

## **Gene Research – Myths and Realities** **Dr. Daniela Conti**

*“The perfumed flowers are our brothers; the deer, the horse, the great eagle are our brothers; the rocky coasts, the green of the grass, the warmth of the pony and the man, all belong to the same family.*

*The white man. treats his mother, the Earth, and his brother, the sky, as if these are only things to be bought, taken and sold, as one does with goats and precious stones. His greed would swallow all the earth till only desert will be left for him. Our traditions are different from yours’.*

*The sight of your cities pains the eyes of the red man. But perhaps it is because the red man is a savage and does not understand. There is no quiet place in the white man's cities. No place to hear the leaves of spring or the rustle of insect wings. But perhaps because I am a savage and do not understand, the clatter only seems to insult the ears. What joy is there in living, if man cannot hear the sweet sound of the wind or the sound of perfumed pine leaves moving in the wind? The air is precious for the red man, because all things breathe the same air. It seems that the white man does not care about the air that he respire.*

*But if we have to sell you our lands, I will pose one condition: the white man will need to respect as brothers all the animals that live on those lands. I am savage but I know no other way of living.*

*I have seen thousands of rotting buffaloes on the prairie left by the white man who shot them from a passing train. I am a savage and do not understand how the smoking “iron horse” can be more important than the buffaloes, when we kill them only for survival. What is man without the beasts? If all beasts were gone, men would die from great loneliness of spirit, for whatever happens to the beast happens also to the man.*

*All the things are inter-connected. We know at least this: the earth does not belong to the man, but the man belongs to the earth. We know this. All things are inter-connected, as members of a family are inter-connected by the same blood. Man did not weave the web of life, he is merely a strand in it. Whatever he does to the web, he does to himself. The whites, too, shall pass perhaps sooner than other tribes. Continue to contaminate your bed, and you will one night suffocate in your own waste.*

*Where is the thicket? Gone. Where is the eagle? Gone. And what is it to say goodbye to the swift pony and the hunt? The end of living and the beginning of survival.”*

I wanted to start with this long citation from the Amerindian chief Seattle because I think that in many of us these words, written about 150 years ago, **vibrate** profoundly and evocate a kind of

nostalgia for a world that was, which was perhaps known by our elders, but which is dramatically disappearing before our eyes.

**Cooperation and Co-Evolution in Life-systems:** The western culture often ignores an essential element in the history of evolution of life on the planet, that is cooperation between the different life-forms, in certain cases developed to the extreme level of symbiosis, where two organisms become inseparable and can not live without the other. This ancestral origin is the reality of every cell composing our bodies. Another fundamental element, systematically ignored is that of co-evolution, where every species is as it is because of interaction with other organisms, things and events. Thus every species and every individual owes its existence to its history. Thus, only in a distorted and reductive way of thinking, a living organism can be de-historicised and de-contextualised, as if it's identity is independent of network of relationships, which made it what it is and, which modify it constantly.

Evolution is co-evolution, in human sphere, as well as for the general relation between organisms and environment. A plant that grows today does so in an oxygen-rich environment created by its ancestors, who had invented a new kind of photosynthesis, an efficient process that generated oxygen as a by-product of energy-metabolism. Over a period of millions of years, this process helped in changing from a methane and sulphur dioxide rich environment to the oxygen rich environment. However, oxygen was toxic for most forms of life existing on earth at that time and this change initiated the first big extinction of life forms on the earth. Those life forms, which tolerated oxygen, or those which became capable of using oxygen through respiration, inherited the Earth, and from those early life forms descended all the life forms that we know today, including those that have become extinct long ago. Environment modifies and selects the life forms and life forms modify the environment – this is an eternal inter-play. This is why the quality of reciprocal relationships between all organisms is important for the continuation of life.

