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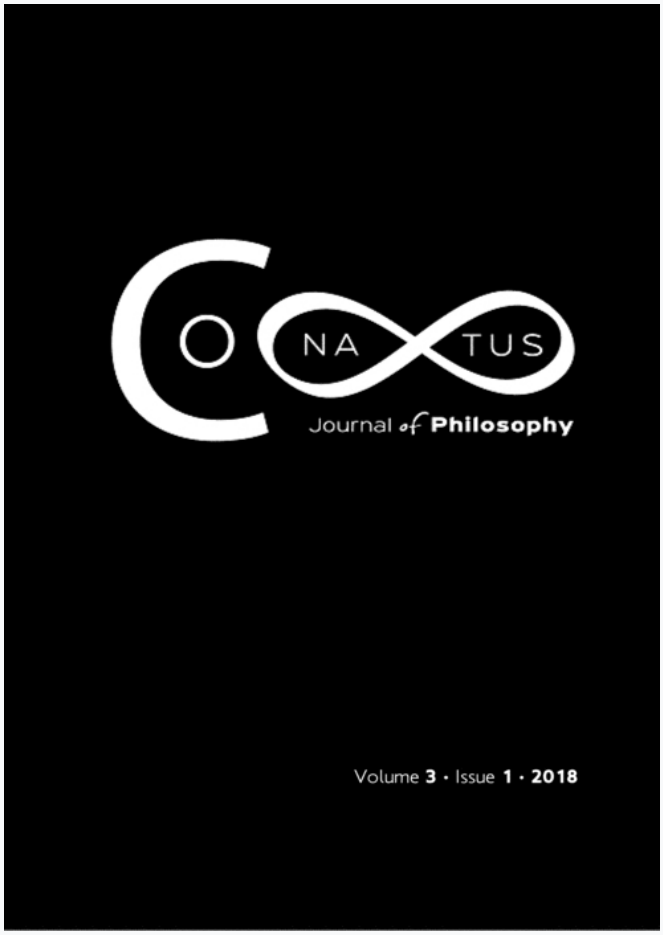

Bioethics and Hereditary Genetic Modifications

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Bioethics and Hereditary Genetic Modifications

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Abstract

Significant breakthroughs in genetic research promoted by the human genome project, advances in molecular biology and new reproductive technologies have improved the understanding and the possibility of genetic interventions as a potential medication for diseases caused by differentiated disorders, especially those that originated in irregularities in individual genes. The progress achieved in contemporary studies has created the likelihood that the man has the technical capacity to modify the genes that will be transmitted to the next generations as well. These are the so-called hereditary genetic modifications, i.e. any biomedical interventions which could be expected to transform the genome which a person could transfer to their offspring. The author analyses in this paper why even the hints of transformations of genes that will be passed on to future generations cause deep bioethical, theological, legal and political debates and controversies. He also believes that in the era of rapid strengthening of the social and technical and technological effects of science, it is very important that scientists, in their perceptions and insights, which particularly in the field of humanities, do not have the character of value beliefs, do not go below the achieved civilization standards of ethical and moral culture and to reflect on different themes with due care and awareness of the dilemmas that they can encounter in their professional work. An adequate interdisciplinary, multidisciplinary and pluriperspective approach, as well as the awareness of the essential compatibility of scientific freedom and responsibility, should ultimately result in a different and more sophisticated attitude of the scientists themselves to the possibilities of their own discipline and the significance of its effects.

Key-words: *genetics; hereditary genetic modifications; controversies; science; freedom; responsibility; bioethics; pluriperspectiveness*

Ambivalence is noticeable in almost every scientific act and every scientific result. It could be said when genetics or some other contemporary discipline is concerned that, to a significant extent, mankind as a community of a single kind of beings depends on them, or furthermore, that the fate of the planet itself, or its survival actually depend on its results. The achievements of these disciplines

facilitates development in both directions almost to the same extent: namely, the results of scientific achievements, although they primarily tend towards progress and achievement of the highest human values, at the same time, they may generate adverse, even catastrophic consequences. Herbert Marcuse, at one stage, even thought that the scientific and technical process almost completely got out of the human control, and that the dilemma whether the planet would survive or fail will be decided by pure coincidence.[1] Closer to the truth, according to the author, is the fact that despite all ambivalence, scientific achievements are still under the control of men, and that in different modes this control can be more efficient and more differentiated in the future. That is why the issue of responsibility[2] of the scientist is of crucial importance, it is a fundamental issue of their actions, and not an auspicious issue that can but needn't be linked to what is happening in the field of science. In other words, this issue must be the starting point of any scientific act, with full awareness of possible abuses and negative consequences that could follow from almost any result.[3] The lack of full awareness of responsibility can be illustrated by disproportionately high investment in scientific programs and projects that have practical application, and significantly less funds in the so-called pure science, i.e. fundamental research, or in social and humanistic sciences which do not generate immediate benefits but allow the development of science as such.

