2008] expresses:

> *"If we realize up to what point our lives are molded by modern technology interconnected systems and how intense is this influence, accept its authority and participate in its functioning, we will start to understand that we already became members of a new order in mankind history"*

In the second decade of past century Spanish philosopher José Ortega y Gasset [2005] proposed as the topic of our times the role scientific development was playing in social changes and cultural perspectives at the time; his vision was optimistic, trustful on the progress and having science as modern panacea. Many things has happened since, and after the two world wars and the menace of massive annihilation, that confidence has been lessened and replaced by an almost cosmic pessimism that associates progress and development with risk, uncertainty and anguish.

Today the success of a technology can be measured by its beneficial effects on human life. According to this, the most successful of all modern technologies are those associated to life and health. We have already mentioned transgenics, but there are many more:

> *"Man feels now able to create biological species and this is serious; the production of biological systems that did not exist since the dawn of times opens possibilities of creating chimeras, what implies the rupture of the natural species concept" [Laín-Entralgo, 1994].*

This all leads to a reconsideration of operating laws and new approaches to moral acts. The technological change is also influencing some other concepts like that of human generation. In the first half of XX Century was still valid Ortega y Gasset's [2005] vision expressed as:

> *"… Life changes but not in a continuous way. It has some stability, that is: life style lasts certain time. Life is based on opinions, valuations, imperatives, characterized by its acceptance and validity, prevailing in the society. They are imposed to any individual, independently of its free acceptance. The operating time of this norms and rules system is more or less coincident with fifteen years. Thus, a generation is a zone of fifteen years during which life is almost uniform. This would be the authentic unit in history´s chronology."*

Compare this vision with today´s situation in which the acceleration of social development dynamics can change in few months, and a system of gadgets and its use is imposed to any individual, accepted or not. Since the beginnings of radio, passing through TV, Internet, Facebook and Twitter, the technological advances define what a generation is, with its own uses and customs, establishing a new unit for history´s chronology with global character, overcoming sometimes centuries of differences between countries. Tunisia´s last revolt has much to do with the existence of social networks, which united people in a common wish to put down a dictatorship of more than 20 years.

The power and potential force that technology endows to governments and enterprises makes critical the consideration of human rights that should not be violated. After a terrific world war which seemed to vanish all rules between peoples for living together, it was necessary the creation of an international instrument to protect humankind against the unlimited power of the state governments. This was the birth of the Universal Chart of Human Rights, and the origin of several movements questioning, at citizen´s level, the validity of certain actions that could be justified from the scientific and technical points of view but were inconsistent with human dignity and security. These movements defended the right of people to previous informed consent and participation in all decisions affecting them, not to be used as experiment subjects only. Bioethics movement was born this way.

4. The problem of values

Values are the qualities associated with some realities that are considered good and appreciated; they posses polarity and hierarchy. Thus, values can be considered positive and negative, major and minor, but without price in money. Human values as liberty, dignity, autonomy, cannot be purchased or traded, in spite that in past times (and perhaps even today) they were purchased as in the case of slaves paying for their liberty or freedom. Technology has induced changes in society's structure; however, it cannot make *tabula rasa* with human values, since these are perhaps printed somehow in the specie's neuronal structure, as we mentioned before in relation with neurosciences [Churchland, 2011]. They must be adapted to a new reality and establish a balance (not in financial terms) between

what is obtained and what is lost, with full knowledge of advantages and disadvantages and with previous informed consent of individuals. Every technical advance means change (innovation), but the essence of human values must be preserved. Technology not necessarily produces a sick society, as some voices claim, if we temperate its consequences by harmonizing innovations with human values.

Ethics of technology is not anymore what Aristotle wanted: the *recta ratio factibilium* [Laín-Entralgo, 1994], since technological possibilities today raise situations whose solutions must be based on an assessment of the results and consequences derived from the actions carried out. Today's technology is having a marked exponential growth [Kurzweil, 2005] but few opportunities to answer some questions regarding its social consequences and impacts on human values. A neat and honest consideration of these answers leads frequently to a conflict between final purposes and values, and if there exist conflict between purposes and values it becomes very important to proceed cautiously in establishing priorities. We are now facing situations which can imply the massive destruction of species, including ours; we can create instruments that can attempt against human dignity and individual privacy (informatics technologies of "hacking" or electronic information robbery). What to do? Stop technical advances? It would not be feasible. It is better to initiate a serious reflection to determine if all what is possible should be done or not and establish a balance "between what should be done and what should not be done within what can be done". Ethics would be then the right reason (*recta ratio*) in this discussion, which is achieved not by means of an individual reflection but by interdisciplinary deliberation within a group honestly interested in encountering answers and free of constraints or compromises.