However the dominant scientific vision at present seems to look at different forms of life in an isolated manner, without considering the complex system of reciprocal influences and the evolutionary pathways connecting them. In biology, this reductionist vision isolates organisms from the context of their relations and from the flux of time, considering them only in terms of their molecules of DNA, as if this is the only key of the life. Starting from such a vision of life, it is possible to change the so called “identity” of the organisms in a mechanical manner, pretending that such an operation will not interfere with overall functioning of that organism. However, there cannot be a plant or an animal, even if you reduce them to their minimum terms, that is to their DNAs, on which you can operate ignoring the relations between the organism and the external environment, between its different cells and between the different components of the same cell. This reductionist model of biology reflects a simplistic view of the world, as shown clearly by genetically modified organisms (GMOs) and clonation experiments.

The soybean modified by the insertion of a bacterial gene for making it resistant to a specific herbicide, is no longer the same soybean. Monsanto, which produced and patented this soybean (and herbicide), has itself admitted that the DNA of the transferred gene contains new sequences that were not there originally and are a result of an interaction between the inserted gene and the

plant system. Let's consider Dolly, the first cloned sheep: she is already old and full of diseases as the adult from which it had been cloned. Why? Because even the time, the memories – that is, the history - are inside the living matter, they modify it and leave their signs also in the DNA. For a living organism, functioning well means being in a flux of continuous transformation, that has a temporal direction made of development → maturity → decadence → death cycle, a complex mix of phenomena that science still does not understand so well.

**Theoretical Fundamentals of Genetic Science:** What are the basic theoretical premises of genetic science? Barry Commoner, a great scientist and father of modern ecology writes<sup>6</sup>:

*“The experimental data, shorn of dogmatic theories, points to the irreducibility of the living cell, the inherent complexity of which suggests that any artificially altered genetic system, given the magnitude of our ignorance, must sooner or later give rise to unintended, potentially disastrous, consequences. We must be willing to recognise how little we truly understand about the secrets of the cell, the fundamental unit of life. [...] ..money has distorted the scientific process as a once purely academic pursuit has been commercialised to an astonishing degree by the researchers themselves. Biology has become a glittering target for venture capital; each new discovery brings new patents, new partnerships, new corporate affiliations. But as the growing opposition to transgenic crops clearly shows, there is persistent public concern not only with the safety of genetically engineered foods but also with the inherent dangers in arbitrarily overriding patterns of inheritance that are embedded in the natural world, through long evolutionary experience. Too often those concerns have been derided by industry scientists as the "irrational" fears of an uneducated public. The irony, of course, is that the biotechnology industry is based on science that is forty years old and conveniently devoid of more recent results, which show that there are strong reasons to fear the potential consequences of transferring a DNA gene between species. What the public fears is not the experimental science but the fundamentally irrational decision to let it out of the laboratory into the real world before we truly understand it.”*

These words summarise all the problematic and risky aspects of the transgenesis and clonation, two main areas followed by dominant apparatus of genetics. On one hand emerges the increasingly intense “colonisation” of the research, even of the public sector, by private interests, often of big transnational groups, which move exclusively for immediate profits and for monopoly on genetic resources and knowledge. This also means, difficulty of finding resources for those researchers, who wish to follow alternative pathways of research, and are thus marginalised from the academic environment. On the other hand, Commoner underlines the cultural deviation of the scientific apparatus that seems reluctant to ask questions about and significantly modify the theories already proved “incorrect” by the new experimental data, as should be usual in science, because the old theories are necessary to maintain and safeguard the economic interests and interests of scientific apparatus.

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<sup>6</sup> Commoner B, Unravelling the DNA Myth – The spurious foundation of genetic engineering, Harper’s Magazine, February 2002

Let us now look at the basic theories, which justify the modification of living organisms through genetic engineering. The basic idea is linked to the “central dogma”, called so by Francis Crick, discoverer of the double helix of the DNA, along with James Watson. Commoner explains this central dogma in the words of Ralph Hardy: “...Ralph W.F. Hardy, president of the National Agricultural Biotechnology Council and formerly director of life sciences at DuPont, a major producer of genetically engineered seeds. In 1999, in Senate testimony, he succinctly described the industry's guiding theory this way: "DNA (top management molecules) directs RNA formation (middle management molecules), which directs protein formation (worker molecules).”