It could be also said that the original idea of science in its form of wonder[4] and curiosity is more beneficial for man than all practical discoveries that undoubtedly radically change the world and establish often an unexpected reality for man himself. The trouble is that the newly established reality can never satisfy the human nature, that the scientific and technical universe has expelled precisely that which this nature is searching for and what it feels like its original domestication. On the other hand, all technical and technological achievements with practical application are the result of purely theoretical, purely scientific research, and not of some sort of rational plan

[1] Consult H. Marcuse, *One-Dimensional Man* (London: Taylor Francis Ltd, 2002).

[2] For more details on the concept of responsibility see A. Čović, "Biotička zajednica kao temelj odgovornosti za ne-ljudska živa bića", in *Od nove medicinska etike do integrativne bioetike*, eds. A. Čović, N. Gosić, L. Tomašević (Zagreb: PERGAMENA / Hrvatsko bioetičko društvo, 2009), 33-46.

[3] Specific human questions play a major role in any scientific process, research, and experiment. Their presence certainly influences the results of contemporary sciences, including genetics. Starting from the first researches by Gregor Mendel in 1865, through the explanation of DNA molecule structure by James Watson and Francis Crick in 1953, cloning of sheep Dolly in 1997, until the project of sequencing of the human genome that was launched at the end of 1990 and the drawing up of the human genome map in 2003.

[4] About wonder as something that initiates philosophizing; Plato writes in *Theaetetus* 155d and *Philebus* 14c-e. Aristotle writes on the same topic, for example, at *On the Heavens* 294a11-28, as well as in other places (*Parts of Animals* 645a5-17. Consult H. Bonitz, *Index aristotelicus* (Vol. 5), (Berlin: Walter de Gruyter & Co., 1975), 323a45-59). On this topic, see also concluding considerations of Immanuel Kant's *Critique of Practical Reason*, http://www.kantwesley.com/ Kant/CritiqueOfPracticalReason.pdf, 199.

of the scientists themselves. The basis is the effort to discover the marvelous order in nature, and practical pretensions would only disable these great scientific ambitions.

The modern civil era is based on the logocentric and homocentric image of the world, whose meaning, on Aristotle's trail, is derived from high trust in human understanding and reason abilities. The Stagirites, moreover, emphasizes that *logos* abilities can only be attributed to people. The anthropocentricity[5] of this *Weltanschauung* is an important reason why our dominant technical civilization did not develop in harmony with nature, but much more often in opposition to it. No human act in the past was able to substantially affect the spontaneity of the existence of our planet. As much as man was changing the natural environment in which he lived, this did not leave a greater trace on Earth itself. The rapid development of technique in the last century put man in a completely new moral situation. The new situation is reflected in the fact that modern man must assume responsibility for the effects that are not the result of the actions of any individual, but represent the collective act, as Edmund Husserl would say, of an "anonymous subject". The effects of modern technique suggest a completely new situation for traditional social and humanistic sciences, since the postulate of an anthropocentric image of the world is essentially derogated in the sense that people as species are unquestionable in their existence on the Earth. Ensuring the survival of the human species in the foreseeable future is a task to whose achievement new knowledge in some of them should contribute, especially in ethics[6] or bioethics.[7] In order for this fact to be confirmed, they need to re-examine the pow-

[5] Aristotle's paragraph from the *Politics* (1256b15-22) is emphasized as a paradigm of the leading western tradition and its unquestionable anthropocentrism. The dignity of an individual is viewed from the perspective of the reasonability of one's nature, and such nature is attributed only to man. Only man is liberated from the empire of the goals, while the so-called non-human living entities related to connections and relations that exist in nature. Only man is aware of himself and is able to distance himself from himself for the benefit of higher goals, to relativize his own interests, up to self-surrendering. Consult J. Derrida and D. Wills, "The Animal That Therefore I Am (More to Follow)", *Critical Inquiry* 28, no. 2 (2002): 369-418. It gives him, as a moral being, the absolute status that establishes his indescribable dignity, which gives him the right not to be "enslaved" by anybody and being a moral being, no to be deprived of his own goals. Human dignity is often associated with Kant's second formulation of the categorical imperative (Trans Allen W. Wood): "Act so that you use humanity, as much in your own person as in the person of every other, always at the same time as end and never merely as means." I. Kant, *Groundwork for the Metaphysics of Morals* (New Haven and London: Yale University Press, 2002), 46-47.

