



**BIOART AND BIODESIGN: THE ETHICS AND
AESTHETICS OF WORKING WITH LIVING SYSTEMS**

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Master's Thesis

Graduate School
Izmir University of Economics

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ABSTRACT

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This study is structured over the effects of technology and science on the development of art and design. In this context, within the framework of the historical process, the reflections of social and scientific phenomena on design and art disciplines are classified chronologically. As a reflection of the technological developments of the 21st century, similarities and differences have emerged in art and design. This interdisciplinary transition has enabled these two different fields to work with living systems. From this point of view, separate from the historical perspectives, a series of new ethical and aesthetic debates have emerged. This research aimed to examine the ethical and aesthetical questions raised by working with living systems within the possibilities of our age. In addition, private and institutional deficiencies in bioart and biodesign disciplines have been discovered in Turkey, and this study aims to provide a starting source for new researchers in these fields.

Keywords: Bioart, Biodesign, Ethics, Aesthetics, Living Systems



ÖZET

BİYOSANAT VE BİYOTASARIM: CANLI SİSTEMLERLE ÇALIŞMANIN ETİK VE ESTETİĞİ

Dömez, Ege

Tasarım Çalışmaları Yüksek Lisans Programı

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Ağustos, 2021

Bu çalışma, teknoloji ve bilimin sanat ve tasarımın gelişimine etkileri üzerine yapılandırılmıştır. Bu bağlamda tarihsel süreç çerçevesinde toplumsal ve bilimsel olguların tasarım ve sanat disiplinlerine yansımaları kronolojik olarak sınıflandırılmıştır. 21. yüzyılın teknolojik gelişmelerinin bir yansıması olarak sanat ve tasarım alanında benzerlikler ve farklılıklar ortaya çıkmıştır. Bu disiplinler arası geçiş, bu iki farklı alanın canlı sistemlerle çalışmasını sağlamıştır. Bu açıdan bakıldığında, tarihteki görüşlerden farklı olarak, bir dizi yeni etik ve estetik tartışma ortaya çıkmıştır. Bu araştırma, canlı sistemlerle çalışmanın gündeme getirdiği bu etik ve estetik soruları çağımızın imkânları dahilinde incelemeyi amaçlamıştır. Ayrıca Türkiye'de biyosanat ve biyotasarım disiplinlerinde özel ve kurumsal eksiklikler keşfedilmiş olup, bu çalışma bu alanlarda yeni araştırmacılar için bir başlangıç kaynağı sağlamayı amaçlamaktadır.

Anahtar Kelimeler: Bioart, Biodesign, Etik, Estetik, Canlı Sistemler

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CHAPTER 1: INTRODUCTION

Technological developments have enabled science to affect all disciplines. Scientific developments and globalization have influenced art and design practices. The impact of biology on art and design has become more critical in the 21st century. The historical process has been examined to distinguish changes in both fields and highlighted the scientific structure. Technological developments affected all disciplines and enabled art and design to break away from traditional art and design objects with modernism. With postmodernism, the boundaries between disciplines disappeared, and ethical and aesthetic concerns began to gain autonomy.

The conflict between nature and culture, which started with Romanticism, became even more important in art and design in the Anthropocene era. Although the embrace of subjective norms by art and design in the postmodern period indicates an artistic attitude independent of aesthetics and ethics, ethical debates, in particular, remain current in terms of bioart and biodesign due to the crises of the Anthropocene period.

In the second chapter, social and technological dynamics that are affecting art and design from past to present are discussed. Then, the historical process that led to the formation of bioart and biodesign from the first human civilizations to the present has been studied in detail. Besides, the purpose of the study and the method of the analysis is also specified.

In the third chapter, literature reviews have been done on the definition and history of bioart and biodesign. Although the disciplines of bioart and biodesign are closely related to each other, the differences between them will be discussed. These two areas, which differ in terms of methodologies, goals, and objectives, will be examined under headings.

In the fourth chapter, the scientific and technological possibilities developed in the formation process of art and design have revealed the unpredictable limits of the new aesthetic and ethical understanding. Firstly, the ethical and aesthetic history of art is examined to understand these limits. Afterward, the ethical evaluation of exhibitions,

projects, and studies realized with living systems, which is the most obvious common feature of these two disciplines, was investigated.

In the conclusion part, the changing comprehension of art and design is appraised. The field in which the bioart transforms the art object and its understanding of exhibition is discussed by referring to the contribution of biodesign in a sustainable approach.

1.1 Problem Definition and Aim of the Study

The main purpose of this thesis is to discuss bioart and biodesign in terms of their ethical and aesthetic values. One of my goals is to compile discussions of ethical and aesthetic issues in bioart and biodesign, and another is to analyze how living systems are used in bioart and biodesign.

1.2 Research Questions

In this context, several research questions are addressed in this study:

- What are the definitions and examples of bioart and biodesign?
- What are the limits of bioart and biodesign in aesthetic and ethical contexts?
- What are the opportunities and challenges of working with the living systems in bioart and biodesign?

1.3 Methodology

In this thesis, through exploratory research, the ethical and aesthetic problems of art and design works created with living systems are examined. First, the differences in the expansions and methods of bioart and biodesign were drawn by related literature. Although many sources from the literature were used in the creation of the chapters of this thesis, it was mainly shaped by the classification styles of the books of Eduardo Kac and William Myers in these fields. Secondly, examples that emerged as a result of the literature review were added in order to understand the ethical and aesthetic limits of bioart and biodesign and their concerns. In order to position the history of design within the history of art, aesthetic and ethical discussions on art are included. Finally, based on the research questions, a literature review was conducted in newer and relative fields such as biotechnology aesthetics, bioethics, and living systems, and

the intersections of these fields and the situations that may arise in the coming decades are evaluated.



CHAPTER 2: HISTORICAL ORIGINS AND CURRENT RESEARCH ON BIOART AND BIODESIGN

Art and design have undertaken an essential task for people throughout the ages. Early civilizations mainly used art for communication and design for tools and necessity. Although these features have brought these two areas closer together, they have sometimes caused them to diverge. For example, art has been intertwined with life in gatherer and hunter societies. This union of art and craft was utterly broken with the Industrial Revolution. With this revolution, technological possibilities have increased rapidly, and technology has emerged as a necessary and inevitable science extension. In this section, how art and design have changed over the centuries, the causes and actors of this change will be examined under two headings within the framework of philosophy, science, and technology.