Thus the final result of a gene transfer becomes as predictable as a corporate organisation: the workers, that means proteins, are going to do exactly what their bosses (DNA) will tell them to do. A gene is seen as the only determinant of a protein-production process, where DNA (through specific RNAs) commands a specific protein chain and there is a constant, unidirectional command-line between the DNA and the protein. Since proteins are responsible for every function and structure present in the body, together the genes of an organism account for all its hereditary characteristics. At the same time, this concept of DNA as the unique determinant justifies the transgenesis: a certain gene from whatever species can be taken, transferred in whatever species, and it will produce the same protein and nothing else.

Thus gene transfer does not need to face the barriers, which need to be respected by traditional genetics, bound by natural mechanisms of reproduction and crossbreeding. For this reason and because it uses specific instruments like artificial vectors for gene transfer, the genetic engineering can not be compared with traditional genetics and represents a new and unprecedented technology of intervention on nature. The argument of “gene as the unique determinant of a protein” is also used to justify the patenting of genes – if a gene controls one particular function, and thus has a determined “utility”, and if one can isolate it and make it do that function in an organism, in which that gene does not exist, then a patentable innovation has been created. (In reality, this is a gross over-simplification of the real situation since the patenting of gene is an extremely confused subject and there are many patents for an entire species as it exists in nature, by-passing thus the vague concept of “utility”.)

But is the central dogma true? Is DNA really at the top of the pyramidal hierarchy representing the molecular fundamentals of life? Well, many discoveries of the last two decades suggest otherwise. One of the important results coming from the **Human Genome Project**, that wanted to identify all the genes determining our characteristics, is that there are insufficient number of genes in human DNA (only 30-40 thousand) to justify one-to-one correspondence between the genes and the hundreds of thousands of proteins which make our bodies. How can we explain the disproportion between the number of genes and the number of proteins? This brings to one of most fascinating discoveries, confirmed also by Human Genome Project, alternative splicing of genes. Without entering in to all the details, to explain this let me start from our knowledge that from the “working copy” of a gene (a RNA), parts relating to entire genetic sequences are cut, while the remaining parts are united to make messenger RNA, which comes out of cell nucleus and is translated in to a protein in the cell cytoplasm. Alternative splicing complicates this, because the pieces to be cut and made in to messenger RNA are not fixed sequences, but these change according to the needs of the

cells. Thus starting from the same gene, we can come to 2, 5, 6 or even more different proteins (for example, a gene in the fruit-fly can produce 38,016 different protein variants). What changes is not the gene sequence in the DNA, but it's the process on the "working copy" of the gene. How is this process regulated? We don't know all the details but this extraordinary and unsuspected flexibility of DNA is influenced by the interaction with the cell environment through a complex network of signals (through contacts and relationships).

**Challenges to fundamentals of genetic-theory:** There are other phenomena discovered during the last 20 years, which contradict the fundamental postulates of genetic-theory. One of these is the still mysterious editing of RNA, which changes the "working copy" of the gene by adding instructions (bases), which influence the final protein. These information do not come from the original gene in the DNA **but** come from somewhere else. Another example is that of development of embryo, when cells sharing the same DNA codes develop in to very different kind of cells. Thus apart from the "programme" written in the double helix of DNA, is there some kind of "spatial project" of the body? How is it codified? We do not know. Special proteins called "chaperones" are needed to act on newly made proteins in chain-form, to make them take a three-dimensional form necessary for their activity. What gives information to chaperones to give correct forms to newly made proteins? Another well-known example comes from the mad-cow disease or BSE, caused by prions. These prions seem to be made only of proteins, without any nucleic acids (DNA and RNA), yet they are infective, simply through contact. All these examples, contradict the basic fundamentals of genetic-theory and some of these seem to suggest that proteins are not simple executors of instructions, but have their own autonomy of action.