[6] On ethics as thinking on practical thinking, i.e. as a philosophical discipline on morality see the author's paper: Ž. Kaluđerović, "Pretpostavke nastanka morala", *Bošnjačka pismohrana* (Zbornik radova Simpozija "Gdje je nestao - moral") Svezak 15, broj 42-43 (2016): 135-147, https://bnz.hr/proizvod/bosnjacka-pismohrana-2016-xx/.

[7] Fritz Jahr coined the original term Bioethics and formulated a Bioethics Imperative: "Respect every living being on principle as an end in itself and treat it, if possible, as such!" F. Jahr, "Reviewing the Ethical Relations of Humans Towards Animals and Plants", in *Fritz Jahr and the Foundations of Global Bioethics*. *The Future of Integrative Bioethics*, eds. A. Muzur, H.-M. Sass (Berlin, Münster, Wien, Zürich, London: Lit Verlag, 2012), 4. In the second edition of the *Encyclopedia of Bioethics*, Warren T. Reich defined bioethics as: "The systematic study of

er of technique, whose deeds thus acquire a philosophical sign, given the importance they have in the lives of the human species.

I.

Significant breakthroughs in genetic[8] research promoted by the mentioned human genome project, advances in molecular biology, new reproductive technologies, have improved the understanding and the possibility of genetic interventions as a potential medication for diseases caused by differentiated disorders[9], especially those caused by abnormalities in individual genes. Limitations of current medical therapies in the treatment of diseases with genetic components lead to the efforts to develop techniques for treating diseases at the molecular level by modifying the cell itself. So far, most research and clinical gene therapy[10] tools have been invested in devel-

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the moral dimensions – including moral visions, decisions, conduct and policies – of the life sciences and health care, employing a variety of ethical methodologies in an interdisciplinary setting". W. T. Reich, "Introduction", in *Encyclopedia of Bioethics*, ed. W. T. Reich (New York: Simon & Schuster Macmillan, 1995), XXI.

[8] Genetics, generally speaking, is defined as "Scientific area of biology on the *heredity and variations in living organisms*". N. Đelić, Z. Stanimirović, *Principi genetike* (Beograd: Elit Medica, 2004), 1.

[9] According to some estimates, currently several thousand different genetic diseases are known (estimates range from 5-7000). For a very small percentage of them there is an adequate testing.

[10] In a broader sense, gene therapy implies any exogenous effect on the activity of certain genes, for example the effect of thyroid hormones used in the treatment of hypothyroidism or steroidal hormones in the treatment of asthma. In the narrow sense, gene therapy implies the treatment of the disease by introducing genetic material into the target tissue of the patient. This definition includes numerous genetic manipulations such as the insertion of a cloned gene (one of the definitions of cloning and research of stem cells says: "Cloning of an organism commonly involves a technique called somatic cell nuclear transfer, where the nucleus of an egg cell (containing its genetic material) is removed and replaced with the nucleus of a somatic cell taken from the body of an adult. If the reconstructed egg cell is then stimulated successfully to divide, it may develop to the pre-implantation blastocyst stage. In reproductive cloning, the cloned blastocyst is then implanted in the uterus of a female and allowed to continue its development until birth. However, in cloning for research or therapeutic purposes, instead of being implanted in the uterus the cloned blastocyst is converted into a tissue culture to make a stem cell line for research or clinical applications". InterAcademy Partnership, "Statement Calling for a Ban on Human Reproductive Cloning", http://www.interacademies.org/13930/IAP-Statement-Calling-for-a-Ban-on-Human-Reproductive-Cloning. The most common genetic modification is directed at the disease-affected cell, but the targets of gene therapy can be healthy cells as well, for example, cells of the immune system, which would represent a form of vaccination. Regarding the purposefulness and rationality of the application of gene therapy in cases where conventional therapies are also available, it is considered that the relevant criteria for the selection of diseases for gene therapy are as follows: 1) that there is no other effective treatment, 2) that one organ is affected (primarily), 3) that there is an animal model and the success of therapy in human cells *in vitro*, 4) a safe procedure, and 5) monogenic disease with the identified genome (in regards to hereditary disorders). There are several ways to implement gene therapy. *Ex vivo* therapy implies that the target cells of the patient are isolated, genetical-

oping techniques for interventions on non-reproductive body cells. Only recently the researchers have started to announce credible successes in improving the health of patients through gene therapy, suggesting new breakthroughs in this field.

