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BIOART AS A DIALOGUE

ABSTRACT

Three definitions of bioart are analyzed in the paper: bioart—as a part of science art, as the creation of some new exciting artworks, and/or as the visualization of certain stages of biomedical and life science research. Bioart is an *in vivo practice* which produces "living artworks" and creates a new reality. It represents the dialogue between art, science and technology and between academic and amateur science. It promotes the dialogue aimed at rethinking the phenomenon of life. It blurs the boundaries between natural and artificial and the limits of human manipulations with the fundamentals of life.

Keywords: dialogue, science art, bioart, art-science-technology intersections (reapprochement), living artworks, visualization.

The development and expansion of novelties provide the human with unprecedented abilities to change nature in its very fundamentals. This raises questions about the goals and intentions of technological interventions in nature and manipulation with nature as well as about human responsibility for both human and non-human nature.

The development and expansion of new emerging science and technologies, also called NESTs, challenges society and impacts all the aspects of social life and the human perception and attitude towards the world. Modern art is also very sensitive to achievements in science and technologies. It is manifested in various forms, one of which is bioart.

Bioart is a relatively new phenomenon; it appeared at the turn of the 20–21st centuries. Nevertheless, the term "bioart"[1] acquires a rather significant proliferation in modern scientific, artistic, media and social discourses, being filled by a variety of contents.

[1] There are several forms of wording: "bioart," "bio art" and "BioArt." In this article the term "bioart" is used.

In this article mainly three definitions of bioart are analyzed, namely: 1) bioart as a part of the science art, 2) bioart as the process of the creation of new exciting (thrilling) artworks, 3) bioart as the process of the visualization of certain stages of biomedical and life science research and an illustration of complex research discoveries. The relationship between them will also be considered and an outline of the specific features of bioart will be drawn, that allow us to define and specify bioart as a dialogue.

BIOART AS A PART OF THE SCIENCE ART

In order to analyze bioart as a part of the so-called science art it is worth to examine briefly the phenomenon of science art. Science and art traditionally were considered the opposite forms of human activities and cognition. As it is already mentioned above, modern art reacts to the challenges of NESTs and tries to rethink the interaction between the human, nature, science and technology and to draw public attention to them as well as to model and simulate the human future. At the same time, art seeks new tools, techniques and materials (electron microscopy, nanoparticles, living cells, tissues, bacteria, etc.) to express the artistic comprehension of the world and changes that it faces. As a result, artistic materials have often been taken over from sciences and adapted to the artistic context where they play metaphorical, hermeneutical and speculative roles.[2]

Now we are witnessing a steady rapprochement between science, technology and art. Science art is one of the results of such a rapprochement (approximation), and it happens to be a derivate from the convergence of art, science and technology. Science art is a complex, multi-faced phenomenon that includes *Information Art*, *NanoArt* (*nanoart*), *High-tech Art*, *BioArt* (*bioart*), *Transgenic Art*, etc. There are no strict boundaries between the mentioned forms of arts because many of them have no fixed areas; they are moving, varying, and overlapping each other, depending on the concept and content of the particular artistic project. This significantly complicates the analysis of science art and its components. For instance, the *Information Art* analysis includes the surveys of artistic work related to biology (microbiology, genetics, animal and plant behavior, ecology, and medicine), physical sciences (particle physics, atomic energy, geology, physics, chemistry, astronomy, space science, and Global Positioning System (GPS) technology), mathematics (algorisms, fractals, genetic art, and artificial life), kinetics (conceptual electronics, sound installation, and robotics); telecommunications (telephone, radio, telepresence, and Web art); digital systems (interactive media, virtual reality (VR), alternative sensors, arti-

[2] Boland, H. 2013. *Art from Synthetic Biology*; http://westminsterresearch.wmin.ac.uk/12742/1/Howard_BOLAND.pdf

ficial intelligence, 3-D sound, speech, scientific visualization, and information systems).[3]

Nanoart also represents a new art discipline at the art-science-technology intersections. It is based on nanotechnology as a leading direction of modern science and technology which inspires great expectations and hopes for solutions of many problems in different domains of human life, now and in a future.

