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Post-Darwinian Biology

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Abstract: *Systems biology and synthetic biology are interdisciplinary scientific approaches developed to improve the ability to understand, predict and control living systems. Both scientific areas capitalize on the production of large-scale data, both in the field of genomics and in a number of related fields, exploring new ways of cross-fertilization - starting both from traditional knowledge in biology - especially from the evolutionary one - articulated together with a series of theories and models coming from sciences such as physics, computer science, mathematics, chemistry and engineering. Systems biology represents a predominantly cognitive scientific approach, while synthetic biology privileges the technical and technological approach, aiming at the creation of living systems, starting from existing biological material and its derivation, or even from non-biological materials, grafted onto living systems. The two approaches capitalize on epistemological orientations based on knowledge versus those based on applications, in other words on analysis versus synthesis as epistemic orientations. Philosophers of science, who examine technological research as a form of human practice, have argued for interdependence, but without a perfect overlap between understanding the functioning of a living system and designing a synthetic one, a distinction between basic and applied science being impossible in the context of biology synthetic.*

Keywords: *synthetic biology; post-Darwinian biology; systems biology.*

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1. Introduction

Systems biology and synthetic biology are interdisciplinary scientific approaches developed to improve the ability to understand, predict and control living systems. Both scientific areas capitalize on the production of large-scale data, both in the field of genomics and in a number of related fields, exploring new ways of cross-fertilization - starting both from traditional knowledge in biology - especially from the evolutionary one - articulated together with a series of theories and models coming from sciences such as physics, computer science, mathematics, chemistry and engineering (Green, 2014, as cited in Zalta, 2017).

Systems biology represents a predominantly cognitive scientific approach, while synthetic biology privileges the technical and technological approach, aiming at the creation of living systems, starting from existing biological material and its derivation, or even from non-biological materials, grafted onto living systems. The two approaches capitalize on epistemological orientations based on knowledge versus those based on applications, in other words on analysis versus synthesis as epistemic orientations. Philosophers of science, who examine technological research as a form of human practice, have supported interdependence (Kastenhofer, 2013), but without there being a perfect overlap between understanding the functioning of a living system and designing a synthetic one, a distinction between basic science and the applied, in the context of synthetic biology (Green, 2014, as cited in Zalta, 2017) is being impossible.

Techno-optimists argue that synthetic biology is developing a number of highly promising applications in terms of global human needs, such as the eradication of poverty and hunger, the development of public health programs, including the creation of vaccines that can rapidly respond to pandemic threats - as was the case with the mRNA technology used in the production of the anti-Covid-19 vaccine -, increasing the accessibility of vulnerable populations to various innovative therapies, thanks to the synthesis of active substances through technologies specific to synthetic biology and, thus, reducing inequalities in access to health services, but also to goods and services, with the condition of maximizing the responsibility of researchers, both for the immediate results of their own research and for the legacy that future generations will receive (Sandu, & Caras, 2013). These expectations have been justified (Brooks & Alper, 2021), with advances in recent years demonstrating the ability of synthetic biology to revolutionize technology, creating applications in seemingly divergent fields such as biocomputing (Grozinger et al., 2019) - the creation of biological circuits used in data processing -, the creation of living materials and electronic interfaces between computational technologies and living systems (Kumar et al., 2017), biorefining (Liu et al., 2020), therapeutic applications aimed at inducing metabolic changes in the metabolism of some microorganisms or even some plants or animals, to generate a series of substances with economic or therapeutic value (Cravens, Payne, & Smolke, 2019). Last but not least, we mention the genetic editing technology (Doudna, 2020), CRISPR, whose use on human embryos (Huidu, 2017) can eliminate genetic defects that lead to an increased risk of diseases such as cancer, diabetes, etc., but can also induce behavioral changes – including moral bioenhancement (Persson & Săvulescu, 2014).

One of the most important goals of synthetic biology, found as such in the research of Craig Venter (Venter, n.d.), is the creation of artificial life and, by extension from this goal, the design of "living technology" (Bedau, 2009) applied on a macro scale. Combined with 3D printer technology, it is hoped to obtain synthetic tissues - including organs capable of functioning independently inside organisms (including humans), thus creating organs for transplantation based on cell culture and 3D printing, and eventually, the creation of macrocellular organisms - originally by 3D printing of some tissues, starting from the reconstruction of the existing molecular structure in databases, tissues that once created become viable and later capable of reproduction (Steen et al., 2008), giving birth to living organs or organisms.

