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DISCUSSANT RESPONSE

by

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to **Mario Giampietro's**

**GENETIC ENGINEERING WITHIN THE BIOSPHERE:
HIERARCHICAL LEVELS AND VALUES**

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Discussion for the paper on 'genetic engineering within the biosphere; hierarchical levels and values' by Dr. M. Giampietro

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The paper presented by Dr. Giampietro concluded that one should take precautions against the development of genetic engineering technology before its full application to the industry and agriculture because of the following two reasons:

- 1) future consequences of genetic engineering are uncertain and thus gambling with high risk since alteration of gene pools in the biosphere may disturb the dynamic equilibrium state of the ecosystem we live in; and
- 2) the ethical problems caused by a wrong decision of the scientists may affect the resilience of our biosphere and therefore the safety of mankind.

He expressed the fear that a boom of genetic engineering industries could repeat again the catastrophic process as done by chemical industries, although there is potential of this new technology capable of solving many problems of mankind. Thus, the paper was concerned more about miss-uses of the new technology and human ignorance of the probable negative impacts on the ecosystem. This conceptual framework has been critically analyzed by presenting the possible risk assessment of genetic engineering at the different hierarchical levels of the biosphere system and the ethical issues of the technology concerned with patenting living organisms which may also be a risk taking gambling because of serious problems concerned.

I am happy with this paper which did not under-estimate the importance and values of this technology and am not going to stress the importance of the technology which will eventually return immense benefits to the human being. This has already begun to demonstrate in various sectors and will rapidly spread over. It is fully agreeable that the problems raised in the paper and that both scientists and policy makers should take critical measure about the risk and the ethical problems of the new technology which may give rise to negative impacts on the ecosystem and thus on the human life.

However, when we talk about the risk and benefit of a new technology, the value should be discussed with relative terms. In the modern industrial society, when a new technology is about to be implemented for its application, the technology or the product should be proved to be more beneficial than the risk for the human being. In this regard, I would like to make a few comment on the paper in terms of the presumption one should take into account in discussing the risk assessment and the ethics of a new technology.

1. The risk and benefit of genetic engineering should be assessed in comparison with those of other technologies such as chemical technology causing more serious damage to the ecosystem. If I may point out one of the assumption underlying the logical development in the paper, it must be that all of the pre-existing factors could no longer be effective to the ecosystem in such a way that only the consequences of a new input technology would cause problems against the established equilibrium system of the biosphere. It is believed that the chemical and mechanical technologies are the ones which increase drastically the entropy and damage to the state of the ecosystem, whereas bio-process technology can be a unique implement to minimize the increasing entropy and to conserve natural resources by utilizing renewable resources and to be compatible with the ecosystem.

Since the industrial revolution, the mankind has been addicted to the benefits and conveniences provided by the progress of technology, nobody wishes go back to the life of pre-industrial civilization nor to stop the modern industries for the purpose of reducing the rate of the entropy increment. Unless one can achieve the zero population growth, the global demands for food and energy will be continuously increased while the resulting wastes will be continuously accumulated.

How is the mankind going to solve these problems? To achieve the natural control of population of the species Homo sapiens, let people die of starving? Let sick people die with disease and chemical pollutants? Let the homeless people freeze to death? The human consciences and the ethics of life would not allow us to make things let it be.

At this point, the relativeness of the risk and benefit of the two technologies must be considered; chemical technology vs. biotechnology. As long as chemical technology already causing the drastic damage to the ecosystem is practiced on this planet of the earth, the mankind must provide an alternative technology in order to conserve natural resources and the ecosystem and to clean up wastes and pollutants for the future survival of mankind. It is most likely biotechnology including genetic engineering that will do these jobs. This means that the risk of genetic engineering would be far less than that of chemical technology causing the damage to the ecosystem and thus to the human life, while the benefits of the former would be much greater than that of the later in terms of the basic demands of human survivals.

2. The environmental risk caused by genetic engineering would not be that serious one might think of. The alteration of genetic information may cause the damage to the stability of genetic pool of a species, to the dynamic equilibrium of the becoming genes composing the structure of ecosystem, and finally to the entire biosphere. Therefore, the danger of the 'one problem, one solution'

approach of genetic engineering should be taken into consideration because any genetic manipulation to use for 'technical solution' would cause pollution to the genetic resources, 'bio-pollution' in contrast to 'chemical pollution'.

However, as mentioned by Prof. Daniel E. Koshierland, Jr. in 'Science'(Vol. 236, No. 4805, 1987, P.1159), recombinant DNA is no longer threatening human kind as much as the risk concerned in the initial days of the technology out-break because "first, much is now known about the events that lead to uncontrolled growth of cells and about the safe application of recombinant DNA. Second, experiments have revealed that genetic engineering has been occurring in nature for eons without catastrophic consequences..... Nature's genetic engineering through selection is much slower than modern laboratory manipulation, but it has been going on for billions of years."