Nanoart represents itself in the forms of nanolandscapes (molecular and atomic landscapes which are natural structures of matter at corresponding scales), nanosculptures (structures created by scientists and artists by manipulating matter at molecular and atomic scales by using chemical and physical processes). These structures are visualized with powerful research tools like scanning electron microscopes and atomic force microscopes, and their scientific images are fixed and further processed by using different artistic techniques to convert them into artworks showcased for large audiences.[4] In fact, nanolandscapes and nanosculptures are the visualizations of objects created by using nanotechnology, and they represent both the scientific and artistic interest.

In many cases, as Martin Ruivenkamp and Arie Rip show, visualizations combine images and imaginations, data-based imaging and impressionistic imagining. Visualization is also an attempt to combine "scientific correctness" with the best way of the presentation of the achievements of nanoscience and nanotechnology in scientific journals, reports, political papers as well as in media not only for specialists but also for a broader audience. This is why Ruivenkamp and Rip propose to use the term "imag(in)ing" that combines some features of real data-based images and imagination about the objects invisible to the human (public) eye. These authors also conclude that nanoart serves as a showcase for nanoscience, and some images of nanotechnology (like *The Nanolouse, Nanogear images* and *the IBM nano-logo*) become already iconic: that is, they are widely seen as representing techno-scientific achievements, even when they only offer a promise.[5]

Nanoscience and nanotechnologies are represented in art not only through visualization, but also in the forms that target other senses. Nanoart is not only a specific type of visual art, but it also appears in other forms, e.g. in Eduardo Kac's project "Aromapoetry," which he calls "a book to be read with the nose" (2011).[6] This book consists of twelve poems, each of them is a distinct and self-contained composition of flavors. At the same time, the book has a dynamic

[3] Wilson, S. 2002. *Information Arts: Intersections of Art, Science, and Technology*. Accessed 14 September 2016; https://monoskop.org/images/3/33/Wilson_Stephen_Information_Arts_Intersections_of_Art_Science_and_Technology.pdf

[4] Orfescu, C. 2016. *Nanoart—Nanodesign*. Accessed 14 September 2016; http://crisorfescu.com/

[5] Ruivenkamp, M., A. Rip, 2011. "Entanglement of Imaging and Imagining of Nanotechnology." *Nanoethics*, 5, 185; http://link.springer.com/article/ 10.1007%2Fs11569-011-0122-2

[6] Rossi, E.G., E. Kac. 2014. "Language and Life." *Arshake*; http://www.arshake.com/en/eduardo-kac-la-vita-nel-linguaggio/

internal rhythm produced through the alternation of different or contrasting smells. Nanotechnology binds an extremely thin layer of a porous glass to every page, trapping the odorants (i.e. the volatile molecules) and releasing them very slowly. To ensure even greater longevity, a set of small bottles is integrated into the book, allowing the reader to recharge every individual page.

Bioart is also a part of science art, represented by very heterogeneous types (forms) of activities, that makes its analysis rather difficult. Many actors involved in the process of institutionalizing bioart try to formulate a right name for it on the basis of their own practices. However, it is hard to reach consensus on terminologies and subject boundaries.[7]

The term "bioart" unites various practices (activities) dealing with different forms of living materials. These forms and these practices have also their specific names, like microbial, or bacterial art, transgenic art, tissue culture, etc. Microbial art presents a collection of pieces by scientists and artists from around the world who make use of a wide variety of taxa (bacteria, fungi, and protists) and different techniques for expressing qualities of these materials.[8] Most often representatives of bacterial art use bacterial culture or colonies to create images (like "Ode to Autumn," created by Maria Eugenia Inda, a postdoctoral researcher at the Cold Spring Harbor Labs in New York, American Society for Microbiology; fanciful patterns/ornaments that are actual colonies of tens of billions of individual microorganisms, created by Eshel Ben-Jacob, Tel Aviv University; bioluminescent paintings, created by members of the Center for Biofilm Engineering and the Montana State University School of Art) on agar substrate in petri dish. This is why this type of bioart as also called agar art.

A British artist Anna Dumitriu, in her project called "Communicating Bacteria," used colonies of genetically modified bacteria that change colors dependent on the behavior and interaction (communication) of these microorganisms. These specific qualities of bacterial colonies are applied for the colouring embroideries of an antique whitework (white on white) and are exhibited to a broad audience. The bacterial art projects are aimed to change the public attitude toward bacteria. One of the goals of the project "Communicating Bacteria" is to underline the importance of the public understanding of microbiology. Dumitriu stresses that many businesses play on public fears in order to add a value to their products (detergents), and newspapers and TV-shows "fill our minds with images of bacteria as armies of tiny monsters ready to attack unless we buy some new hand wash or detergent." Instead, she discovers alternative forms of bacteria control based on the interaction of bacterial colonies. The Communicating Bacteria Project combines bioart, historical textile techniques and 3D mapped video projections to explore a new research currently being undertaken in the field of bacterial communication, to engage a wide audience

[7] Boland, H. 2013, op. cit.