2.1 Historical Origins

From the existence of humans to the present, nature has played an important role. One of the underlying stages of human evolution is having the instinct to imitate. People have studied living and non-living things in nature. They have applied and adapted these behaviors that they learned and imitated to their lives. Nature has always encouraged people to do artistic and scientific research. Their desire to explore, wonder and evaluate lead humans to discover different expeditions with the help of other science. Consciously or unconsciously, they found solutions by inspiring nature, and this has affected many fields from art to design, from mathematics to architecture. Humankind, struggling in line with the thoughts of feeding, sheltering, and hunting, invented tools.

“From a broad range of early cultures, extending back to about a million years, natural objects began to be used as tools and implements to supplement or enhance the capacities of the hand” (Heskett, 2005, pp. 8-23).

As Heskett stated above, people used natural materials to make things easier than to do by hand. The simplest example of this is digging the soil. We can handle the work more efficiently by using any material from nature than by hand. Another use is to transform natural materials into forms. The purpose of most early inventions was to

find techniques, shapes, and patterns for adapting to new purposes and applications. Human beings also had different methods of expressing themselves, apart from using hands and tools.

They also used art as a tool to express their feelings and thoughts. Cave paintings made in the Palaeolithic period are the first examples of this (Çakır and Özgür, 2018). Art has emerged from man's curiosity, the desire to dominate natural events, and the desire to understand nature.

Technique, science, and art have developed according to the needs of society. However, human beings have not been content with the natural from the first human to the present. For this reason, it has constantly produced new tools and forms of expression. In this way, man has reshaped nature and created different forms of production and knowledge inspired by nature.

Civilizations first appeared in Mesopotamia. Animal shapes and plant motifs are used in architecture because they are believed to have protective properties. In the Sumerians, gods represent the forces of nature. In addition, there are animal depictions of nature in the Assyrian and Babylonian civilizations (Köroğlu, 2018).

Inspiration from nature is also crucial in Egyptian civilizations. Living systems such as birds, leaves, and snakes were used in Egyptian hieroglyphics. In addition, Egyptians created a geometric design inspired by nature. They made significant progress in agriculture through this system (Kostof, 1995).

After the Egyptian Civilization, Ancient Greece also tried to imagine nature. Subjects such as still-life (*Naturaleza muerta*) are frequently seen in Greek Art. At that time, rural landscapes in nature were reflected in their artworks. They did not know how to apply perspective, but they have depicted objects as similar rules as the nearest object was more significant than the further ones. Due to the geographical location, the changes in the climate and the indented and protruding coasts in the region also affected the art of that period (Moffett et al., 2003).

As can be seen, reflecting nature into art was continued from tribal society to early civilization, from cave paintings to murals, from Africa to Mesopotamia, from Egypt to Ancient Greece. The natural philosophy that emerged in the Ancient Greek

civilization brought this relationship to a philosophical dimension. Other essential theories and concepts that emerged in Ancient Greece are beauty and mimesis. In this study, it is necessary to examine the natural philosophy and mimesis theory to understand natural interaction in art and design disciplines. In addition, it is equally important to mention the concept of beauty that emerged during this period in terms of the change of aesthetic values in the following periods.

Pre-Socratic philosophers began to research on fire, water, air, and soil, which were the basic substances of nature. Philosophy of Nature has emerged by questioning the beginning of life, how they exist, and their causes. Thales is regarded as the pioneer of philosophy in this context.

The fundamental element of Thales philosophy was fed on nature and science. According to him, the first source of the universe was water, and every living matter depended on it (Çiçek, 2011). Plato opposed the first natural philosophers considering fire, water, earth, and air as the first element of everything. According to Plato, human nature is superior to wild nature. Therefore, the mind and spirit rule over the human world. Plato's idea of form is the first expression of man's separation from nature. According to him, precise and universal knowledge in mathematics and geometry is in contradiction against the change and transformation of character (Platon, 1994).

Aristotle put forward a different philosophy of nature than Plato. According to Aristotle, the form takes place in visible things in nature (Topdemir, 2004). As clearly understood here, Plato tended to separate man from nature with his understanding of art and knowledge. But Aristotle tried to bring man closer to nature through a method based on experience.

Beauty is another concept proposed and discussed by Aristotle and Plato. What constitutes the concept of beauty, which seems to be the area of interest of aesthetics, has been given different answers for centuries. From the Greek to the Renaissance, beauty was thought to be an objective, physical property. In short, the view that beauty is inherent in the object has been advocated. However, during the process, the thought that beauty is formed in the viewer's eyes became dominant (Tekel, 2015). As aesthetics emerged as the philosophy of beauty, I will discuss Aristotle's and Plato's perspectives in more detail in the following chapters.

Another major theory is Mimesis. While examining Mimesis, differences emerged in terms of Aristotle's and Plato's thoughts, just like in Natural Philosophy. Mimesis means imitation or re-presentation. The whole of nature and human behaviors based on imitation in art is defined as the word Mimesis. Art has emerged through imitation of nature, in other words, mimicry (Haçerlioğlu, 1979).

Aristotle defined Mimesis as the perfection and imitation of nature. Aristotle described Mimesis in his book Poetics, and it was stated that all branches of art consist of imitation. Tragedy, comedy, music, or sculpture are all imitations. Art branches differ from each other by means of imitation, imitation objects, or imitation styles (Aristoteles, 1987).

Whether art is an imitation or reflection of reality, the matter is what kind of reality is the projected reality is. Three answers have been given on this subject throughout history. One of them is that art reflects the apparent reality. The second answer is that art is a reflection of the general or the essence. The third answer is that art reflects the ideal (Moran, 2002).

According to Plato, art is the exact reflection of the visible reality, and in other words, art mirrors reality. Platon adapted this theory of mimesis to aesthetics in his book The Republic. However, there are differences in Aristotle's and Plato's narrative of mimesis (Moran, 2002). For example, while Aristotle thought that imitation would contribute to the emotional development of people, Plato believed that imitation would harm human development (Aristoteles, 1987).

The concept of Mimesis is vital in the fields of art and design since its emergence. Mainly, it has formed the basis of the development and shaping of design and the emergence of Biomimetics. For this reason, I will mention the Mimesis theory again in the following chapters.

At the same time, homologies found in the geometries of human physiology and other forms in nature were first noticed by the Classical Greeks. Then, during the Greek Golden Age, the developments in the fields of art, architecture, and mathematics were based on the principles of biology, which laid the groundwork for the science and arts of the European Renaissance (Yetisen et al., 2015).

The Renaissance started in the 14th century and had continued until the 17th century. Renaissance means “rebirth” (Yerli, 2017). The long period of cultural decline and stagnation in Europe ended with the Renaissance. There have been discoveries in many areas, such as new scientific laws, forms of art and architecture, new religion and political ideas, and new lands. With the realization of geographical discoveries, the perspective on nature has changed. Perspective development, one of the crucial stages in the representation of reality, completed its growth in the Renaissance.