Progress in research in the modern age gives rise to the possibility that man has a technical capacity to modify the genes[11] that will be transferred to the next generation. This is about the so-called hereditary genetic modifications, or any biomedical interventions from which it could be expected to transform the genome[12] that a person can transfer to their offspring. One form of hereditary genetic modification is the treatment of embryos or reproductive cells that develop in an egg or sperm of the developing organism, and the transmission of its hereditary properties. The second form of the so-called germinal therapy is the modification of gametes (sperm or ovum cells) or the cells from which they originate. Other evolving technologies, such as the insertion of artificial chromosomes, can also induce genetic changes that can be inherited.

What are the possible explanations for the development and application of such technologies? In theory, the modification of genes that are transferable to future generations can have a number of advantages over gene therapy of somatic cells. The hereditary genetic modifications offer the possibility of preventing the inheritance of certain genetically-based illnesses within a family, instead of repeating the somatic therapy from generation to generation. Some scientists and bioethicists believe that germinal interventions are necessary from a medical point of view to prevent certain types of disorders, because there are situations in which screening and selection are not applicable, as in the case of parents with the same mutation.[13] Because germinal intervention can act at the earliest stage of human development, it also offers the potential to prevent irreversible damage that can be associated with defective genes before they occur. Over a long period of time, germinal gene modifications can be used to reduce the occurrence of certain hereditary diseases in the human gene pool

ly modified, and then returned to the patient. In *In-situ* therapy, the therapeutic gene is inserted into the localized and accessible part of the body (for example, in melanoma of the skin) along with the vector. *In vivo* therapy means that the therapeutic gene is inserted directly into the body (in the circulation, in the liver, muscles, lungs ...). Data is from I. Novaković, "Tehnologija rekombinovane DNK i genetičko inženjerstvo. Testovi hibridizacije, molekularna citogenetika, PCR", 11-13, http://www.mfub.bg.ac.rs/dotAsset/37433.pdf.

[11] Genetic modification, in its broadest sense, implies any alteration in genes, potentially by recombination of inherited parent genes, and is obtained by combination of parent organisms, hybridization during the process of breeding and selection of organisms. Genome changes can be also changes in the number of chromozomes, or larger changes in genetic makeup, obtained by cytogenetics techniques. Genetic modification can occur at a gene level, or at the level of a smaller group of genes, by techniques of molecular genetics, i.e. genetic engineering.

[12] The genome is a set of hereditary factors or genes that are found only in one set of chromosomes. Consult: D. Marinković, N. Tucić, and V. Kekić, *Genetika* (Beograd: Naučna knjiga, 1985), 21.

[13] See B. K. Zimmerman, "Human Germ Line Therapy: The Case for Its Development and Use", *The Journal of Medicine and Philosophy* 16, no. 6 (1991): 597.

that cause great suffering and problems.

Attempts to modify the genes which will be transmitted to future generations, cause profound bioethical, theological, legal and political dilemmas because of the possible change in the fundamental characteristics of our descendants. These techniques can give mankind extraordinary control over the biological properties and personality characteristics that are today considered as essentially human.[14] Scientists and (bio)ethicists pay attention to hereditary genetic interventions in humans, especially in the last four and a half decades. Already in 1972, several scientists warned that future gene therapy of somatic cells would imply the risk of unintentional change of germ cells as well as of target somatic cells. With the current gene addition technology, iatrogenic genetic damages can occur as a result of unintended germinative side effects of somatic cell therapy. These problems are at least as great as the consequences of genetic damage that might arise from the intended germinal transfers. Therefore, attention must also be paid to the accompanying or side effects of somatic cell therapy, as well as to those that are currently being planned.[15]

What are the intrinsic considerations, i.e. the bioethical aspects that must be considered before possibly starting with hereditary genetic modifications? First of all, it is necessary to ask oneself if there are fundamental reasons for such interventions, i.e. whether they are in principle morally permissible. Secondly, we need to examine the social dimension and the moral action or the impact that these technologies can have on human society.