[8] *Microbial Art.* 2016; http://www.microbialart.com/

increasing the debate and understanding of this potentially new form of infection control.[9]

At the same time microbial (bacterial or agar) art exhibited in the form of photographs or video images can be considered a kind of visual art. It should be noticed that such a use of living materials (trees, bushes, herbs, flowers etc.) has got a long history in culture. They are applied by landscape architects, gardeners, florists and designers for the decoration of parks, urban areas, courtyards, houses etc. In these cases, artists apply the aesthetically featured characteristics of different plants (their color, form, texture, size etc.) mostly for decorative purposes. The Traditional Flower Carpet in Brussels and numerous flower festivals all over the world are examples of such arts.

It is obvious that both the traditional flower art and microbial art belong to visual arts, but the differences are in materials used, also in the forms of public perception, aesthetic value and in messages addressed to audience. The traditional use of plants for decoration or flower festivals are aimed to demonstrate both the intrinsic beauty of nature (natural materials, mostly higher plants) and skills and mastery of breeders, floral artists and designers. Such a kind of performances and exhibition usually are of a high aesthetic value which is also shared by spectators generating positive emotions. In contrast, microbial art masterpieces present a part of the invisible living world to the audience through photos and videos, and it is aimed at broadening public imagination about this world as well as about the very nature of it. The aesthetic and ethical value of such masterpieces is a matter of heated debates and controversial assessments.

Nora S. Vaage points out that bioart is rarely aimed "to give pleasure through the experience of harmonious beauty. Instead, artists seek to reflect some aspect of human existence, to provoke, criticize, or create immersive experiences."[10]

BIOART AS A PROCESS OF CREATION OF NEW THRILLING ARTWORKS

Another meaning of bioart is connected with a drastic transformation of the fundamentals of life. In this sense, bioart is considered a derivative from new emerging sciences and technologies (NESTs) which operate with genetic materials, living tissues, bacteria and organisms and can be used for producing new functions in living systems by modifying biomolecules and cells, or designing artificial cells. These practices are based on achievements of DNA technology, molecular and synthetic biology (SynBio), genomics, xenotransplantation, etc.

[9] *Bioart and Bacteria—The Artwork of Anna Dumitriu*, 2016; http://annadumitriu.tumblr.com/CommunicatingBacteria

[10] Vaage, N. S. 2016. "What Ethics for Bioart?" *Nanoethics*, 10, 87–104.

Hundreds of artists around the world use different techniques of molecular biology, biotechnology and nanobiotechnology.

It was Eduardo Kac who coined the term "bioart" ("BioArt") in the end of the 1990s, especially to describe a process of creation of certain new thrilling artworks. Kac also introduced the term "transgenic art" to indicate new forms of art based on the use of genetic engineering techniques in order to transfer synthetic genes to an organism or to transfer natural genetic material from one species into another, to create unique living beings. Both bioart and transgenic art may be described as the synthesis of art, science and technology, and they represent a part of science art.

Bioart is an attempt, chance or opportunity to embody the human fantasy in creating chimeric creatures not only in human imagination, but also in reality and to present them to public eye. The chimeric creatures that embody the human fantasy (like "GFP Bunny"—a green fluorescent rabbit, and "Edunia" created by Kac or "The Pig Wings Project" by Oron Catts and Ionat Zurr in cooperation with Guy Ben-Ary) are among the works of bioart.