Salthe, introducing the concept of post-Darwinian biology, shows that "development, not evolution, could be considered the central theoretical framework of biology" (Salthe, 1993). The term post-Darwinism has a relatively long history in the field of biology, as a critical theory to the idea of the evolution of species, being especially used by the structuralist current in biology.

2. The structuralist theory of species development

The criticism brought to the idea of the evolution of species - in a structuralist key - does not aim at a creationist alternative, but, rather, calls into question the strictly functionalist perspective of Darwin's theory, according to which the most adapted specimen survives. From a structuralist perspective, survival represents a development, an increase in the complexity of the system - which is the element that leads to a real evolution of species. The primary forms of unicellular or even simple multicellular organisms are still present in nature - whether we are talking of bacteria, algae, coelenterates, etc. However, as time passes, the food chain becomes increasingly rich, increased levels of complexity are added as new species appear, *homo sapiens* being considered the most evolved living being, without being, however, from a strictly biological point of view, also the most adapted to the environment in which it lives. On the contrary, we could say, the human species adapts its environment to its own needs, refusing to adapt itself to the environment. Basically, we are talking about evolution *stricto senso* in the Darwinian manner, as long as there is no minimal semiosis, through which a species adapts its environment to its own needs even to a very small extent. We are talking about signs of intelligence in species that, on the so-called evolutionary scale, are not placed very high - as in the case of those who make their nest, bringing not only grass or feathers to make it as warm as possible, but also introducing decorative elements, as in the case of the monkey striking the nut against the stone, in order to break it, or of the crow throwing it from a height, for the same purpose. We are talking here not only of a simple adaptation to the environment, but of an adaptation of the environment to the needs of the respective individuals.

The more developed the elements of intelligence, the greater the complexity of the evolutionary processes involved; we are talking about a development and not just a simple evolution, in the sense of random mutations followed by natural selection. As long as there are learning processes and an intergenerational transmission of practices such as feeding or learning routes from the feeding place to the hive/nest/burrow, the mentioned pre-semiotic elements bring evolutionary advantages that make the species better positioned in the food chain, despite the relative biological inadequacy. As far as the human species is concerned, it was intelligence that placed it not only at the top of the food chain, but also in a position where it threatens the extinction of some/many species and major ecological imbalances, making nature unable to cope in adapting to human needs and thus, slowly, the natural areas disappear.

Post-Darwinian models of understanding natural development instead of the classical idea of natural selection establish a series of principles for a biology alternative to the Darwinian *mainstream*, starting from a different view of morphology and taxonomy. Webster believes that a reply to evolutionary theory should consider a theory of transformations. Natural history would no longer be so significant for understanding the transformation of species, as long as they do not actually evolve, but only develop, in the sense of increasing the systemic complexity of the organisms that compose them.

From the point of view of a postmodern philosophical vision, the theory of the evolution of species is criticizable, as it is based on a presupposition - that the development of complexity has an evolutionary meaning, that is, one from lower to higher. The evolution from inferior to superior is criticized in postmodern philosophy, especially from the perspective of the refusal of dialectics, of the idea that simple quantitative accumulation leads to a qualitative leap. The idea of endless progress is one of the specific metanarratives of modernity, and therefore Darwin himself uncritically takes up the idea of progress, assuming that between the first living organisms and the most evolved ones in the food chain, there are qualitative differences, the transition from one species to another being achieved through an evolutionary leap. However, if the principle of survival of the fittest were universal, qualitative leaps would lead to the elimination of older and, as such, less adapted species. This, however, is not true in nature, much older species - of reptiles, for example - coexist with mammals, theoretically superior in evolution, but practically not necessarily more adapted to the environment than the former. The disappearance of large reptiles in the Quaternary gave a chance to small mammals, but also small reptiles, birds, to climb the food chain, but the disappearance of dinosaurs and the survival of mammals is not related to their adaptation to the environment, but to a geoclimatic accident, probably due to the impact of an asteroid with the earth. Small reptiles and mammals have accidentally reached an adaptive advantage, precisely because of their size that allowed them to survive with a much smaller amount of food, with a much more efficient dosage of energy.