Freeman Dyson, a renowned scientist, was invited by Princeton's Major to become a member of a group integrated by eleven persons to deliberate about citizen's distrust on recombinant DNA experiments. The group was composed by two physicians, three writers, three scientists, a teacher, a Presbyterian minister, and a housekeeper. Later F. Dyson reported his experience during the deliberations and pointed out that: "The first lesson we learned was about the importance of listening. The only way to eliminate distrust is to hear those persons who are in disagreement with us and convince them to hear patiently the arguments presented by their critics." [Dyson, 1993].

Each controversial topic could be carefully discussed attending every possible point of view; the result could be at least to create in the experimenters or decision takers a cautious attitude that prevents monstrosities derived from the unrestricted confidence on science and its applications, as sometimes occurred in the past.

The quality of a society is not measured by the amount of knowledge it handles, but by the values applied in the use of that knowledge; the problems generated by the uses of technology should be analyzed under this criterion. Unfortunately, as an almost general result we could state that new technologies have contributed to enhance the gap between the rich, technically prepared and informatized, and the poor deprived of computers and technically illiterate; they have made possible the emergence of a society that does not allow uneducated young people to find an honorable way of living, but at the same time creates many opportunities for those with easy access to the world of high technology.

5. Social participation, not only the experts

Once a complex technology has been extensively diffused and adopted, it is extremely difficult to replace it, or even restrict or reorient it. Powerful economic interests and social

inertia that opposes changes make things happen this way. Some common examples are the automobile and the TV: any attempt to restrict or alter the modalities of their use will find strong opposition from large sectors of society. Then, the proper selection of the technologies that will be adopted by society requires our participation from the beginning, in order to evaluate the pertinence and possible benefits or disadvantages that will result from its adoption. This participation requires, of course, the most complete information available and the discussion. Scientists or technology experts tend to ignore or undervalue opinions coming from unprofessional persons when the discussion is about complex technological developments, but they forget that research and experiments are paid by society and that is society at large who faces the consequences when something goes wrong and results are not as good as expected.

Another important fact that we must take into account is that recently adopted technologies are not always available to all sectors of the society, so its benefits are restricted to small groups. For example, neurotechnologies to enhance memory or learning capacities of people could be inaccessible to large sectors of the society, by economic or political reasons. In that case, would not these technologies increase the gap between the rich and the poor? ... Or between developed and underdeveloped countries? Is it fair that only the educated people of a country can have access to the best opportunities and living standards? Is it acceptable that marginal groups of society would be condemned to hunger or unemployment?

If technology establishes the limits of what we can do and ethics the limits of what we should do, it seems reasonable to start a dialogue between them. The best and simplest way to establish such a dialogue is through a committee integrated in the most plural way, where all social actors are represented, not only the experts. Because, finally: Who is really an expert when we are trying to foresee the future development of an emergent technology?

Take, for example, the research on genomics and human reproduction techniques by genetic manipulations with the use of stem cells; this has been a polemic field from the very beginning, in spite of the fact that possible applications are still of an essentially speculative character. Could these research areas with a high potential to transform society proceed independently from public deliberation?

On the other hand, the technological products that can affect human life operate in an empty legal context, with no governmental regulations or proper social surveillance. Social groups oscillate between absolute apathy and irrational emotivity, opposing all changes and progress. This is why the discussion of these topics becomes so important when it is carried out in the core of a well-informed society. The ethical consequence of technological progress is a concern not only of the experts but of all affected people.

Another issue in which the ethical considerations are of primary importance is that of global warming and climate change. This is mainly due to the CO_2 emissions produced in the industrialized countries, but the victims of the more severe damages are those living in the poorest countries; they lose their homes, crops and lands when their regions are hit by hurricanes or droughts. A global policy to control greenhouse gas emissions can come only from a free an independent ethics-based decision taken by the major countries, since no other mechanism is at hand to press those countries to do so. In this broader stage, it is very desirable that more and more countries participate in the design of the ethical frames that will regulate human relationships in the coming years. This task should not be accomplished exclusively by the technologically advanced nations; it would be a fundamental contradiction.

5.1 Bioethics committees

Our modern societies are eager to receive the benefits from the scientific-technological development, but without paying a high price for mistakes and its consequences that frequently come together with some researches. This makes it necessary to supervise openly the interdisciplinary committees that will give suggestions and recommendations about research activities and proposals, looking to preserve individual liberty, dignity, and benefit. Conflicts arising from these discussions, which are not easy to overcome, have to be solved at a final executive level.