It also demonstrates human abilities to change nature or even to improve it. In the Introduction to the book *Sings of Life: Bio Art and Beyond* (2007) Kac refers to the writing of Jorge Luis Borges *Manual de zoologı'a fanta'stica* (The Handbook of Fantastic Zoology) first published in Mexico in 1957, and he cites this famous Argentinian writer, stating that people's imagination can create "an endless variety of monsters" and to be described in legends and literature; but, fortunately, "our monsters would be stillborn, thank God."[11] In nature chimeras may appear as a result of chromosomal anomalies, but they have a very little chance of survival. Nevertheless, since 1980s, as Kac notices, living chimeras (that is, animals with cells from two beings) became a part of our reality thanks to advances in genetics and other fields of life science. The term "transgenic art" was proposed for denoting this new form of activities based on the use of genetic engineering techniques to create fanciful living organisms.[12] Bernard Andrieu proposes to call such creatures scientific chimeras.[13]

Catts and Zurr emphasize in the comments of their *The Pig Wings Project* that winged bodies have been used in most cultures and throughout history.[14] As a rule, many fanciful winged creatures embodied either good/angelic (bird-wing) or evil/satanic (bat-wing) aspects of life. Bird wings have been associated with angels while bat wings symbolized dark satanic forces. Catts and Zurr in

[11] Kac, E. 2007. "Introduction. Art that Looks You in the Eye: Hybrids, Clones, Mutants, Synthetics, and Transgenics." In: *Signs of Life Bio Art and Beyond*. Eduardo Kac (Ed.); https://www.digitalartarchive.at/fileadmin/user_upload/Virtualart/PDF/360_Signs_of_Life_-_Bio_Art_and_Beyond.PDF

[12] Kac, E. 2016. *Transgenic Art*; http://www.ekac.org/ transgenic.html

[13] Andrieu, B. 2016. "Embodying the Chimera: Biotechnology and Subjectivity." In: *Signs of Life Bio Art and Beyond*.

[14] *The Pig Wings Project: Oron Catts & Ionat Zurr in Collaboration with Guy Ben-Ary.* 2016; http://www.tca.uwa.edu.au/pig/pig.html

cooperation with Guy Ben-Ary and many other researches in biomedical science have used tissue engineering and stem cell technologies in order to grow pig bone tissue in the shape of three sets of wings. It was presumed that the living tissue of engineered pig wings will be animated by using living muscles. From this position bioart can be also considered a transition from mystical to scientific chimeras.

Some representatives of bioart proclaim an ambition to increase biodiversity under the conditions of loss of natural diversity of plants, fungi and animals and manifest human power to outmatch natural evolution. Kac compares the work of modern artists, who deal with living material, with the "work" of natural evolution: "In art, to work with biomedia is to manipulate life, and any kind of life manipulation is part of the global network known as evolution."[15] This trend has been developing within the transhumanism discourse and debates about nature and human enhancement. In such a way man takes on the role of God as a creator of living beings or the function of natural evolution (new creationism). At the same time many representatives of bioart emphasize creative "cooperation" with nature and true care about nature.

Despite the great diversity of projects united by bioart it is possible to identify some common traits. First of all, bioart is *in vivo practice* and *life is a raw material* for bioart. Consequently, bioart is a form of artistic activity that produces "living artworks" and creates a new reality that needs to be defined, analyzed and evaluated.

In order to understand bioart and science art, in general, this phenomenon should be considered in the context of art evolution in the 20th century and the dynamics of the relationship between science, technology and art should be taken into account. Stephen Wilson in the preface to his book *Information Arts: Intersections of Art, Science, and Technology* (2002) proposes to consider science and technology as a means for the analysis of interaction between science, technology and art. He believes that such an approach can be seen as part of essential rapprochement between art, science and technology and as a key to what art may look like in the 21th century. At the same time, it is crucially important to examine the role of science and technology in art development.[16]

Wilson also emphasizes that the investigation of convergence, interaction between art, science and technology and the interpenetration of them will help to understand the radical shift in the boundaries of "art" over the last century that makes it difficult to achieve consensus on the definitions of art, as well as the nature of the aesthetic experience, the relative place of communication and expression, or criteria of evaluation. However, there is some agreement on these

[15] Kac, E. 2007, op. cit.
[16] Wilson, S. 2002, op. cit.

features: art is intentionally made or assembled by humans, and it usually consists of intellectual, symbolic, and sensual components.[17]

Bioart as a part of the general process of cultural changes during the 20th century reflects some key tendencies which take place for a hundred years. The changes are rooted not only in a gradual convergence between science, technologies and art (cinema, photography, media art etc.), but also presume a shift of the cultural paradigm. For instance, Carol Becker notices the significant bias in the area of the artistic quests (displacement interests) and theorization about them. During the 1980s–1990s artists and philosophers were focused on the topic of "mining of the nuance of one's historical self, conceptualized in society, or what one is."[18] The unprecedented development of science and technology and their rapid entry into all the spheres of society displaced emphasis (accents) on the questions of incorporation of otherness, the recombination of the natural and the fabricated, the combination of physical and virtual, the breakdown of distinctions between art and science.[19]