Even in the absence of evolutionary accidents - such as the one related to the disappearance of the dinosaurs -, natural selection cannot be thought of in a qualitative sense, since we cannot create quality standards in terms of adaptation to the environment, as long as in the same ecosystem, symbiotically and complementary, species completely different from each other work, symbiosis without which the so-called more evolved organisms could not survive. We exemplify here the elements of symbiosis existing in the human body, correlated with the intestinal flora - without which the digestive processes would not be possible. We also exemplify the same idea through the process of pollination – without which most plant species would disappear, their adaptation to the environment including the process of pollination by another species from a completely different kingdom.

3. Intelligent design theory

A second direction critical to the theory of evolution of species, also not accepted by the mainstream of biology, but with important meanings from a philosophical point of view, is the theory of intelligent design. This theory is part of the so-called scientific creationism, often considered as pseudoscience, but is embraced by a large number of people who refuse to accept the theories of modern science, and especially the fact that the universe and life itself do not have a Creator, namely that everything that surrounds us - although of a complexity almost impossible to understand in its true dimension - is the result of chance. Unlike traditional, religiously inspired creationism, which remains faithful to the dogma of creation described in the Bible – *ex nihilo*, in seven days, etc. -, the so-called scientific creationism accepts a series of evolutionary elements both at the level of the universe itself, and at the level of the living world, but these evolutions are the result of a conscious project and the intervention of a transphysical Force of divine origin.

The advocates of this theory consider as unacceptable, even from the perspective of the theory of probabilities, the existence of a diversity of species with a level of complexity such as that of the human species, but also of animals, which appear absolutely by chance and develop only in a strictly evolutionary manner (Helgen, 2004).

The theory of intelligent design was born in 1966, being presented by Michael Behe in *Darwin's Black Box* (1996). Most of the scientific literature developed around the subject is not based on a philosophical dispute brought to Michael Behe's arguments, which center around the improbability of the emergence of a biochemical complexity of the level of that existing in advanced biological systems. The scientific world is generally satisfied with criticizing this theory - especially from anti-religious ideological positions, drawing attention to the fact that the penetration of this theory into the academic world is particularly dangerous, as it would legitimize the teaching of creationism in public schools (Aviezer, 2010).

The creationism-evolutionism dispute is fundamentally rejected on a scientific level, as it undermines the very foundations of modern science, its fundamental assumption being that everything in nature can be explained without the need for the intervention of a supernatural force. The theory of intelligent design is rejected as such, without being epistemologically or even philosophically counterargued, as scientifically unacceptable. This leads us to the idea of science as a power game in the manner presented by Foucault (2001). The ideologization of the "scientist" makes the philosophical dialogue between science and religion as forms of knowledge to be difficult, as long as modern science confiscates the discourse about truth and refuses approaches such as the theory of intelligent design, without rejecting them with arguments, imputing from the beginning that they do not respect " the new dogma of science" - that there is no God. When Behe's argument centers on the improbability of life arising by random biochemical processes from prebiotic organic or even inorganic substances, the theme is derided—as having political implications.

Synthetic biology's claim to produce living organisms from prebiotic substances seems to invalidate intelligent design in terms of the argument used by its proponents regarding the improbability of life arising from prebiotic substances randomly. However, *per contrario*, if synthetic biology obtains symbiotic entities starting exclusively from prebiotic materials through strategies of combining molecules in the form of DNA structures, this brings arguments precisely to the followers of the theory of intelligent design, namely the fact that, in order to reach the level of complexity required in combining molecules in the form of nucleotides requires enormous computing power and combining rules that, in the absence of intelligent design, become even more improbable as one realizes the enormous computing power required to design a live system with a simplified genome.

Basically, in order to generate a living structure, even with a simplified genome, it was necessary to decode the DNA and explain the functions that the various DNA sequences carry out. Awareness of the level of complexity makes, at least at the level of common sense, the very idea of intelligent design even more credible. In his argument for intelligent design, Behe does not assert that a high level of biochemical complexity cannot arise through gradual evolution over long periods of time, as Darwin's theory asserts, but rather that it is possible for a large number of substances, but certain evolutionary leaps are not only improbable, but even impossible, in his opinion. Behe speaks of an irreducible complexity.