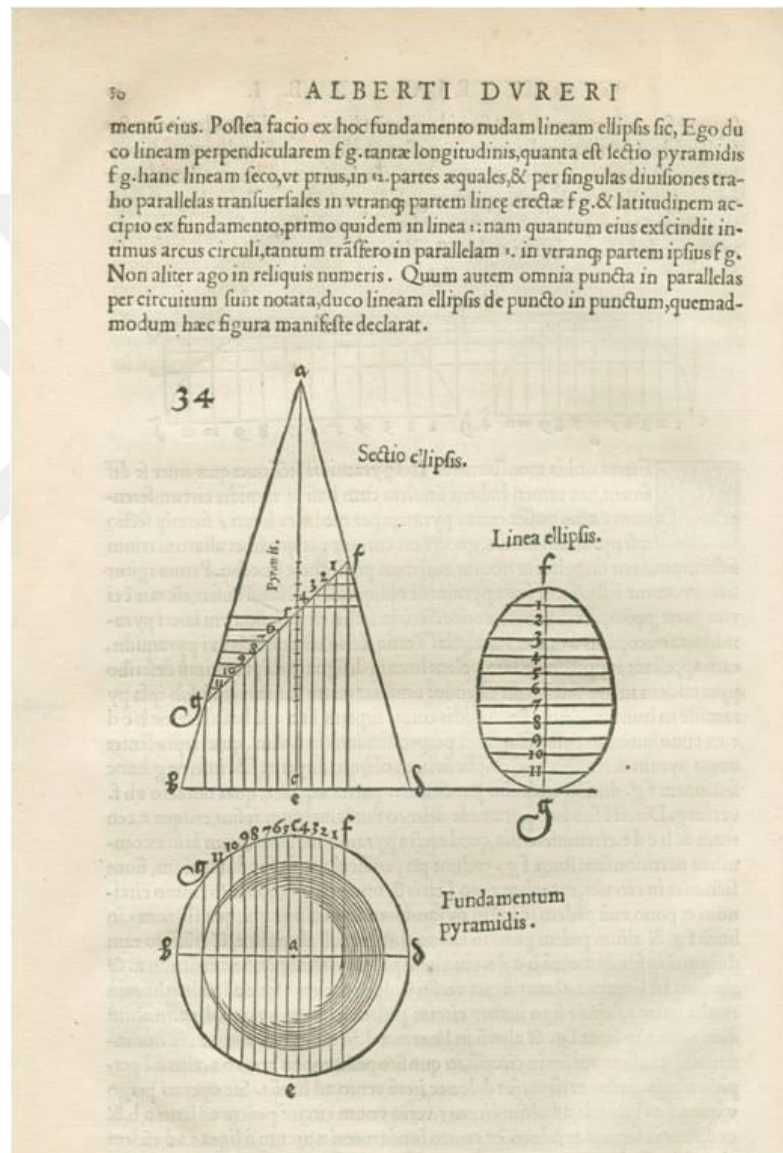


Figure 1-Sample page from Albrecht Durer's book “Underweyung der Messung” (Source: Dürer, 1525)

Renaissance artists were influenced by the Ancient Greek philosophers' handling of nature and developed these ideas. During the Renaissance, the identities of scientists and artists intertwined. Albrecht Durer's interest in perspective and geometry, the perspective that Piero Della Francesca treats like a mathematical puzzle, Luca Pacioli's learning from mathematics and reflecting on his works are among the most important examples of the progress of artistic and scientific knowledge (Alioğlu, 2010).

Leonardo da Vinci, one of the important artists of the Renaissance, researched visible nature with a scientific eye. Da Vinci, whose oldest paintings date back to 1475, was not only interested in painting but also gave importance to technical studies. In his research, he designs more complex mechanisms based on traditional and straightforward systems. While Leonardo examines machine systems such as spinning wheels, pulleys, levers, wedges, and screws, he brings out new and different forms by blending them with aesthetic concern and knowledge. He has worked in many fields such as a perspectograph, projector, and hydraulic system. Anatomy studies are also included in this scientific study developed by Da Vinci. It establishes a link between human and animal physiology (Vezzosi, 2015).



Figure 2-Leonardo Da Vinci's design called “Flying Machine” (Source: Commons, 1488)

According to Leonardo's opinion, the artist should turn to nature instead of imitating the artists who produced works before him. He argued that Classical Greek philosophers and writers should be re-examined and evaluated. According to him, scientists and artists must convey their ideas without any influence (Vinci, 1992).

Da Vinci studied living forms in nature and was impressed by the diversity among them. We can see these in many studies which he designed inspired by nature. For this reason, when we examine Leonardo's work, we can see elements of biomimetic. These interdisciplinary studies by da Vinci establish an essential link in science, art, and design. The Renaissance, of which Da Vinci was an influential artist, led to significant developments in religion and aesthetics and rejected the scholastic thought of the Middle Ages. Leonardo Da Vinci's work is still seen as a source of inspiration today. Today, it is understood that many of the machines he designed were made of living things in nature.

Like Leonardo, Newton is the owner of many inventions and engineering marvels. However, both of them believed in theoretical mathematics. Leonardo's inventions were expressed in the form of drawings, while Newton's in the form of equations. When examined from the framework of theory and practice, Leonardo made a significant contribution to science. Still, we see him more in the history of art. Newton is considered to be the first physicist in history (Shlain, 2004).

Observations and experiments gained importance in the Renaissance and gave direction to the search for a new society. One of the factors that make this period necessary is the geographical discovery of the world. New climates, deserts, and tropical regions have been found along with newly discovered parts of the earth. In addition, the invention of the printing press is one of the most important inventions of the Renaissance. Thus, the spread of information has become more accessible. In this period, belief in divine and superhuman forces that were thought to cause illnesses began to be opposed. Instead of this belief, more scientific inferences based on experiments and observations have emerged.

According to Zafer Gençaydın, art started with the culture of the Neolithic age, and as a result of the intense division of labor with industrialization, art begins to break away from society. Even in ancient times, art and craft were intertwined; they were

not separated from each other. The aesthetic activity of man and daily life practice has not moved away from a social unity. Technology, which dates to the early Renaissance, is a necessary and inevitable extension of science. Art, a powerful means of expression and communication, has changed significantly with the industrial and technological revolutions (Gençaydın, 1988).

With the Industrial Revolution, science, and arts, which were previously the equipment of a craftsman, break away from craft production and reshape as professions. This restructuring of production enables the design to be institutionalized to apply art to production. The development of science and technology has led to the emergence of new expressions of art and design. With the change in the social community, the place of art in society has begun to change.

In the era of the industrial revolution, natural sciences were considered model sciences. Biology elements such as symmetry, asymmetry, and spiral are used to explain pattern formation in art. Biology has served art morphologically for centuries (Weibel, 1998).