These shifts can be illustrated by Kac's project *Natural History of the Enigma*, which was developed in years 2003–2008 and first exhibited at the Weisman Art Museum, in Minneapolis from April 17 to June 21, 2009. This project demonstrates the contiguity of life between different species and represents artist's reflection on this question. The central work in the *Natural History of the Enigma* series is a *plantimal*, a new life form created by the artist and called *Edunia*. "Edunia" is a genetically engineered flower that has red veins on light pink petals. The red veins are results of the expression of the artist's gene isolated and sequenced from his blood.[20] The living being called "Edunia" represents not only experimentations on the genetic compatibility of different species, but also a new kind of "self" that is partially flower and partially human, which would never appear in natural condition. The construction of such creatures is possible only in the laboratory thanks to the advances in genetics and molecular biology. Moreover, Kac states that care for this plant is also the concern for ourselves.

BIOART AS POPULARIZATION OF SCIENCE

While art searches for new forms of expressions of artistic ideas and rethinking the challenges of NESTs, science also searches for new forms of self-presentation in professional and business circles, for policy and decision makers, as well as for broader community through media, exhibitions and performances. In other words, modern science and technologies need to be more un-

[17] Ibid.
[18] Becker, C. 2016. "GFP Bunny." In: *Art Journal* (2000); http://www.ekac.org/cbecker.html
[19] Ibid.
[20] Kac, E. 2016. *Natural History of the Enigma*; http://www.ekac.org/nat.hist.enig.html

derstandable for society, so they seek new ways of communication with the public outside of scientific communities. For the popularization of results of their research, science and technologies apply not only traditional methods like popular science magazines, television and radio, but they also employ artistic means and language.

Researchers involved in the spheres of molecular biology, nanobiotechnology, biomedicine etc. pay special attention to the promotion of the results of their studies because these spheres are closely related, on the one hand, with human hopes for better life, and, on the other hand, with the fears of intervention in human identity. Consequently, people's attitude towards science and technology depends on message which NESTs send to the society and its particular target groups.

For instance, FASEB (Federation of American Societies for Experimental Biology) initiated in 2012 annual exhibitions to share the beauty and breadth of biological research with public.[21] The images (photos, graphs or videos from different parts of research, e.g., electron microscopy, fluorescent microscopy, medical/anatomical illustrations, x-ray crystallography, histology, gel electrophoresis, data visualizations, etc.) presented at such kinds of exhibitions are also a part of bioart. In this sense, bioart is becoming public relations for corporate science, especially for pharmaceutical companies and life-science research institutes.[22]

The efforts of scientists and companies which deal with NEST in the promotion and popularization of their findings in media and in artistic areas stimulate the development of so-called amateur science or do-it-yourself biology (DIYBio). As a part of amateur science DIYBio is performed outside academic and business institutions (at home, in garages, and offices); all equipment for such amateur experiments can easily be purchased on ecommerce sites, and materials used in these experiments are ordered via conventional mail. DIY biologists are represented by a large number of individual and amateur research groups throughout the world. In 2008 they founded the global network with the mission of establishing a vibrant (exciting), productive and safe community of DIY biologists (DIYbio.org).[23] Significantly, the DIY biologists define their central mission as the establishing and development of a dialogue with a broader public for a better understanding of modern biotechnologies and their potential able to benefit everyone. This mission coincides with the definition of bioart as activity aimed at dialogue.

In 2011 a series of congresses in Europe and the USA was conducted to agree upon principles for the code of ethics for the emerging DIY Bio move-

[21] "BioArt Scientific Image & Video Competition." 2016; http://www.faseb.org/Resources-for-the-Public/Scientific-Contests/BioArt/About-BioArt.aspx

[22] Thacker, E. 2006. "Open Source DNA and Bioinformatic Bodies." In: *Signs of Life Bio Art and Beyond.* Kac, E. (Ed.). Cambridge (Mass.)–London: The MIT Press.