**Implications of these challenges to fundamentals of genetic-theory:** The research of the last two decades suggests that DNA is a very flexible system and fundamental unit of life the cell, considered as an integrated system, result of thousands of years of co-evolution of all its components, including proteins and nucleic acids. DNA cannot function alone and is not the head of any hierarchical pyramid. Of course, it has a key role; in its molecule there is the registration of the evolutionary history of the species - it is an essential archive, historical and continually changing and becoming – and the organism takes information from this archive for its development and for its daily life. However, it is not the only determinant. The organism, through its cells' functions, makes decisions all the time about the genes to be activated and those to be inactivated, about the kinds of proteins to be produced and those that are not needed, in a process of constant interaction with the environment. "Cellular democracy" is the name given to this process by the scientist Mae-Wan Ho, creating a new and very powerful image of biological complexity.

These results have enormous implications for the biological theories and have created some disturbance and anxiety among those united under "Intellectual Property Rights Ltd" bandwagon, formed by big corporations as well as by medium and small companies involved in genome research and gene sequencing, hunting for genes to be patented.

**Patents and Genes:** Just to get an idea about the enormous interest of biotech industry in gene patents, I can refer to an interview made by John Doll, director for Biotechnologies at US Patent and Trademark office (USPTO) to Scientific American magazine in 2001. He said, "The only

number we have about patented gene can be a hypothetical estimate. Since 1980, our office has released more than 20,000 patents on genes and related molecules (human as well as from other organisms). In addition, we know that there are about 25,000 pending requests for patents linked to genes and related molecules.”

Given the fact that information about patented gene sequences is fragmented and covered with secrecy, we do not know the number of human genes already patented! And, in the middle of enthusiasm came the cold shower of the results of the Human Genome Project. When it was announced that the human genes were only 30-40 thousand, the financial trading indices for biotech companies dealing with genetics went down. With the genes and sequences already patented or ready to be patented, these companies are going to have a big amount of capital, excluding the late-arrivers. At the same time, there were already attempts to negate the results of the two teams involved in human genome research, insisting that in reality the number of human genes is much more, 60, 90 or 120 thousand. The biotech industry, built on the foundations of patents for exploiting the monopoly over “genes of single diseases” or “genes of behaviour”, feels shaken to its core by the discovery that single genes do not control single proteins, but that DNA lives and functions as a complex system, co-evolving with proteins. That is why the confusion of the “Intellectual property rights Ltd” that if a gene is not the only determinant of a protein, what will be the value and credibility of their patent on that gene? Who is going to resolve the long and tortuous legal conflicts between commercial exploitation of two different proteins deriving from the same gene?

**Calming the panic of “Intellectual Property Rights Ltd.:** The panic about the results of Human Genome Project has been calmed through the reductionist logic. There are still more patents to be awarded. Now the object of hunting is “Proteoma”, all the proteins taken together. Mr. Doll of the USPTO has found a solution, “Proteins deriving from different sequences of the same gene can become distinct ‘inventions’ and thus can be object of separate patents”.

Considering the challenge posed to our sense of humanity and to our intellect by the complex web of life, such discussions and solutions for buying, selling and controlling our life system, may seem petty and selfish. This is inevitable product of that all pervading thinking, where power is the only goal and in the name of power, wars, genocides and disasters of different kinds are carried out.

**The Challenge to us:** It is important to bring a profound change to our way of dealing with issues. We have to make a distinction between power and strength, aware that power can only generate accumulation and necessarily leads to new conflicts. The strength is, on the other hand, the unending source of complexity that continuously generates life at a higher level of emancipation. Cooperate is the new verb that we have to put in to use. We are part of a complex system that lives in an even bigger and more complex system, as the Amerindian head-chief Seattle had spoken 150 years ago. Wilhelm Reich wrote in all his books that love, work and knowledge are the source of our life and these should govern our lives. Instead, we see continuous impoverishment of these simple yet profound concepts. Personally I believe that we need not be courageous but we just need to remove our fears and to liberate our creative force. Love cannot be bought or sold, work cannot be exploitation, knowledge is the wisdom of being what we are: living beings in relationship with

other living beings, “forced” to cooperate with others. This is the future that I would like to wish for all of us.