Some analysts claim that human genes have specific significance and value because, biologically speaking, they are essential for the existence of mankind. Others argue that genes make it possible to distinguish people from one another as individuals, and that they are the core of humanity. On the basis of these views, conclusions are drawn that genes deserve a special status that preexcludes germinal intervention in order to modify them.[16] But even if it is recognized that human genes have extraor-

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[14] Consult C. F. von Weizsäcker, *Die Verantwortung der Wissenschaft im Atomzeitalter* (Göttingen: Vandenhoeck & Ruprecht, 1986).

[15] In addition to significant technical constraints, gene therapy implies the problems related to adverse effects that can occur due to the handling of hereditary material. Possibly, the viral vector may cause severe and even lethal infections in the patient, as was the case with a young man who received gene therapy due to ornithine transcarbamylase deficiency (1999). Also, the insertion of foreign DNA can trigger carcinogenesis processes, which is in practice recorded by malignant disease in several cases. It is generally believed that the best prospects for the application of gene therapy are in malignant diseases, and the majority of the most tested gene therapy protocols in humans so far is related to the treatment of malignant diseases (about 69%), followed by the treatment of monogenic diseases such as cystic fibrosis, Duchenne muscle dystrophy, ADA deficiency, haemophilia (17%) and the treatment of infectious diseases, primarily AIDS (12%). See I. Novaković "Tehnologija rekombinovane DNK i genetičko inženjerstvo. Testovi hibridizacije, molekularna citogenetika, PCR", 14, http://www.mfub.bg.ac.rs/dotAsset/37433.pdf.

[16] Consult A. R. Chapman, *Unprecedented Choices: Religious Ethics at the Frontiers of Science* (Minneapolis: Fortress, 1999), 153-156.

dinary significance and value, this does not have to be an argument for *a priori* rejection of all studies on hereditary genetic modifications. The genes, as well as other parts of the human body, have a derived value and significance, and only through human thinking discourses[17] they gain their specific status, which should not be inviolable and untouchable in an almost religious sense. By contrast, precisely because genes have such a great significance for action in human beings, it is also bioethically important that they perform their function in the most appropriate way. Moreover, it can be argued that if there is a technical possibility in this direction, without serious damage to human well-being and the values that dominate the human society, people are almost obliged to repair genes both in current and future generations.[18]

It is also noted that future generations have the right to inherit an unmodified human gene base because the gene pool represents their "genetic heritage", resources or wealth to which all people are equally entitled as to the "common heritage" of the human species. An additional assertion, e.g. in the resolution of the Parliamentary Assembly of the Council of Europe, is that individuals have the right to genetic heritage that has not been artificially modified, except in circumstances that are recognized as compatible with full respect for human rights.[19] Though they sound quite acceptable, these views can be challenged as well. Strictly speaking, while individual humans have germinative cells and their genus, the human species has no "germinative line" in the genealogical sense of the word. Human gene pool is also a kind of heuristic abstraction, not a natural thing, because the reference material in nature is

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[17] See W. Heisenberg, *Physics and Beyond* (New York, Evanston, and London: Harper & Row, Publishers, 1971), XVII.

[18] The argument that genetic modification of an organism is impersmissible from the bioethical point of view since it is in opposition to the natural flow of things, i.e. because it is unnatural, should be additionally problematized. Namely, to (self)understanding of the essence of man belongs the feeling or image of a kind of the sundering of the direct i.e. natural existence of man, which makes man in its own perspective a unique event in the world, because his existence is represented to him as un-natural, artificial, modifiable, as second-nature or the highest point of the continuity of nature. In other words, spiritual existence of man may be understood as the highest step of his natural existence (or nature in general), or as a walkaway from natural existence. Hence, to say that something is un-natural does not mean nor imply that it immanently bears a negative axiological sign.