[23] *An Institution for the Do-It-Yourself Biologist*2016; https:// diybio.org/

ment. The key principles of European DIY Bio movements are the following ones: transparency, safety, open access, education, modesty, community, peaceful purposes, respect, responsibility, accountability. The North American DIY Bio community builds its code of ethics on the principles of open access, transparency, education, safety, environment, peaceful purposes, tinkering ("Tinkering with biology leads to insight; insight leads to innovation").[24] From this point of view the DIY biologists represent not only private independent activities, but they also play a role of a mediator between science and the general public. While DIY Bio groups are experimenting with biomaterials, boiart is also a part of DIY Bio and vice versa.

The cooperation between representatives of bioart and DIY-biologists proves this. The world-renowned artist Oron Catts, the current director of SymbioticA, the Centre of Excellence in Biological Arts, within the School of Anatomy and Human Biology (The University of Western Australia), in cooperation with other artists and scientists starts tissue engineering (tissue culture) and biotechnology in an artistic context and ethical aspects of regenerative biology technologies.[25] Since the early 2000s he and his collaborators have also organized a series of workshops for artists and other interested parties including DIY biologists. Nora S. Vaage from the University of Bergen considers these workshops as an evidence of flexibility of the boundaries between bioart and DIY biology in practice.[26]

WHY BIOART IS A DIALOGUE?

Many representatives of bioart emphasize the dialogic orientation of their activities. For instance, Kac regards dialogue f as a core of his artistic projects. He states that he has used each of his art pieces and performances to attract media attention and to encourage thereby a public dialogue about the social issues of the topics raised in his projects.

Dialogue is deeply rooted in human culture and in the history of philosophy. Generally, dialogue is defined as a conversation of two or more persons or as an exchange of ideas or opinions on a particular issue with a view to reaching truth. At the same time dialogue has specific features which differ it from other types of conversation, among others debate—a formal contest in which the affirmative and negative sides of a proposition are advocated by opposing speakers.[27] *Debate* is built on opposing positions; each side is convinced in the righteousness of its own arguments.

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[24] Ibid.

[25] *Royal College of Art Triumphs Bioart with New Appointments*2016; http://www.wired.co.uk/article/catts-and-zurr-synthetic-biology-rca

[26] Vaage, N. S. 2016, op. cit.

[27] Swidler, L. 2016. *Debate*; http://www. dictionary.com/browse/debate

In contrast, *dialogue* is based on the assumption that neither side has a full understanding or comprehension of the subject. Consequently, no one side has a monopoly on the truth of the subject, but both need to seek further. Dialogue is the means of learning a new truth that both sides can agree on and a two-way communication between persons who hold significantly differing views on a subject, with the purpose of learning more truth about the subject from the other.[28] The extrapolation of this understanding of dialogue onto the situation of the relationship between science, technology and art allows to speak about bioart as a dialogue.

Leonard Swidler, a founder and president of the Dialogue Institute, provides an analysis of different approaches to the understanding of truth as a goal of dialogue in the Western culture. He stresses that our understanding of truth and reality has underwent a radical shift. In short, it has become "deabsolutized" or "relational," that is, all statements about reality are now seen to be related to the historical context, praxis intentionality, perspective, etc. of the speaker, and in that sense dialogue is no longer "absolute." He clarifies its position as follows:

> "If my perception and description of the world is true only in a limited sense, that is, only as seen from my place in the world, then if I wish to expand my grasp of reality I need to learn from others what they know of reality that they can perceive from their place in the world that I cannot see from mine. That, however, can happen only through dialogue."[29]

When we consider bioart as a dialogue we have also to identify the parties of this dialogue (or dialogues) and answer the question what is this dialogue about. From the brief analysis of definitions of bioart it follows that this dialogue is multi-dimensional, multilateral and multidisciplinary one, because it relates to art, science, technology, media, law, education, religion, and to society as a whole.

The multilateralism and complexity of issues raised by bioart was, for instance, demonstrated by the posters with images of Kac with his creature rabbit Alba (GFP Bunny), which already became an icon of the transgenic art. These posters were placed on the streets of Paris (December 3 and December 13, 2000). The goal of that action was not only to inform public about the achievements and potential of genetic engineering, but also to encourage thinking about the questions raised in the realms of ethics, art, science, religion, media, relationships between human and non-human species (family) and about human attitude toward nature.

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[28] Swidler, L. *What Is Dialogue?* 2016; http:// dialogueinstitute.org/what-is-dialogue/

[29] Ibid.