Life sciences advanced significantly in the 19th century and, many questions arose with Charles Darwin's reformulation of The Theory of Evolution. As a result, painters have begun to question traditional representation and beauty, which was the primary purpose of art (Strosberg, 2015).

When we look at this period, art and science began to be more influenced by each other. These changes in art have opened a new door to the shift in traditional art perception. One of the important movements that emerged in line with this idea in the 19th century is Art Nouveau. It originated in England as a reaction to the machine age and has had an extraordinary impact on design. During this period, German biologist Ernst Haeckel first used the word ecology.

In his drawings inspired by nature, Haeckel also demonstrated his respect for evolution (Rothenberg, 2011). Ernst Haeckel contributed to biology by illustrating thousands of new species. Shortly after Haeckel's work, D'Arcy Wentworth's description of the myriad connections between biological form, physics, and mechanics proved how optimization successfully exists in nature (Myers, 2018). He explores the shapes and patterns at the origin of nature. It brings mathematics in nature closer to the present (Rothenberg, 2011).

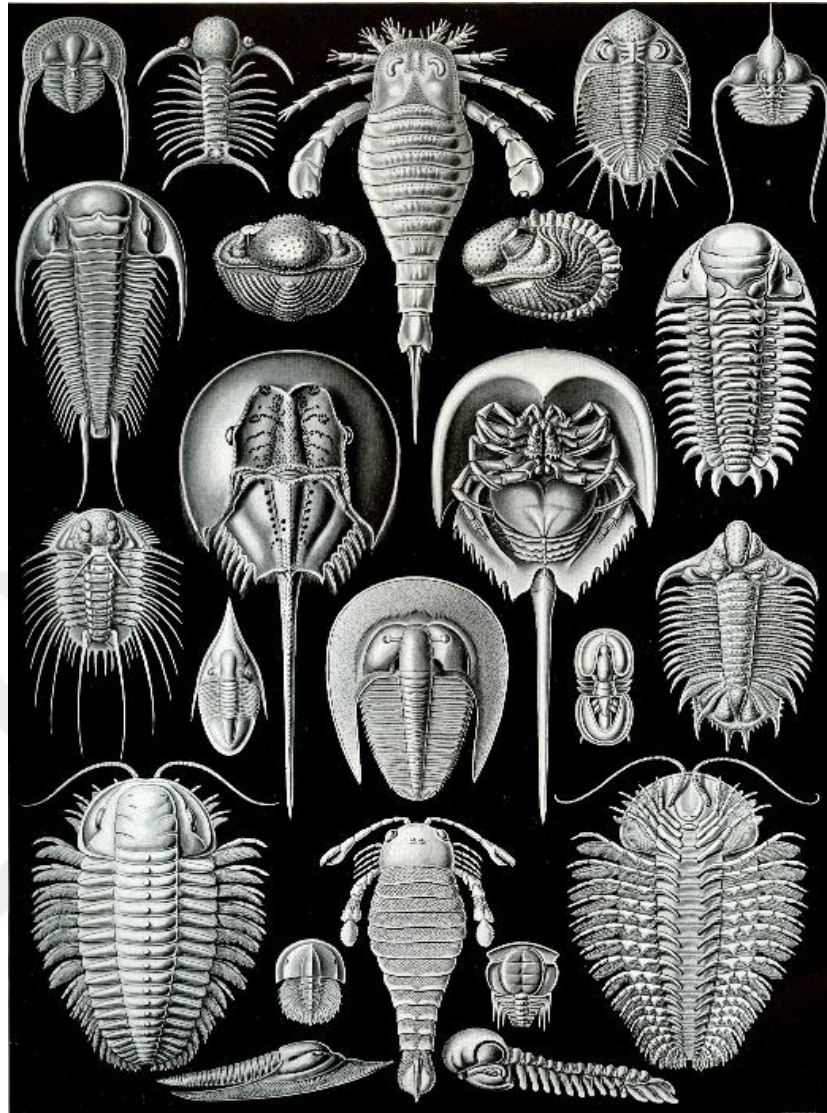


Figure 3-One of the drawings found in Ernst Haeckel's book "The Art Forms of Nature", published in 1904 (Source: Myers, 2018)

The influence of Ernst Haeckel and D'Arcy Wentworth Thompson on architecture and design is widely mentioned in the mainstream of art history (Rothenberg, 2011). At the same time, when we examine the works of these two crucial figures from a contemporary perspective, we see their contribution to the formation of Biodesign. In the Biodesign book published by William Myers, he especially emphasized the importance of these two people while describing the historical process of biodesign (Myers, 2018).

In the 20th century, the concepts of modern art and contemporary art were intertwined. It has led to the destruction of traditional, historical, or academic forms and patterns to create an art suitable for changing societies, habits, powers, and economic conditions. The most important of these movements and styles can be called surrealism, expressionism, dadaism, futurism, constructivism, cubism, pop art, and minimalism, etc. Each art movement emerged as a reaction to the previous one or a more contemporary version of the previous movement. However, what is essential for us here is to examine the parallel and intertwined relationship of the leading artists of these movements with science.

Science and art are intertwined with greater intensity with the advent of avant-garde and modernity. Arthur I. Miller, Professor of History and Philosophy of Science at University College London, summarizes this interdisciplinary transition of the 20th century as follows:

*“As the century progressed, artists continued to look to breakthroughs in science for inspiration. Einstein’s famous equation $E=mc^2$ was central to Kandinsky’s creation of Abstract Expressionism; while in *Nude Descending a Staircase*, Duchamp reflected Einstein’s notions of movements in space and time. Relativity also influenced the Futurists, a group of dapper young Italians who rejected the static nature of Picasso’s Cubism, and evoked speed, violence, and technology of modernity. Dali was inspired by relativity and then by quantum physics in his efforts to represent the passage of time. Mondrian reduced the world to lines at right angles, capturing what he saw as the dynamic nature of the cosmos in equilibrium, while Malevich concentrated on the end of the material world, as represented by the second law of thermodynamics, which states that the universe will eventually run down. In Malevich’s white-on-white paintings, everything disappears” (Miller, 2011, p. 1).*

As Arthur I. Miller mentioned, this cross-border relationship between art and science paved the way for the beginning of an interdisciplinary journey. Moreover, this journey paved the way for new aesthetic values to enter our lives apart from the perception of beauty in aesthetics. For example, values like funny, elegant, naive, and even ugly (Kırhallı and Koçyiğit, 2019). All these values have a relation and importance to

aesthetics as much as beauty. With the change and transformation of art and design, people's perspective on the object has also changed.