According to Darwin's theory, only those mutations that are favorable for survival are genetically transmitted to the next generations. Behe notes that "a mutation that confers no survival advantage is unlikely to be passed on to the next generation" (Behe, 1996). The gradual accumulation of favorable mutations cannot, in the view of the founder of the theory of intelligent design, explain the development of many vital biochemical mechanisms. As an example, it gives the mechanism of blood clotting. A large number of chemical reactions are required to occur simultaneously for the coagulation process to occur. It must occur simultaneously and not successively, and in the absence of any of these reactions, coagulation does not occur. It is impossible to explain from an evolutionary point of view the emergence of all these mechanisms by simple disparate genetic jumps, in the form of accidents or mutations, because they would not appear simultaneously, but successively. But if they appeared successively, they would not be transmitted to succeeding generations, since none of the necessary mutations, separately, would be favorable to survival, but only when they occur together.

This theory is rejected, considering that all the necessary mutations can occur randomly throughout evolution and can be preserved in DNA so that at a certain time a new mutation generates a new process that combines all the previous processes, starting from the random activation of the genes necessary to generate each particular process (Aviezer, 2010). Accepting or rejecting the theory of intelligent design is beyond the scope of this paper, as we do not intend to question the validity of the Darwinian theory or its competing theories. Philosophically, we find that science, as classically conceived, requires the existence of only one valid theory to explain a class of phenomena, and there can be no competing theories. As long as the theory of the evolution of species is the dominant theory in biology, evolutionary biology will represent the scientific foundation on the basis of which we are offered explanations of the origin and development of life. However, we note that the rejections of the theory of intelligent design do not make it implausible, but simply argue that it is not impossible for the evolution towards complexity to be based on random mutations, and as such the theory of intelligent design as formulated by Behe cannot overthrew Darwin's theory of the evolution of species from its position as dominant theory. When, in public debates, the question of presenting both theories - both the evolutionary one and the one of intelligent design - was raised, traditionalist epistemologists vehemently rejected this possibility, since in science there must necessarily be only one explanation - and it can be rejected only when it is irrefutably proven wrong, and only by replacing it with another theory of superior explanatory power.

4. The postmodern perspective of posttruth

From a Foucauldian perspective, we find here a "codification of power" necessary to maintain the coherence of the respective scientific field. If alternative theories were simultaneously exposed as having a high degree of plausibility, parallel scientific lines would have to develop for each of the theories and, at some point, the necessary coherence to develop a technology starting from that science would no longer exist.

Postmodern philosophers of science (Kuntz, 2012) attack the traditional scientific view of the world and undermine the "truths of science", starting precisely from challenging the theoretical imperialism of some of the theoretical constructions that underpin the *mainstream* - such as the Darwinian theory. The scientific view is by definition rationalistic, assuming absolute objectivity on nature in the case of the physical sciences, on life in the case of the biological sciences, or on the social world in the case of social sciences. The world consists exclusively of real objects, which behave according to natural laws, which can be known and whose understanding allows the explanation of the whole world. It is precisely this reification of the world that generates the epistemic imperialism of some of the theories, due to their claim to store absolute truth. The objection of the postmodern philosophers of science shows that, regardless of the degree of plausibility of a theory, it cannot store the claim of absolute truth, but only a certain degree of verisimilitude. A postmodern epistemologist would argue that evolutionary theory is now credited with a higher degree of confidence than intelligent design, and as such more plausible. This epistemology excludes absolute truth from science, leaving room for the possibility of contesting some theories. This paradigmatic mutation takes the form of post-truth ideology.

The post-truth ideology mainly targets public policies – in thus case, science policies are centered on the tolerance of "alternative truths". This tolerance is based on the deconstruction of the idea of a single truth in all branches of cultural, social or political life. This paradigm (Bufacchi, 2020) leads to the emergence of a new form of science, which does not submit to a single theoretical perspective and which emphasizes the applied side of technological research rather than the theoretical one. Hence, the postmodern character of synthetic biology, which refuses a unifying theory, assumes explanatory claims on life itself, not through discoveries of a theoretical nature, but through its pragmatic reconstruction.

5. The post-Darwinian nature of synthetic biology

Returning to synthetic biology, its post-Darwinian nature is based on human intentionality and artificial design to create new species. By biosynthetic design, these species have a purpose in nature – to manage or produce substances necessary primarily for the human species, and only secondarily for the maintenance of biodiversity. If theories of *intelligent design* envisage a Creator external to known ecosystems, synthetic biology expressly introduces elements of intelligent design – more specifically, species engineering. The conscious project in synthetic biology has a non-evolutionary purpose, since the good of the created species is not pursued, but of another species - the human one - or of an ecosystem in the broadest case, regardless of the own good of the created species. Of course, from an ecoethical perspective, the newly created species has value in itself, but this value does not derive from its fundamental ontological value, as a component of biodiversity, but on the contrary, from its instrumental value as a biomachine.