While there is no single body of knowledge controlling research in the area of bioart,[30] it is extremely important to keep in mind that dialogue is a continuous learning process for the sides participating in it.

Swidler defines the general goal of dialogue as an opportunity for each side to learn more about each other, and to change accordingly. At the same time dialogue is an opportunity to learn more about itself (Self),[31] i.e., dialogue is a way to understand others and a form of self-understanding. From this point of view, bioart is an attempt of a better understanding of modern art, science, technology, and, last but not least, important problems of modern society. To paraphrase the statement that the dialogue partner becomes for us something like a mirror in which we perceive ourselves in ways we could not otherwise do,[32] it is possible to say that bioart is a mirror of science. In bioart science adapts the language of art and vice versa, and artists cooperate with scientists. This process is called the scientisation of art. According to Eugene Thacker, bioart projects can contribute to the discourse on biotechnology. He underlines theoretical, pedagogical, political and institutional standpoints in this discourse. From a theoretical standpoint, bioart creates certain contexts in which diverse provocative, controversial issues of our days can be raised.[33] Bioart is an integral inseparable part of these contexts. This is why a particular individual bioart project should also be assessed within the context in which it is created and presented.

Nora S. Vaage proposes the term "contextualism" as the most adequate and preferable one for the analysis and assessment of bioart projects including their moral and aesthetical values. Taking into account that bioartists apply different approaches, and their artworks generate different ethical issues, she believes that the contextualist approach is "the most productive perspective for bioart assessment, that is each artwork should be treated locally and considered separately for its specific ethical relevance."[34]

Contextualism corresponds to the multi-dimensional dialogic nature of bioart. Moreover, Thacker states that the context in which bioart is met is crucial, and it needs to be problematized in order to avoid the reduction of bioart to the role of commentator of science for ordinary public or "tired narrative of recuperation of the avant-garde."[35] Bioart does not only create a medium for a dialogue between science, technology and society enabling a public understanding of modern science and technology and an adequate assessment of public fears and hopes related to NESTs, but it also designs a new (third)

[30] Bolland, H. 2013. *Art from Synthetic Biology*; http://westminsterre-search.wmin.ac.uk/12742/1/Howard_BOLAND.pdf

[31] Swidler, L. 2016, op. cit.

[32] Ibid.

[33] Thacker, E. 2006, op. cit.,

[34] Vaage, N.S. 2016, op. cit.,

[35] Thacker, E. 2006, op. cit.,

reality which does not belong entirely to the realms of science nor technology, nor art.

CONCLUSION

It can be concluded that bioart encourages dialogue on the number of issues which can be contingently divided at least into the following blocks, or clusters.

First, bioart represents a dialogue between art, science and technology or between art and techno-science (NESTs), aimed at the mutual adaptation of the means of the cognition of reality, languages, forms and methods of communication with public and particular social groups. These result in the rapprochement of the mentioned spheres of activities and in a closer cooperation between scientists and artists.

Second, bioart induces dialogues aimed at the rethinking and redefinition of the phenomenon of life, and boundaries between the natural and artificial. It also stimulates discussions about human responsibility for the preservation of identity of life and about the status of bio-facts and bioartistic (living) artefacts. The need to define certain "permitted" limits of nature transformation by means of NESTs and the boundaries of human activities, as well as the basics of interference in life and manipulation with living forms follows from this. Biosafety and biosecurity (biohacking; green-goo scenario; environmental impacts) are in the time-table of this dialogue. Here we do not consider the participation of religion in the dialogue about and within bioart because this participation forms a special dimension of the rethinking of many ethical questions actualized by both NESTs and bioart. Neither do we touch the question about the place of media in the development of bioart, nor its presentation to the audience, nor the role of media in maintenance of the dialogical character of bioart. Modern media do not just transfer images from the spheres of techno-science or bioart laboratories to the public. They actively construct new realities and new forms of communication.[36] This is why media and bioart should be a topic of a special detailed thorough analysis.

Third, bioart is a dialogue between academic and amateur science, including the ways of the cooperation and involvement of DIY-biologists in research for scientific and commercial purposes. Simultaneously, the question about the development of the DIYbio Code of Ethics and the risks/benefits assessment of DIY activities becomes a crucial one.

[36] *GLOBALE: Exo-Evolution*. 2016; http://zkm.de/en/event/2015/ 10/globale-exo-evolution

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