2.2 Current Research

Today, ecological problems occur due to urbanization and economic development. Research has begun on many vital issues: the depletion of natural resources, air pollution, reduction of water resources, waste problems, high energy consumption, and rapid population growth. In addition to these, the damages were created by global climate changes and human activities that drive cities to destruction. To produce innovative solutions to the existing problems in the cities and continue the principle of sustainability, essential developments in design and art have occurred. The solution-oriented view of design and the original expressive power of art are combined in this context. In this section, important recent events that led to biodesign and bioart will be examined.

The social structure has changed more in the 20th and 21st centuries. The dynamics of the world have begun to change by globalization. In addition, new technological developments have emerged after the industrial revolution. Due to these developments, new tools have been developed to observe nature, and the opportunity to examine nature at the atomic level arose. Thus, instead of the thought of mere imitating nature, knowledge and laws explaining nature began to be investigated (Öztoprak, 2020).

In nature, the processes and systems of every living thing are efficient, and these organisms have the most appropriate way of using materials and energy. At this point, the importance of biomimicry is under too rigorously. This new branch of science generates ideas for solving problems by examining models that are found and based on existing designs in nature. Inspiration from nature has continued from the past to the present. However, the acceptance of biomimicry as a branch of science took place in the 20th century.

Living things also have been used in art since the early twentieth century. The earliest use of live animals in art is the three paintings exhibited at the Salon des Independents in Paris in 1910. Journalist Roland Dorgeles ties a brush to the donkey's tail. With the

tail's movements, these paintings are created with fauvist color swatches (Davis, 2007).

“News of the prank spread among the avant-garde and inspired the radical wing of the Russian cubo-futurists to name their group “Donkey’s Tail.” The group included Kazimir Malevich, Marc Chagall, and Natalia Goncharova. Donkey’s Tail disbanded in 1913, one year after it formed, but the idea that nonhumans could play a role in art was not forgotten” (Gessert, 2010, p. 1).



Figure 4-Photograph of Roland Dorgelès painting by attaching a brush to a donkey's tail, 1910 (Source: Meakin, 2011)

Although many problems have arisen with the development of science and technology, the transition between disciplines has begun to seek solutions and different studies such as Fleming's scientific discovery. Alexander Fleming was interested in painting as well as scientific studies. He made watercolor works as an amateur. He drew figures on papers and Petri dishes using different types of bacteria. Continuing these unusual experimental studies, Fleming discovered *Penicillium Notatum* in one of his works and had the chance to observe the effects of fungus and its components. Mold fungus

is not a new discovery for the scientific world. However, Fleming made a scientific discovery when he observed that mucus killed this bacterium.

“Fleming's bacterial paintings became noteworthy for the discovery of penicillin on his art. Fleming found that fungi killed bacteria in paper artwork, contributing to the discovery of antibiotics” (Yetisen et al., 2015, p. 726).

With his “Germ Paintings” studies, he discovered Penicillin in 1928 and caused a significant improvement in the field of health. In this context, the first step was to modify living materials for artistic purposes, which are called bioart nowadays.

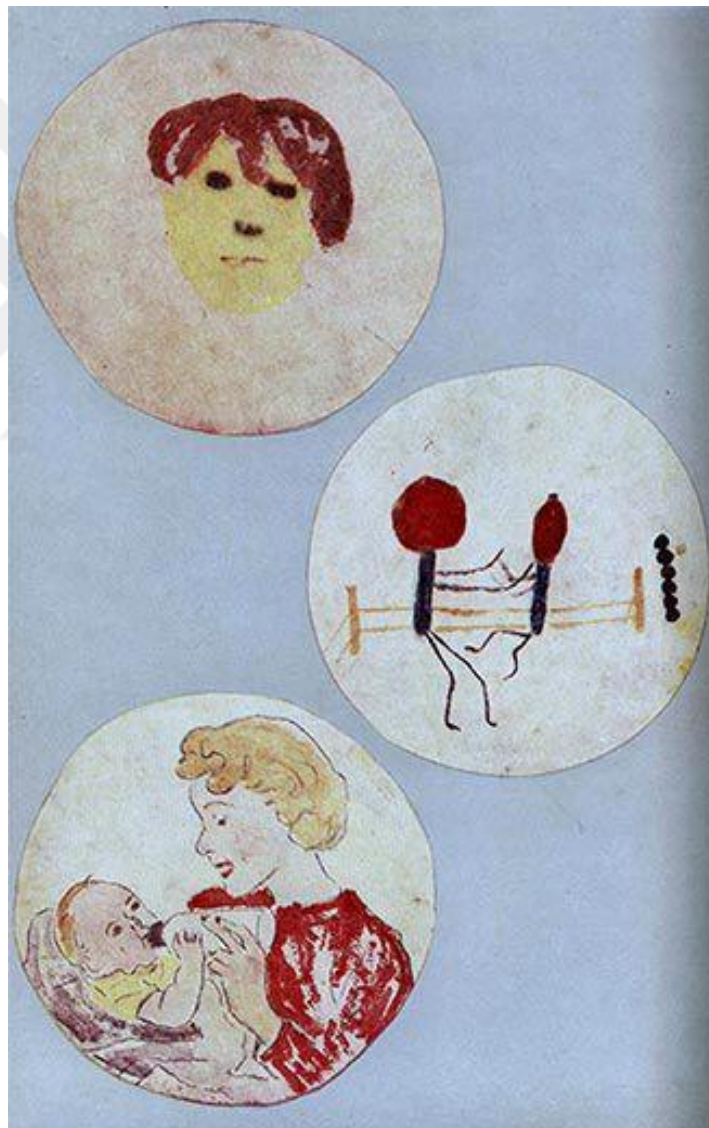


Figure 5-Examples of Alexander Fleming's Germ Paintings (Source: Dunn, 2010)

Edward Steichen is another person who has signed an essential example for bioart. The first exhibition of living beings as art took place in the Modern Art Museum in 1936. The artist created a new living organism with chemical interventions on the plant named Delphinium. According to Edward Steichen;

“The science of heredity when applied to plant breeding, which has as its ultimate purpose the aesthetic appeal of beauty, is a creative art” (Davis, 2007, p. 11).



Figure 6-Edward Steichen's Delphiniums, 1936 (Source: MoMA, 1936)

He was the first modern artist to express that genetics is an art medium. In 1982, 46 years after Edward Steichen's exhibition, George Gessert began hybridizing irises in his garden (Gessert, 1993). Being both a horticulturalist and a contemporary artist, Gessert stands out from other hybrid-plant producers. Because he accepted the formal exhibition and publication venues, these two artists showed that Mendelian genetics (1866) applications also fall into the bioart categories (Yetisen et al., 2015). We will

refer to George Gessert's work again in the following sections. Still, before that, it is necessary to look at another important event in the 1930s.