6. Transhumanism and synthetic biology

A major direction of expression of contemporary techno-optimism is represented by the transhumanist paradigm. Transhumanism is considered to be a socio-cultural movement that advocates the use of technology to improve the physical, psychological, social and moral life of both individual humans and the human species in general. The technologies targeted by the followers of transhumanism are diverse, ranging from (bionic) prostheses to implants or even pharmaceutical products that significantly alter the functioning of the human body or mind (Mariscal, 2021).

Techno-optimists believe that various changes to the human condition through technology will necessarily lead to an increase in the quality of human life and, at the same time, life expectancy (More & Vita-More, 2013). Genetic engineering and genetic editing will play an important role in the improvement of the human species, by eliminating some diseases of genetic origin, but also by improving the performance of brain activity or other systems - such as circulatory, digestive, etc.

The creation of a human-machine interface of bio-cybernetic origin is seen as a hope for the growth of human intelligence, for the emergence of new ways of direct communication between the human brain and, eventually, various cybernetic systems, connected to each other through the Internet, which would allow remote interactions.

For their part, the techno-pessimists question the alteration of the human condition through invasive genetic editing techniques - as is the case with those used for the purpose of moral bioenhancement (Persson & Săvulescu, 2014), by editing genes that control aggression. Radical techno-pessimists believe that genetic editing, combined with direct human-machine communication via neural interfaces, will lead to the extinction of the human species in its current form and its replacement by posthuman species (Bostrom, 2005).

The biomedical literature dealing with human enhancement practices distinguishes between those that are already traditional—such as wearing glasses, simple prostheses—and those that use cutting-edge technologies, including genetic engineering and synthetic biology, and which usually raise issues of ethical nature when widely used. Technologies dedicated to human enhancement currently aim to enhance specific traits and capabilities, usually individual, personal and less characteristic of the species. These perfectibility of individuals, whether they are of a psychological nature - psychotropic substances, meditation - or of the nature of corrective or aesthetic medical-surgical interventions, do not influence the functional capacities of the human species in the long term, except when, for example, we are talking about discoveries or scientific achievements culturally transmitted from one generation to another. The use of fire, coins, writing, modern medicine and computers – there were so many leaps in the development of the human species, the former ensuring its supremacy over other species, and the latter laying the foundations for the species' autonomy from nature.

Most human enhancement technologies involve a series of trade-offs, either related to the impact on nature or to the quality of life - of the individual or others -, increased frailty or dependence on technology, which makes human value (Juengst & Moseley, 2019, as cited in Zalta, 2017) of the improvements brought by technology to be either strongly contested or, on the contrary, overestimated.

Efforts for human improvement are rooted in the philosophical and religious tradition of the West, in both traditions improvement having an ethical and axiological character rather than strictly anthropological. In the religious vein, improvement leads to the thought of holiness, or at least an aspiration to holiness. Philosophical quests regarding human perfection, when not tangential to religious ones, concern moral perfection leading to the emergence of a moral consciousness, in the Kantian sense. In current times, human improvement is rather understood from a psychological perspective, as an improvement in the quality of life, by increasing self-esteem, life satisfaction and standard of living. Also, the enhancement aims to improve the social relationships that the individual develops, social acceptance and increased role performances (Persson & Săvulescu, 2014). Medical improvement refers to anatomical or physiological changes that increase the individual's performance - either at the biophysical, intellectual, mental or affective level.

An important distinction, frequently made in transhumanist philosophy, is that between treatment and enhancement. As a rule, the treatment aims to eliminate or reduce the effects of some diseases, including genetic ones - in which case genetic editing and, in general, gene therapy have an important role -, and which is carried out within the limits of biological normality. Improvement aims at overcoming the biological normal and increasing the bio-physiological performance of the individual beyond its natural limits.

