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Genetic forum

Humanity and human DNA☆

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ABSTRACT

Genetics has marked the second half of the 20th century by addressing such formidable problems as the identification of our genes and their role, their interaction with the environment, and even their therapeutic uses. The identification of genes raises questions about differences between humans and non-humans, as well as about the evolution towards trans-humanism and post-humanism. In practise, however, the main question concerns the limits of prenatal genetic diagnosis, not only on account of the seriousness of the affections involved but also because of the choice to be made between following-up the medical indication and engaging in a systematic public health strategy aimed at eliminating children with certain handicaps. History reminds us that genetic science has already been misused by political forces influenced by the ideas of eugenics, particularly in the Nazi period. We may wonder whether it is reasonable to formulate a judgement on the life of a child yet to be born, merely on the basis of a DNA analysis. My experience as a practising geneticist and my involvement in French politics forces me to stress the dangers of a new eugenics hiding behind a medical mask. As demonstrated by epigenetics, human beings cannot be reduced to their DNA alone. In our society, one of the problems concerns individuals whose lives may be considered by some as simply not worth living. Another problem is the place and the social significance of the handicapped amongst us. Fortunately, recent progresses in gene therapy, biotherapy, and even pharmacology, appear to be opening up promising therapeutic perspectives. We should bear in mind that the chief vocation of medical genetics, which fully belongs to the art of medicine, is to heal and to cure. This is precisely where genetics should concentrate its efforts software.

Genetics has marked the second half of the 20th century, contributing to the extraordinary scientific revolution of modern times. Only 30 years after the fundamental discovery of the DNA double-helix in 1953 by James Watson and Francis Crick, geneticists were already dreaming of deciphering what they metaphorically called the "great book of life" or the "genetic program". In so doing, they endorsed the idea that the entire story of life had been written beforehand and was actually unfolding somewhat like a computer software. But that was when their ideas were influenced by François Jacob's "*Logic of Life*" (1974), which implied that each protein in a living organism resulted from the expression of a single gene.

Since then, new ideas have emerged and geneticists have been forging ahead on such fascinating projects as the identification and evaluation of genes, the analysis of the interaction of genes with the environment, as well as the investigation of their therapeutic applications.

1. Identification and evaluation of genes

It has taken the science of genetics many long years of patient work on organisms ranging from the primitive blue algae to the complex *Homo sapiens* to unravel the mysteries of the DNA molecule, which through its universal code, underscores the unity of the living world.

This fundamental discovery raises the question of the place of mankind in the universe and, more specifically, in the order of the living. The theories of Lamarck (1774–1829) and Charles Darwin (1809–1882) are now being revisited as the evolution of the species is seen in a new light. Teilhard de Chardin (1881–1955) would have enthusiastically incorporated the new ideas emerging into his theory of the origin of mankind while reconciling Christian faith and modern science as he sought so hard to do.

However, the identification of genes raises ever more forcefully the question of the frontier between the human and the non-human since the similarity of human and non-human genetic sequences could lead to some confusion. In short, is a human gene fundamentally different from a non-human gene? It is well known that genetic coding sequences may correspond perfectly from one species to another, opening up unexpected perspectives. On its

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own, the structure of a gene is insufficient to characterise its human origin. In fact, genes transferred from one species to another can undergo the same expression as in the original organism. It is interesting to note that 99% of human DNA is identical to that of the macaque. We might wonder if the explanation lies in what actually happened in Africa, somewhere between Zambia and Ethiopia, where humans or pre-humans are first believed to have appeared about 200,000 years ago. Paleogeneticists are only just beginning to hint at some possible answers to this riddle.

Digging into the past is inseparable from reaching out to the future of the evolutionary process. The time scale stretching over millions of years is such that we may feel little concerned by the phenomenon. However, genetic experimentation may well create evolutionary shortcuts since humans now have the power of modifying all living organisms, including themselves. This leads to some delicate questions about the future.

Some philosophers have theorised what they believe to be a possible, if not ineluctable, evolution. According to them, humanity would appear to be at a radical turning point in its history. For instance, Francis Fukuyama, in "*The End of History*" (1989), outlines what might be the advent of "post-humanity". Transhumanism, an ideology currently in vogue, calls for a new humanity capable of ensuring its own transformation. Using powerful nanotechnologies, biotechnologies, information technologies and brain sciences, transhumanism aims at transforming ordinary humans into cyberhumans. Post-human utopias oblige us to face questions about humans who, only yesterday, were considered animal-like or barbaric, and are tomorrow likely to be turned partly or entirely into machines.