[19] "Recommendation 934 on Genetic Engineering", adopted on 26 Jan. 1982, in *Texts Adopted by the Assembly*, 33rd Ordinary Session, Third part, January 25-29, 1982 (Strasbourg: the Council of Europe, 1982). Article 1 of the "Universal Declaration of Human Rights" from 1948 states: "All human beings are born free and equal in dignity and rights", http://www.un.org/en/universal-declaration-human-rights/. And in Article 23 of the "Constitution of the Republic of Serbia" the constitution-maker states: "Human dignity is inviolable and everyone is obliged to respect and protect it" ("Ustav Republike Srbije", Beograd: Kanc. za sarad. s med. Vlade Republike Srbije, 2006), 9. This is not only an ontological statement, but at the same time a source of the law and therefore Article 3 of the Constitution stipulates: "Rule of law is a fundamental prerequisite for the Constitution which is based on inalienable human right". Consult "Ustav Republike Srbije" (Beograd: Kanc. za sarad. s med. Vlade Republike Srbije, 2006), 4.

missing. Individuals simply inherit a specific set of genes derived from their parents. Therefore, from the biomedical perspective, there is no intergenerational "human germination line" that can serve as a backbone and an important factor for the future of the human race.

Since it is important to ensure that future generations have open access to the benefits of genetic research, it is conceptually wrong to interpret the human gene pool as a "gift" accumulated by wise investment during natural selection, and which can be controlled and managed by people today. The evolution process that controls the allelic[20] content of the human gene pool is not something that can be managed or controlled. The human gene pool is not fixed and constant, but in a constant flow throughout the human history.

Other analysts believe that, in principle, it should not been allowed to change the genetic appearance of future individuals through germinative interventions, because their approval can not be obtained, that is, consent.[21] Of course, this is the so-called intergenerational ethics,[22] where it is not easy to determine the nature and the basis of the obligations that the present generations have towards the future generations. The responsibility of preserving the interests of future generations as such is undoubtedly the responsibility of present men, but the question is whether this obligation should completely stop researching hereditary genetic modifications. The obligation to take the offspring into consideration can also be expressed as an obligation to provide a better life for the offspring, which may include the elimination of harmful genes and the subsequent improvement of the health perspective of future generations.

A special aspect of the impact of hereditary genetic modifications on the community which to be emphasized is the segment concerning the equality and justice[23] of people. Well-off citizens could, besides providing their children with the best economic, social and many other prerequisites provide them the best "nature" as well. The material advantage of a small number of people would thus be capitalized in the

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[20] Different forms of the existence of one gene are called alleles of that gene. See V. Diklić, M. Kosanović, J. Nikoliš, and S. Dukić, *Biologija sa humanom genetikom* (Beograd: Grafopan, 2001), 231.

[21] Consult M. Lappé, "Ethical Issues in Manipulating the Human Germ Line," *The Journal of Medicine and Philosophy* 16, no. 6 (1991): 621-639.

[22] On rights of future people *vis-à-vis* presently living people see more in *Stanford Encyclopedia of Philosophy*, https://plato.stanford.edu/entries/justice-intergenerational/.

[23] Literature on both philosophy and law mentions numerous types of justice, including anamnetic, distributive, economic, egalitarian, formal, global, civil, international, intergenerational, corrective, commutative, cosmopolitan, compensatory, criminal, procedural, spatial, political, retributive, distributive, restorative, reparative, world, substantive, social, transitional, legal, women's, etc. About certain aspects of justice, consult the author's books: Ž. Kaluđerović, *Presokratsko razumevanje pravde* (Sremski Karlovci-Novi Sad: I. k. Z. Stojanovića, 2013); Ž. Kaluđerović, *Helensko poimanje pravde* (Sremski Karlovci-Novi Sad: I. k. Z. Stojanovića, 2010).

genetically better offspring, which would further deepen the gap between people and create a dangerous dimension of "natural" inequality among people.[24] This only indicates how much care should be taken in the course of potential development of hereditary genetic modifications and even more with their possible use. A commutative form of justice in health in many, even in some highly developed countries has not been implemented in practice or is still at a declarative level[25], which could, hypothetically, lead to more frequent use of new technology by highly educated and well-off people. This, accompanied by the so called racial point, namely possibly the more widely spread use of hereditary genetic modifications by one race, could make *hiatus* among humans in genetic matters as well, and lead to potentially very dangerous social and political consequences in some countries, as well as at the international level. The hereditary genetic modifications can also increase prejudice towards people with special needs, which additionally points to care, caution and careful control, because prejudices[26] are already difficult and slow to change.

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[24] This gap is inspired by various quasi-scientific theses about the intrinsic superiority of the rich and inferiority of the poor. Intelligence test (IQ test) e.g. was originally established as a way of discrimination between "capable" and "incompetent" people. The assumption was that intelligence is an innate genetic quality, so the early version of this test accordingly overlooked the impact of education. As a consequence, an inaccurate conclusion was drawn that poorer people have a lower intelligence coefficient than the rich. A well-known representative of this thesis and the founder of the first department for human genetics in the world was Francis Galton. See F. Galton, *Hereditary Genius* (Honolulu, Hawaii: University Press of the Pacific, 2001).