Synthetic biology researcher Drew Endy formulates the question: "what if we could free ourselves from the tyranny of evolution by designing our own offspring?" (Endy, 2012, as quoted in Newman, 2012). Unlike the eugenics practiced by the Nazis, which aimed to eliminate people with disabilities or those belonging to certain ethnic groups considered inferior in order to "purify the human gene pool" of the so-called superior races, the improvement of the human species through synthetic biology may be feasible from the technological point of view, since a series of changes in the genome carried out on embryos from a given population can be hereditarily transmitted to future generations, thus creating improved populations more adapted to the environment or more capable of adapting the environment to their own needs (Sandu & Caras, 2013). Newman believes that the risks of applying synthetic biology to creating embryos that are more viable and more likely to have a healthy and long life are significant, although there is also a real chance of actually creating a viable and improved embryo (Newman, 2012).

Of course, not every intervention in the genome is carried out through the specific tools of synthetic biology, and classical genetic engineering applied to embryos can also give favorable results, but also present the same risks mentioned previously in the creation of offspring that correspond to the intention of improvement. The specificity of synthetic biology in gene editing is that of using bioinformatics in combining genes to create other genetic mechanisms that do not exist naturally. If the improvement through genetic engineering is rather carried out at the individual level, avoiding the embryonic genome to eliminate possible mutations, synthetic genetic engineering expressly aims at the creation of adaptive mutations, which generate reactions not specific to the human species. These edits can include the transplantation of genes from other species, which would "lend" the new posthuman species their specific genetic traits: vision in the dark similar to infrared vision, the ability to hear ultra or infrasound, the regeneration of amputated limbs, etc. More precisely, the distinction is made between the activation of atavistic genes - currently inactive in humans, but which pre-exist in one's own phylogenetic line and, respectively, the transplantation of genes that do not naturally belong to one's own phylogenetic line. In the latter case, we are talking about a specific application of genetic engineering along the lines of synthetic biology.

Nouvel Pascal notices a frequent error when transhumanist literature refers to synthetic biology, namely the fact that a correct distinction is not made between the synthetic man and the new man - in the sense of "enhanced". The idea of synthetic man is correlative, for the mentioned author, with the expression "biology is technology" (Carlson, 2010, as cited in Nouvel, 2015). The same author mentions: "this confusion leads to an erroneous orientation of the debates regarding the following technical progress: the synthetic man, strictly speaking, is neither a new man nor a superman, contrary to what a good part of the transhumanist literature suggests" (Nouvel, 2015).

Speaking about the synthetic man, in the sense of man-machine, with reference to a model that comes from post-Cartesian modernity, P. Nouvel, analyzing R. Carlson, shows that, in the absence of a purpose on the basis of which a synthetic entity was created, which would contradict the very Kantian idea of man - adopted by the modern Western world -, we cannot speak of a synthetic man even if a series of interventions specific to synthetic biology would be the basis for improving some of his particularities. Just as in nature we speak of properties of living systems rather than their purposes, so too the human being, even if he will ever be genetically modified, should not be considered a synthetic entity, since he would become a product like computers equipped with Artificial Intelligence and, implicitly, his fundamental rights could be denied. In this sense, the discussion about a possibility to patent the human genome once decrypted is open in the bioethical literature, where this claim of patenting genetic lines specific to synthetic biology, which could be implemented in human beings, is generally considered unacceptable, because it violates the dignity of the human being (Van den Belt, 2013).

7. From biotechnologies to synthetic biology from the perspective of the sociology of knowledge

There is a limited number of studies in the sociology of knowledge that analyze the social impact that the development of synthetic biology has, and how the public perceives the emergence and development of this field of science, the excitement and the social fear that this field brings.

A first thematization of the social impact of synthetic biology aims at the self-perception of professionals in the field in their capacity as scientists, being carried out by the sociologist Balmer and his collaborators (2016), in the volume *Synthetic Biology: A Sociology of Changing Practices*. The authors' research, based on interviews, shows that participation in research networks leads to the construction of a professional identity. The interviewee specifies that he defines himself as a practitioner of synthetic biology, as he is part of research networks in the field and, following communications within these networks, he has identified a number of his professional practices as similar to those of other professionals, who perceive themselves as *synthetic biologists*[1]. The respondent shows that his activity is that of a specialist in molecular biology or biotechnology, but recently this has been labeled as synthetic biology. Basically, a whole series of activities in the series of technologies were rethought as parts of synthetic biology although, *stricto senso*, this science, as conceived by Craig Venter, was limited to the production of synthetic organisms.