In 1938, the Exposition Internationale du Surréalisme exhibition was opened at the Galerie Beaux-Arts in Paris. The title of Salvador Dali's work in this exhibition was *Rainy Taxi*. The work consisted of snails, ferns, two mannequins, and a pipe system that led to rainfall. The only common feature between *Rainy Taxi* and Edward Steichen's *Delphiniums* is that they use living materials. However, as we've seen in these examples, different approaches have allowed the bioart to diverge since then. The outbreak of the Second World War interrupted the study of the use of living materials in art. But work resumed in the 1950s. Since then, artists have experimented with various life forms, first in the United States and Western Europe, then in Canada, Russia, the Balkans, Australia, Japan, and China. (Gessert, 2010).

With the deterioration of the natural environment, new approaches in art emerged. Environmental art emerged in the 1960s and continued into the 1970s. Environmental artists such as Robert Smithson, Hans Haacke, Walter De Moria, Robert Morris, Christo, and James Turrell have reshaped the landscapes. It is covered an exceptional and broad field that collectors could not achieve. Robert Smithson covered the slopes with asphalt. Christo Vladimirov Javacheff re-coated the barrier islands using plastic. However, some results that artists could not foresee emerged in these works. The era of environmental art was when the natural environment and the vulnerability of species were noticed. It was also an example of awakening to ecological problems. Some artists have included these issues in their work (Kastner and Wallis, 1998).

In the mid-1970s, artists began to be wary of their interactions with nature. Thus, large-scale works that do not harm the environment started to emerge. In addition, artists began to work on improving the environment. At the end of the 20th century, with the development of life sciences, environmental art paved the way for the emergence of bioart. In the 1980s, the developing life sciences, astronomy, astrobiology, and the search for extraterrestrial intelligence (SETI) played a major role in the development of bioart. (Yetisen et al., 2015).

In the 1980s, we see the work of artist Joe Davis. Today, he is a research partner in the Department of Biology at MIT (Reichle, 2009). Davis has organized projects involving

interstellar radar transmissions for extraterrestrial intelligence and has worked with Harvard geneticist Dana Boyd and others. Davis and Boyd started considering alternative biological carriers for such messages because there were limitations in Radar technology. As a result of the researches, a study called Microvenus has emerged. This work is the first work created with molecular biology tools. (Yetisen et al., 2015).

“Microvenus consists of a graphic icon (like a ‘Y’ and an ‘I’ superimposed) that was coded into a sequence of DNA nucleotides. The sequence was synthesized with Martin Bottfield at Harvard. The resulting synthetic oligonucleotides were purified at UC Berkeley with Dana Boyd and later transformed at Harvard with laboratory strains of E. coli by single-strand, blunt-end ligation with pUC19 and pSK-M13 ϕ plasmid vectors. Microvenus was the first of several artworks that employ increasingly complex strategies to artificially encode human knowledge into DNA” (Davis, 2007).

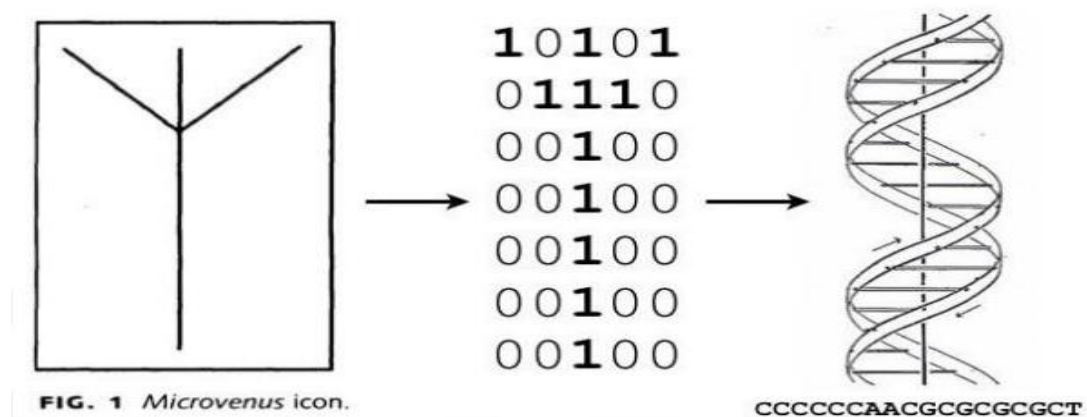


Figure 7-Joe Davis, *Microvenus*, 1986 (Source: Mclaughlin, 2017)

In the 1990s, this biology-centered interdisciplinary interaction began to be separated into different terms. In 1997, two important events co-occurred. First, the bioart statement emerged with Eduardo Kac's *Time Capsule* (Kac, 2007). The second event is the expression biomimicry became famous due to the detailed research of Jenine Benyus. She examined biomimicry in detail with her book *“Biomimicry: Innovation*

Inspired by Nature” published in 1997. The term was first coined as “biomimetics” by Otto Schmitt and added to the Webster's Dictionary in 1974 (Vincent et al., 2006).

One of the first examples of biomimicry is the study of birds and their abilities to fly. Da Vinci studied the anatomy and flight of birds in detail and produced many sketches and notes. He was not incredibly good at creating a flying machine, but he became the first example of biomimicry.

According to Benyus, biomimicry has gathered nature under three headings.

“1.Nature as model. Biomimicry is a new science that studies nature’s models and then imitates or takes inspiration from these designs and processes to solve human problems, e.g., a solar cell inspired by a leaf.

2.Nature as measure. Biomimicry uses an ecological standard to judge the “rightness” of our innovations. After 3.8 billion years of evolution, nature has learned: What works. What is appropriate. What lasts.

3.Nature as mentor. Biomimicry is a new way of viewing and valuing nature. It introduces an era based not on what we can extract from the natural world, but on what we can learn from it” (Benyus, 1997, p. 7).

In her book, Benyus examined the animals, plants, and many other living formations in nature. They revealed the working principles of these systems. These studies are especially important for scientific development. Benyus stated that biomimetics addresses all classes rather than a specific plant or animal species when solving a problem. These can be considered as bacteria, fungi, plants, and animal species (Benyus, 1997).

Although biomimicry and biodesign seem close to each other, they do not mean the same thing. William Myers explained the term as follows in his book “Bio Design: Nature, Science, Creativity”.

“Biodesign goes further than the many biology-inspired approaches to design and fabrication. Unlike biomimicry, cradle-to-cradle, and the popular but frustratingly vague ‘green design,’ biodesign refers specifically to the incorporation of living organisms or ecosystems as essential components,

enhancing the function of the finished work. It goes beyond mimicry to integration, dissolving boundaries between the natural and built environments and synthesizing new hybrid typologies” (Myers, 2018, p. 4).