In any case, why would a molecule like DNA, which evolved right up to the development of humanity, not continue its evolution even further? The way we look at humanity differs according to whether we consider it to be the end-product of evolution or simply as an evolutionary step towards some unimaginable future. Long after Ovid's "*Metamorphosis*", written at the beginning of our *era*, and the kabbalistic myth of "*Golem*" lost in the mists of time, some modern authors evoke the advent of "cyborgs" and "androids", whereas others, treading the theological path leading from the alpha to the omega of life, believe in the divinisation of humanity, tearing itself away from its biological condition to rejoin God. And yet others remain in doubt, not knowing what to think. Finally, the great question of humanity could be formulated thus: "*What are we really going to make of ourselves*?"

Not wishing to go any further into this fascinating subject, which would carry us into the realm of fiction, let me keep to more down-to-earth problems.

The identification of genes allows the establishment of criteria for selecting the best genes and eliminating the others. Of course, everyone would welcome the contribution of this approach towards new diagnostic techniques, more precise genetic counselling, better medical prescriptions, and long-awaited genetic therapies. Today, although no treatments have been found for most genetic diseases, increasingly effective techniques are being developed for the prenatal diagnosis of the diseases.

Prenatal diagnosis dates back to a little over 30 years. Genetic and ultrasound techniques have helped to detect several types of embryonic or foetal anomaly, allowing parents to make informed decisions concerning the continuation or the termination of the pregnancy. At this early stage, geneticists aimed at satisfying a specific demand from parents facing a difficult situation, often struck by misfortune. In the absence of a cure for prenatally detected diseases, the possibility of terminating the birth of an affected child gradually came to be accepted. The idea behind this was to comfort the parents, allowing them to conceive and give birth to the normal children they desired.

This initial strategy underwent a change when there was a growing public demand for equal chances in life. The option of terminating a pregnancy was extended to parents considered at risk because of advanced maternal age, abnormal ultrasound findings, or unsatisfactory serum protein assays. It was less an answer to personal demands from parents than an attempt to reduce as far as possible the number of likely victims of neonatal diseases. The main affection concerned was, of course, trisomy 21.

Moving away thus from the desire of helping parents in distress, were we not switching over to an attitude that might resemble that of eugenics? This question literally preoccupied me towards the end of the 1980s as I pondered on the work of Francis Galton (1822–1911) who had coined the term "eugenics" to describe an ideology constructed on the bases of medical hypotheses. A century later, might we not be reverting to the medical sources of eugenics?

As a member of the French Parliament, I took advantage of my elected office to share my worries about the medical termination of pregnancies with fellow-legislators and members of the government. As a result, I was asked to lead a parliamentary mission of inquiry to determine whether there was any need for new legislation on the subject. However, as soon as the inquiry began I felt an instinctive reticence on the part of those interviewed. Gradually, it became clear that this reticence was rooted in History. Indeed, there is a great deal to be learnt by analysing the dangerous links that might develop between the field of politics and that of genetics. Let me present just two examples.

The first example concerns a theory formulated by the geneticist Trofim Lyssenko (1898–1976), aimed at legitimising the repressive politics of the Soviet Union in the 1930s. This theory claimed it was indispensable to discredit the "*bourgeois intellectuals*", who were often trained abroad, and replace them with the "*true sons of the soil*" who owed their careers entirely to the Soviet State and would therefore be suitably docile elements for the Communist Party.

The second example concerns the laws imposed at the beginning of the 1930s by the Nazis in Germany, aimed at preventing the transmission of hereditary defects. Prenuptial medical examinations were made compulsory, and sterilisation was prescribed in several medical conditions considered hereditary, such as congenital mental weakness, schizophrenia, maniaco-depressive psychoses, epilepsy, blindness, deafness, physical malformation and serious alcoholism. Sterilisation was also prescribed for criminals classified as hardened or dangerous, and the laws were soon applied to individuals suspected of "asocial" behaviour with a tendency to refuse social integration. During the war years, these laws were extended to people considered racially inferior, such as Gypsies and homosexuals. Another aspect of Nazi "population politics" was represented by the laws promulgated in 1935 to ensure racial purity by forbidding Germans to marry or engage in sexual relationships with Jews. The whole world now knows of the horrors that followed with the organisation of concentration camps and the Shoah – a ghastly period for humanity that some actually dared to call the "*golden age of racial biology*".

Let us not forget that it was the Second World War that taught us how cruelly Medicine, the art of healing, could be perverted to degrade the human condition. After the terrible war-time revelations, the 1947 Nuremberg Code laid down the foundations of Biomedical Ethics.

In each of these examples drawn from history, the science of genetics was evidently exploited by political forces for their own purposes. However, what may be even more significant from a semantic point of view is that the word "*genesis*" is at the origin of words such as "*gene*" and "*genome*" as well as "*genocide*" and "*eugenics*". All these words share the same roots and belong to the same family. The desire to give birth to children gifted with as many