The reconfiguration of large sectors of bioengineering as part of synthetic biology is probably due to the tendency to legitimize this practice, based on the positive impact on the public that this technoscience promises to solve many - if not most - of the problems humanity is facing (hunger, pollution, poverty, chronic or acute diseases, etc.). This leads us to consider that the migration of large areas of what is traditional biotechnologies towards synthetic biology means that, in the perception of specialists in the field, techno-optimism far exceeds techno-pessimism regarding synthetic biology. It is, however, possible that public trust in synthetic biology has recently eroded with the use of mRNA technology, defined as a constitutive part of synthetic biology and which has been challenged by a significant part of the vaccine-resistant public and has faced labels from the sphere of conspiracy theories.

A number of technologies are being rebranded as synthetic biology because there is a state of anomie in regulating the limits of synthetic cell research, and institutes such as the Weizmann Institute of Science in Rehovot, Israel – which promise to "make us all young and happy through synthetic biology " – is actually conducting experiments on non-embryonic stem cells – currently derived from mice, but with the stated intention of doing the same on human stem cells – aiming to create functional embryos in the synthetic womb, in order to generate viable organ parts for transplantation , thus creating clones with the role of producing organs perfectly compatible with the cloned person, in order to use some organs as "spare parts". By declaring these embryos to be products of synthetic biology and not real human / animal embryos, complications related to the

[1] The term was kept in the original English language, since its translation into Romanian, by "synthetic biology", would distort the meaning of the term. In the future, we preferred to use the phrase *practitioner in the field of synthetic biology* for those who perform laboratory work in the field, or *bioengineer in the field of synthetic biology* for those who carry out activities of an engineering nature.

issue of the dignity of the human species, human rights and the prohibition of human cloning and the creation of cloned embryos are avoided. Being considered synthetic embryos, basically these "quasi-biological" entities are viable, but can be much more easily manipulated for "technological" purposes. The replacement of an original human organ with a so-called synthetic one would no longer be considered a transplant, but a prosthesis (Aguilera-Castrejon et al., 2021).

The advance of biotechnologies, including those considered to be part of synthetic biology, is correlated with the general lines of knowledge policy in the European Union, which propose, as a sustainable development strategy, the migration to a knowledge economy and a knowledge-based society. Along with communication and computer technology, biotechnologies are able to underpin policies based on the promise of prosperity generated by technological advance. The knowledge economy and the knowledge-based society are not without social risks, the prosperity generated by technology can be correlated with increasing inequality between developed and developing states, between social and cultural categories that have and do not have access to technology, between individuals who have the capacity and availability of lifelong learning and those who do not.

Also, the risks of some technologies, including some biotechnologies, are related to the damage to some ecosystems, to the point where the pollution becomes irreversible, and society must run other programs, also based on knowledge, to eliminate the dysfunctionalities of already outdated technologies. Synthetic biology intervenes here through projects aimed at developing synthetic organisms capable of metabolizing pollutants and thus greening entire ecosystems. Although we notice the ideological optimism behind these promises and the use of technological discourse as a discourse of power - in the Foucauldian sense - we cannot help but notice changes in lifestyle and quality of life due to the use of new technologies. Anti-Covid vaccines, especially those based on synthetic biology, allowed the faster resumption of the mobility of people globally, as long as the existence of vaccines allowed the movement of people at national and international level, but in some places it brought phenomena of discrimination against unvaccinated people, whose freedom of movement and, in some states – Austria and Italy –, access to the exercise of the profession in the case of workers in fields with significant exposure to the public, was restricted due to the lack of vaccine. This restriction of freedom of movement or exercise of certain professions led - directly or indirectly -

to the restriction of freedom of conscience, as long as some people refused vaccination based on objections of consciousness.

8. Conclusions

From the perspective of the sociology of science, the following definition of synthetic biology is required: "that science which aims at the design and engineering of biological constituents, innovative systems and components, as well as the redesign of already existing natural biological systems. Synthetic biology is an application of the systematic design of living systems based on engineering principles" (Kitney & Freemont, 2012). This definition of synthetic biology is consistent with that coming from the field's epistemology.

Synthetic biology is a post-Darwinian construct not because it denies the theory of evolution or even the role of random mutations in phylogeny, but because it seeks to create life based on a project with a well-defined goal, the cells and organisms created being designed to perform functions of an economic rather than evolutionary nature.

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