Without any human intervention, there has been genetic recombination and alteration of genetic information in the natural state by way of either self association processes of living cells or physico-chemical factors of environment. And each of becoming processes or systems of genes has been contributed the stability of dynamic equilibrium of the total ecosystem. However, among genetic pools, the dominant ones in the biosphere are not other population of species, but the species Homo sapiens who takes the top of the position of the food chain pyramid. This means that human being himself is the major cause of ecological destruction rather than other living species. All other species whether it is evolved by natural processes or by human intervention would become a component of the natural equilibrium processes of the biosphere as it wins the passive natural selection process. In such cyclic processes of the ecosystem in the dynamic equilibrium state, the increased human population and the non-biodegradable wastes generated by the human society are the major consequences of increased entropy in the irreversible thermodynamic system of the biosphere and are the major factors causing irreversible damages to the equilibrium state of ecosystem.

According to the neo-Darwinism, the quantitative factors which decide the direction of evolution are not determined by the struggle for survival but by the difference of the rate of proliferation in species. Therefore, the genetic engineering could be a decisive factor eventually which could accelerate the speed of evolution by producing individuals with a high rate of proliferation following the changes in new environment. But new organisms made artificially will be tested for their new traits given to an organism to see whether it can be co-existed with 'the whole system' tightly controlled by the system of pre-existing organisms today, all of which have been selected by this test process called the natural selection in the past several billion years.

However until now, new man-made organisms through conventional breeding technology including high-yield crops and good breeds could survive and demonstrate their high productivities only in protective environments provided by human beings. We know well that if this kind of improved organisms is confronted with the natural ecosystem, it would not survive with its severe processes of the test. In fact, to obtain the survival capability of a newly created species in the dynamic equilibrium system it would be entirely different problem with the case of survival under the artificial environmental conditions.

Therefore, it cannot be over-emphasized that a new organism altered artificially for the profit of man can survive in nature only with the care of man. But it cannot entirely exclude the apprehension about sudden changes in the ecosystem that may possibly be occurred, by shortening the evolutionary process of organisms taken for several billion years if genetically engineered organisms could be selected not in the artificial environment but in the natural environment. Especially, we cannot overlook possible risks that new hazardous or pathological microorganisms genetically engineered may cause the dreadful results even to human life.

Fortunately today, as the genetic engineering is making a fast progress, it reaches the stage in which experiments of recombinant genes can be handled

safely and basic processes of abnormal growth of cells such as cancers has begun to understand, so that we feel relieved from worry of the risk of gene manipulation as being thought in the early days. However, even at this point as long as there is no absolute proof for the safety against various biohazards that may occur to the ecosystem as well as human beings, a tight legal or systematic regulation and control of the output of genetic engineering is unavoidable reality.

3. Bioethical problem should be addressed to the medical application of human gene manipulation, rather than genetic transformation of animals and plants for the benefit of mankind. The paper concerned about the patenting a transgenic animal which may lead to ethical problems with respect to the possible destruction of natural order of genetic barriers among species and possible infringement of carnivorism by eating meat of transgenic live stocks. One can hold a different view on the possibility of carnivorism with transgenic animals, depending on as to how one looks at the products of human gene expressed in different organisms other than human body. Eating DNAs and proteins with a characteristic information of the human origin produced in different organisms would be no less or no more than those synthesized by chemical means. This would not be equivalent to the carnivorism which concerns more about 'the ethics of dignity of human life.'

Bio-ethical problem of genetic engineering should be directed to the case of genetic manipulation of human being to create new human characteristics as has it been done in the field of 'eugenics' about one half of a century ago or gene transformation of human cells to control the genetic diseases as seen in 'gene therapy'. In order to apply the technology for controlling genetic diseases of human being, scientists should be humble about the dignity of human life rather than simply utilizing it only for their scientific achievement or personal recognition.

In this context, I would allow a patent for transgenic animals and plants as long as the subject of gene manipulation is not a human being nor applicable for the production of foods by farmers. Scientific inventions must be protected as a patent if its industrial application can possibly be explored for a new business opportunity, regardless of the subject of a patent dealing with materials or living matters. Or else otherwise, scientific achievement would not be respected properly by the money making sectors.

4. In conclusion, the basic problems of the risk and the ethics in application of genetic engineering raised by the paper should be supported and not be under-estimated since uncertainty and disputes in value have always given to us a fear and frustration in introducing a new technology. However, we should build more knowledge about the possible risk and benefit of the technology with respect to the ecosystems as well as the human society. We must provide careful regulatory measure of biohazard and bio-ethical problems which can be generated by the course of application of genetic engineering technology. The more attention should be given to problems of biohazard which could be generated by the release of pathogenic microorganisms and disease-causing genes into environment and to problems of bio-ethics as dealing with genetic manipulation of human beings and the transformation of human life.

Quoting the last statement of the paper - "It is time to work on a new science in which harmony between peoples is obtained through harmony with nature" - I should like to extend it to the value of 'the ethics of knowledge' of a new scientific discipline not to be fear of it but to use it properly for the benefit of human being and to minimize the rate of entropy increment in the biosphere.