Biodesign is a newer expression compared to bioart. Working with living things is one of the common features in both areas. With the development and use of biotechnology, some question marks have arisen in these two areas. There are many ethical issues associated with misusing the potential of biological entities. When we look at bioart, it is impossible to produce critical solutions in this context, but it may lead us to ask questions for the awareness of the human impact on science and nature. The relationship of bioart and biodesign with ethics and aesthetics is multifaceted. Especially when evaluating biodesign studies from an ethical point of view, it is necessary to look at biosafety discussions. In the second part, the fields of bioart and biodesign, which differ in terms of method, purpose, and objectives, will be examined in detail under separate headings.

CHAPTER 3: FROM BIOART TO BIODESIGN

Art and Design are two separate areas of expertise. When it comes to biology, the boundaries of these fields have begun to cross each other and become blurred. Christina Cogdell expressed this interdisciplinary transition in the following words:

“What if Chicago-based bioartist Eduardo Kac’s Alba, a rabbit made of a genetically engineered green-fluorescing protein, were not a bunny but a furry room—say, your bedroom—designed by the Spanish “genetic architect” Alberto Estévez?” (Cogdell, 2011, p. 25).

Although these two areas appear to be a crossover, there are major differences between them. William Myers, who has books on both biodesign and bioart, conveyed the differences in these two areas as follows:

“...Biodesign is an approach that integrates biological processes and cycles within ecosystems in art schools, studios, and amateur and professional labs worldwide. In such a climate of into practices as wide-ranging as graphic design, manufacturing, and building. It goes experimentation and energy we can fairly say that this genre will continue to thrive, fueled by beyond mimicry to integration of the biological, and living material often becomes a part the rapid advances in biological sciences as well as the growing need for the public to engage of the finished product or system that has utilitarian application. But biodesign can also be with them”... “Bio Art is an umbrella term for a host of practices that draw from fields such as synthetic. By contrast, Bio Art is a practice that utilizes living biology as an artistic medium, or biology, ecology, and reproductive medicine, often combining art’s pictorial processes and addresses the changing nature of biology’s meaning through its output...” (Myers, 2015, p. 7).

When referring to Myers biodesign above, he stated that it “...integrates biological processes and cycles within ecosystems in...”. It is clear that bioart has no such “direct” purpose. However, bioart can help to ask questions for these types of topics. Eduardo Kac, Marion Laval-Jeantet, Benoît Mangin, Marta de Menezes, George

Gessert, and Paul Vanouse redraw the boundaries of the bioart with the manifesto they published in 2017. With this manifesto, the differences between bioart and biodesign came to the fore again. The manifesto posted on Kac's website is as follows:

“• Bio Art is art that literally works in the continuum of biomateriality, from DNA, proteins, and cells to full organisms. Bio Art manipulates, modifies or creates life and living processes.

- In manipulating biological processes, Bio Art intervenes directly in the networks of the living.*

- Life has a material specificity that is not reducible to other media.*

- Without direct biological intervention, art made solely of acrylics, paper, pixels, plastic, steel, or any other kind of nonliving matter is not Bio Art.*

- All art materials have ethical implications, but they are most pressing when the media are alive. We advocate for an ethical Bio Art: ethical with respect to humans and nonhumans.*

- Some bioartists use living media to express human concerns, while other bioartists celebrate nonhuman organisms and our connections with them.*

- Bio Art has no obligation to thematize topics that relate to biology or the living.*

- We trust art audiences to recognize that because Bio Art is alive, all Bio Art has political, social, cultural, and ethical implications, whether or not these are made explicit by the artist.*

- Bio Art challenges the boundaries between the human and the nonhuman, the living and the nonliving, the natural and the artificial.*

- This manifesto recapitulates and restates issues addressed in our work from the beginning” (Kac et al., 2017).*

In order to distinguish the purpose, method, and differences between these two disciplines mentioned above by William Myers and bioart artists, we need to then separately.

3.1 Bioart

“Bio art is a new direction in contemporary art that manipulates the processes of life” (Kac, 2007, p. 18).

The phrase “Bioart” was coined by Eduardo Kac in 1997 concerning his artwork Time Capsule. However, it was originated at the end of the 20th century (Kac, 2007). As we examined in the previous chapter, the changes in the historical processes from Fleming’s bacterial paintings to the inclusion of DNA in art, bringing a new perspective to its changing paradigm, have laid the groundwork for the emergence of bioart. Bioart is a contemporary art interpretation and combines the vibrant movement of nature with art and technology.

According to Alexander N. Melkozernov and Vibeke Sorensen, bioart is an art application that uses molecules, cells, genes, organs, tissues, living organisms, ecological niches, landscapes, and ecosystems. Bioart also creates new artistic media by using biological processes such as growth, cell division, and photosynthesis. At the same time, they used the following expressions in their articles.

“Bio-art originated in the last four decades of the twentieth century in response to accelerating progress in biology-centered and human-centered science and technology” (Melkozernov and Sorensen, 2020, p. 1).

When we look at it from a more general perspective, we see that bioart establishes a bridge between artist, science, public and biological organism or biological concept. As stated by Eduardo Kac, bioart employs one or more of the following approaches:

“ (1) the coaching of biomaterials into specific inert shapes or behaviours; (2) the unusual or subversive use of biotech tools and processes; and (3) the invention or transformation of living organisms with or without social or environmental integration” (Kac, 2007, p. 18).

This new contemporary art space offers an innovative, theoretical, and practical approach. Bioart emerged in the 21st century as an official subject of academic study by private research centers and universities. Artists generally produce their works in laboratories or art studios by using scientific processes (Azamat and Karahan, 2019).

According to Ali K. Yetisen et al., the pioneers, programs, and initiatives in the interface of biology and art are shown in the figure below.