[25] Official formulations are completely acceptable. According to Article 20 of the "Health Care Law" of the Republic of Serbia: "The principle of equity of health care shall be realized by the ban on discrimination while providing health care on the grounds of race, sex, age, national affiliation, social origin, religious beliefs, political or other affiliations, income scale, culture, language, kind of disease, mental or bodily disability." Consult "Zakon o zdravstvenoj zaštiti", https://www.paragraf.rs/propisi/zakon_o_zdravstvenoj_zastiti.html.

[26] The word "prejudice" should be here understood in line with its etymology: "pre-judgement", therefore something that precedes the judgement. Even today, when scientists and philosophers make significant efforts to clarify certain things, they do so in environments where many prejudices are already present. However, the nature of the scientific opinion is that it is not led by existing prejudices, but explores them, critically reviews and replaces them with explanatory clarifications and an adequate understanding. Many US federal states passed laws that stipulated imprisonment and/or sterilization for the so-called inferior categories of population. The inferior categories of the population ment mentally ill, people with low intelligence coefficient and criminals. How much prejudices have gained momentum is illustrated by the fact that in some countries the notion of inferiority was understood even more broadly, so it included both homosexuals and communists. Overall, during the 1930s, approximately 20,000 people were sterilized in the United States. The negative eugenics culminated in extensive sterilization procedures carried out in Nazi Germany. Through such acts, from 1934 to 1945, some 400,000 "genetically vulnerable" people were forcibly sterilized, according to an appropriate law on the protection of descendants from hereditary diseases. Of course, this number does not include thousands of Jews, Roma and other victims who were unlawfully sterilized in concentration camps during the war. Finally, about 200,000 people on the European soil were "eliminated" as a result of Operation T4 ("euthanasia") and its consequences between 1939 and the end of the Second World War. See https://www.britannica.com/event/T4-Program.

The problem that may arise in regards to the germinative manipulation in humans can result in acceleration of tendencies for the commercialization of children's gender as well, even children as a whole, and their assessment according to appropriate quality standards, no matter how harsh and unacceptably this phrase sounds. Given the increasing tendency for patients to be treated as consumers of certain services and the ever-present idea of the economic justification of certain treatments, this danger is increasingly present.

Bioethicists also express concern that the advancement technology may lead to the imposition of a harmful or distorted perception of normality and alongside of that what constitutes an improvement in human characteristics.[27] Therefore, for some it is dangerous to define a normal human genome uniformly, since thus all deviations from the normal sequence will be considered abnormal and undesirable. Problems also exist due to different cultural and social paradigms in some countries, for which subsequently there could be attempts to impose them to other countries and nations.

The author is at the standing point that the use of hereditary genetic modifications for preventive purposes and for the treatment of clearly indicated diseases in future generations does not necessarily lead directly to eugenics, but that strong measures are needed to ensure that the entire activity at some point does not turn into a tendency towards improvement of human traits.[28] If hereditary genetic modifications are used at all, they should be used exclusively for therapeutic purposes, and only when other treatment options do not give specific adequate results.[29] Of course, there will always be a risk that the development of applications to correct the defective alleles will be, due to the same nature or similarity of the technology, transformed into a seemingly hard to notice improvement of someone's characteristics. For example, the ability to correct genes that are responsible for the development of Alzheimer's disease can at the same time mean the ability to improve someone's memory.[30]

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[27] There are theses that, in the absence of an objective and unique definition of a "normal" state, the meaning of what is considered normal will be highly variable and fluid, which would not be a surprise given the skeptical and relativistic spirit of the epoch. The result of such processes may be that what now seems to be radical and unacceptable could become quite acceptable in the near future.

[28] It is recommendable to favor basic studies at the cellular and animal levels that concern the consequence of germinative modifications. This is consistent with a long tradition of scientific freedom and reflects the understanding that the prevention of such research can deprive the humanity of unexpected discoveries that can inform or make progress in other areas of medical research, as well as in the research concerning hereditary genetic modifications.

[29] There is interesting information that appeared in the media at the end of 2017. Namely, for the first time, scientists have tried to alter a gene in the human body in order to permanently alter this person's DNA and thus cure the disease. Brian Madeux (age 44), who is suffering from a metabolic disorder called Hunter's syndrome, intravenously received billions of copies of the corrective gene and a genetic tool that needs to cut his DNA in a precisely defined place. See https://www.apnews.com/4ae98919b52e43d8a8960e0e260feb0a.