The commission mentioned by F. Dyson [1993] is a variation of the Institutional Review Boards (IRB) which the Department of Health and Human Services (DHHS) of the United States in its Regulations for the Protection of Human Subjects established in 1991:

> *"a) Each IRB shall have at least five members with varying backgrounds to promote adequate and complete review of research activities commonly conducted by the institution. The IRB shall be sufficiently qualified through the experience and expertise of its members and the diversity of the members, including race, gender and cultural backgrounds and sensitivity in such issues as community attitudes, to promote respect for its advice and counsel. Each IRB shall include at least one member whose primary concerns are in nonscientific areas."*

Those committees are deliberating organisms that make careful and complete considerations about the advantages and disadvantages of any decision prior to its adoption, with votes fully supported before emitted. This deliberation about situations that are partially known but whose effects or consequences are not clear or predetermined, is carried out by exchanging personal arguments and points of view in a dialogical process whose only purpose is to find the truth, leaving apart any dogmatic position. This is the philosophy that should be applied to the analysis of the technological research that can affect human life and values. The work of a bioethics committee, according to Diego Gracia, a Spanish expert in these topics [cited by Martínez, 2003, p. 70], must proceed in the following way:

1. Identify the problem
2. Analyze the "relevant facts" with the highest possible precision
3. Identify the involved values
4. Identify conflicting values
5. Identify the fundamental or most important conflict between values
6. Deliberate about possible courses of action
7. Deliberate about the course of action that optimizes conflicting values. Determine the most convenient course of action
8. Deliberate about agreement between most convenient course of action and culture
9. Take a final decision.
10. Check the legal or illegal aspects of this final decision.

Today these Bioethics Committees are integrated and in operation in almost all hospitals and medical research centers around the world, and had been taken as models for the integration and operation of similar committees in other fields of scientific research.

6. Are there any bases for rational optimism?

The answer to this question depends on the point of view we adopt or the group we belong to, since there are at least two possible positions in relation to the future evolution of technology: the position of those who do not accept that technological development could

change the nature of human beings and the traditional values of humankind, and that held by those who are convinced that a progressive hybridization of humans and machines is inevitable, or even desirable (what has been called a cyber-organic species or simply cyborgs), beyond any axiological consideration. This last group, visibly represented by persons like the renowned inventor Raymond Kurzweil [2005], considers that we should develop a pure technology model without ethical restrictions; they base their optimism on a kind of enthusiasm for technology and its benefits. They hold that genetics, nanotechnology and robotics will create a species of unrecognizably high intelligence, memory, durability, comprehension capacity, and so on. Humankind, they think, is at the threshold of a new age of achievements and happiness. However, if the ethical considerations are set apart and machines in our bodies (*nanobots*) can rebuild cells, for example, why could not they be reengineered as weapons? They seem to forget considerations of this and other types, as those of political and economic nature, and the fundamental fact that technology needs massive social acceptance and confidence. It is not enough to convince us that human ingenuity is unlimited and can make possible most of our dreams; it is also necessary to convince us that such developments are desirable. We are, certainly, the most well-informed society in history, but … are we the wisest?

What can support the optimism of the other group, those who do not accept an uncontrolled development of technology and want to preserve human values and nature as we know them today? Well, they must base their optimism on evidence rather than speculations. Along history humankind has seen a considerable improvement of life conditions and physical progress, in spite of wars and natural catastrophes. Man has been a very successful species in controlling his surroundings and developing a production capacity to meet his needs and make true his dreams. The dire predictions made in the past about the limited capacity for food production in comparison to population growth had vanished thanks to technology. And the same is true in connection with other commodities. In 1798 Malthus published his classical work on his catastrophic predictions about the impossibility of feeding human population due to the fact that food production was growing linearly while human population increases at a geometrical rate. Two hundred years later Malthus predictions are far from being confirmed, although from time to time a new version of Malthusian arguments alerts us about the proximity of a new crisis. Among these Neo-Malthusians we found at the end of the 1960's the Club of Rome [Meadows, 2004]: they feared that the earth was rapidly running out of everything due mainly to the fast population growth. In 1968 Paul Ehrlich, a respected biologist from Stanford University and president of Stanford's Center for Conservation Biology, published *The Population Bomb* [Ehrlich, 1971], in which he posited that sustainability is determined by three basic factors: population, resources availability and technology. The basic argument was this: more people imply more poverty, which in turn implies more people. This book stimulated the movements looking for accomplishment of zero population growth. Some years later appeared the book *The Limits to Growth*, from a group of researchers working at the Massachusetts Institute of Technology, headed by Denis L. Meadows under request of The Club of Rome. They studied five indicators related to economy: population growth, resource consumption, technological development, food production, and pollution. Using a computer model and the best data they could find at the time for these indicators, they concluded that "if the present trends continue unchanged, the limits to grow on this planet will be reached sometime within the next 100 years" [Meadows, 1992]. Nevertheless, they