[30] Hereditary genetic modifications, however, do not represent neither close nor real medi-

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It is not to be expected, however, that scientists will abandon their projects because of the potential dangers of future inventions, nor are things so black that Peter Sloterdijk should be followed in the conclusion that anything that anyone does today in the space that is under the influence of technical advancement, has been put into the function of general military strategies, including, according to him, the technological progress itself.[31]

The process of spreading scientific and technical achievements is an anthropological phenomenon that is difficult to stop, because it is considered to be the ontological determinant of the modern man. The society truly has a complex task to balance between the scientific freedom of research and the responsibility of preserving social norms and social values.[32] "Scientific freedom ... is an acquired right, generally approved by society as necessary for the advancement of knowledge from which society may benefit." But "scientific freedom and responsibility are basically inseparable."[33]

The usual behavior of a typical scientist, especially in natural and technical sciences, until recently was characterized by simplified utilitarian reasoning and scientific reductionism, thinking and decision making on science in its narrowest part, excluding

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cal or scientific problem for most of African, and not only African, developing states, since they have to deal with more important health issues. A confirmation of this thesis can also be obtained by a brief insight into the official statistics of the United Nations Organization. According to them, the leading causes of child mortality in developing countries are the following diseases: pneumonia, diarrhea, malaria and varicella (all illnesses that can therefore be relatively easily prevented by the elementary improvement of basic health care). Annually, from over 470,000 people die from malaria in the world, out of which about 80% are in seventeen mainly African countries. In 2013, over 140,000 children, mostly under five years of age, died of varicella. In the same year, less than 1.5 million people died from tuberculosis, while the number of AIDS fatalities was also around 1.5 million people. Finally, nearly six million children under five years of age die annually from various diseases that can be cured. The UN's official data was taken from *The Millennium Development Goals Report 2015*, http://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20(July%201).pdf.

[31] See P. Sloterdijk, *Critique of Cynical Reason* (Minneapolis London: University of Minnesota Press, 2001).

[32] Article 12b "Universal Declaration on the Human Genome and Human Rights" reads: "Freedom of research, which is necessary for the progress of knowledge, is part of freedom of thought. The applications of research, including applications in biology, genetics and medicine, concerning the human genome, shall seek to offer relief from suffering and improve the health of individuals and humankind as a whole." Consult "Universal Declaration on the Human Genome and Human Rights", http://unesdoc.unesco.org/images/0012/001229/122990eo.pdf.

[33] See AAAS Committee on Scientific Freedom and Responsibility, *Scientific Freedom and Responsibility* (Washington, DC: American Association for the Advancement of Science, 1975), 5, https://www.aaas.org/sites/default/files/SRHRL/PDF/1975-ScientificFreedomResponsibility.pdf.

or faintly mentioning the cooperation between different areas and the compatibility of their methods. Fortunately, there are more and more scientists who change the original attitude and it can also be said due to the holistic approach of certain social and humanistic sciences, and they begin to look at problems more comprehensively, taking into account knowledge from multiple disciplines when making conclusions on the use or non-use of certain methodology and technique. The smallest common denominator of all people should, or in fact, would have to be the attitude of Hans Jonas that "we should not compromise the conditions for an indefinite continuation of humanity on earth."[34]

The existing largely heteronomous prohibitions, although necessary, are not sufficient if the scientists themselves do not develop the awareness that they should follow the general humanistic moral principles and principles of scientific criticality. In complex times of strengthening social and technical and technological effects of science, it is necessary to (bio)ethically codify the issue of social responsibility of scientists, which because of its adequate internalization must be an integral part of their *paideia* from the earliest days. It is very important that scientists and philosophers in their conclusions and insights which, especially in humanities, often have the character of value beliefs, do not go below the achieved civilization standards of ethical and moral culture, and that they consider various topics with due care and awareness of the dilemmas that can be encountered in their professional work. An appropriate interdisciplinary, multidisciplinary, transdisciplinary and pluriperspective approach should ultimately result in a more delicate and responsible attitude of the scientists themselves towards the possibilities of their own scientific discipline and the significance of its effects.

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[34] Consult H. Jonas, *Princip odgovornosti* (Sarajevo: Veselin Masleša, 1990), 28.

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