left open the possibility of altering these growth trends and to establish a condition of ecological and economic stability that can be sustainable far into the future.
Fortunately, none of these apocalyptical visions have come true. In 1980 the economist and expert in administrative sciences Julian L. Simon published a book [*The Ultimate Resource*, 1996] which contained a good deal of arguments intended to prove that population growth is not by itself a menace. His reasoning was on the line of "both, foxes and people like to eat chickens; but while more foxes mean less chickens, more people means more chickens". In other words, the larger the human population that can create and invent, the easier for a society to raise its production and living standards. Simon's central premise was that people are the ultimate resource: "Human beings", he wrote, "are not just more mouths to feed, but are productive and inventive minds that help find creative solutions to man´s problems, thus leaving us better off over the long run". In the average, a person using modern technologies can produce more than he or she consumes. According to Simon, natural resources are getting less scarce, world food supply is improving, world pollution is being controlled, and population growth has long-term benefits. Having opposing visions, Ehrlich and Simon entered in a famous wager in 1980, betting on a mutually agreed-upon measured of resource scarcity over the decade leading up to 1990. Ehrlich chose five commodity metals; Simon bet that their prices would decrease and Ehrlich bet they would increase. Ehrlich ultimately lost the bet, and all five commodities that were selected as the basis for the wager continued to trend downward during the wager period.
The two trends that Simon believed best represented the long-term improvement in the human condition along history due to the technological development, were the increase in life expectancy and the decrease in infant mortality. Those trends, Simon maintained, were the ultimate sign of man´s technology victory over his problems.
Anyhow, the debate between optimists and pessimists is not yet settled, but if we consider that optimism is more an attitude than a vision of the expected then the only way to give sense to the human actions based on our best rational efforts is to keep by principle an optimistic stand, since any alternative could not favor life. As we have seen, if the positive results of the applications of new technologies were balanced against the risks involved, no doubt the first would prevail when used with prudence. That is the challenge of our times.

7. Conclusions

Up to now technology has been an instrument of man to control nature in search of better living conditions. As any living organism, technology has evolved in an almost continuous way by incremental innovations to become, at present times, a very complex system that is developing its own laws and its own government. Then, we have to be cautious not to be controlled by our own creation [Roe-Smith & Marx, 1994].
On the other hand, if the success of a technology is measured by its beneficial effects on human life, then the most successful of all modern technologies are those related to human health; perhaps because these are the most visible results for the majority of the people. However, the climate change, the foreseen energy crisis, as well as biotechnologies, genetics engineering, telecommunications and Internet, together with its implications for human life and values, are forcing us to wake up from the "technological somnambulism" envisioned by Winner [2008], to abandon passivity and take a more active role in orienting and controlling the future technological development. It is too much what is in stake to let the experts or politicians alone make the job of decision taking. And we cannot forget that we

will make our decisions about technology in a world built by technology itself, so we are constrained by what past technology has made of our world; we are not entirely free to choose a course of action. Nevertheless, the sooner we assume a participative role the more effectively we can steer our future and choose the kind of world we wish for our descendants. One thing we can take for granted: technological progress cannot -and should not- be stopped, since it is inherent to human nature. We cannot go back to earlier periods of history, but at the same time we must struggle to have the kind of progress that can provide the greatest benefits for all of us. And following Peter Drucker [2011] we could conclude that: "…. A time of true technological revolution is not a time for exultation. It is not a time for despair either. It is a time for work and for responsibility."

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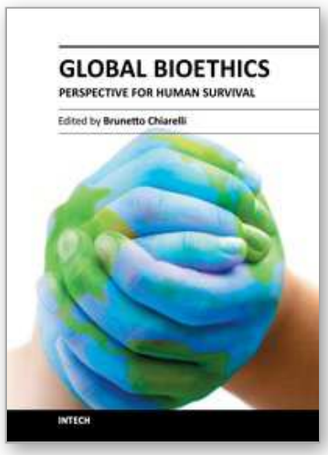
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Two new factor have been added to the ideological change in the second half of the past century: the “ecological impact” of humankind on the environment due to the population increase; and the “ innovative impact of science, first with atomic physics, which introduced the scission of the fundamental unit of matter, the atom, and then witch molecular biology, which led to the decoding of genetic information and intervention of biological engineering that annihilate our concepts of individual and species as fundamental units in biology. This stage of fundamental rethinking is however overshadowed by the threat of ecological disaster and catastrophic population increase, which not only impose limits to development, but undermine the very survival of Humankind. The future survival our species in fact depends on the interaction between its reproductive characteristics and the productivity of the territory, which, even if increased by the intellectual capability of the human brain, has intrinsically limits. The adaptive choices (which are also biotechnological and biomedical) of the interaction between human population and the natural ambience is the conceptual basis of the new discipline “Global Bioethics”.

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