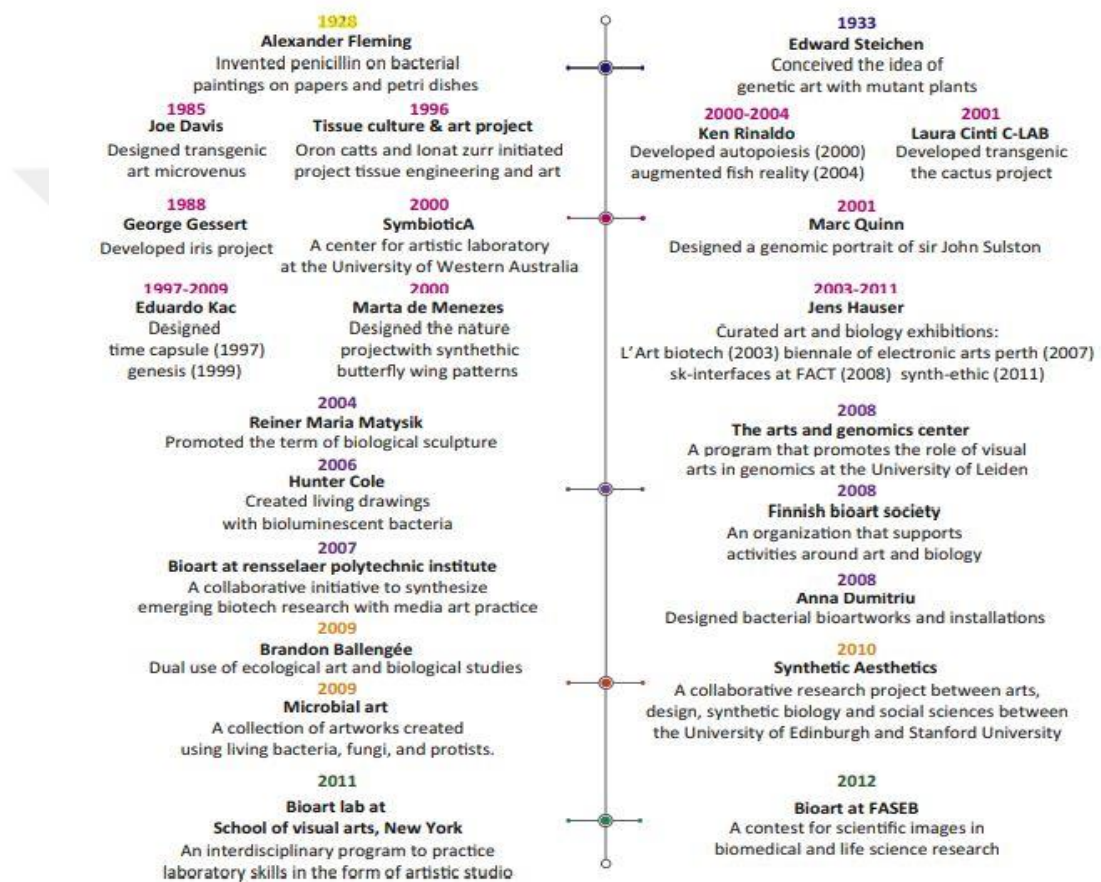


Figure 8-Pioneers, Programs, and Initiatives at the Intersection of Biology and Art (Source: Yetisen et al., 2015)

The scope of bioart varies by artist. For example, some artists limit bioart to living forms, while other artists broaden their research using what they gain from contemporary medicine and biological research (Pentecost, 2008). Ionat Zurr and Oron Catts define “Bio-artists as artists who are using life and living beings both as a medium and as subject matter” (Zur and Catts, 2004).

Biotechnology has also enabled bio-artists to use genetic engineering and cloning technologies to produce their work. It provides a multidisciplinary infrastructure and has created a new community that transcends traditional ideas of art and science. Bio-artists can ask further research questions and contribute to technology while adopting biological methods in collaboration with scientists (Azamat and Karahan, 2019).

In line with the methods and purposes, bio-artworks is divided into three subgroups. Pierre Luigi Capucci's bioart terminology diagram makes these concepts more clear.

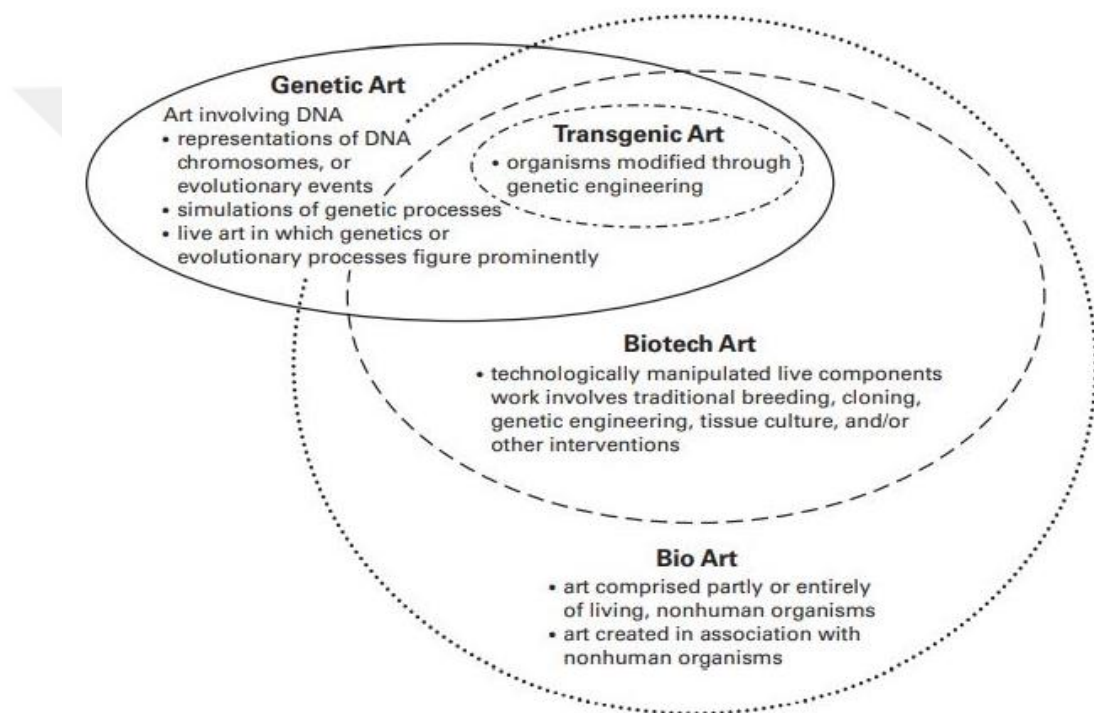


Figure 9-Pierre Luigi Capucci's bioart terminology diagram (Source: Gessert, 2010)

When we examine this diagram created by Pierre Luigi Capucci and accepted by many sources, we encounter different titles. Although these areas with different titles seem independent from each other, they are intertwined with each other. In order to observe the commonalities and distinctions of these areas, we will examine them under different headings.

3.1.1 Biotech Art

Biotechnology has an essential role in agriculture, medicine, and industry. However, it has strengthened our understanding of the biological sciences. Biotechnologies have been included in the adventure of merging the world of art and science. Advances in biotechnology have offered artists the opportunity to work in laboratories to create living and semi-living works of art. In this context, new categories have emerged. Art curator and writer Jens Hauser were the first to introduce biotech art into use among artists. According to him, biotechnological art was explained as follows:

“Biotech art broadly to include life forms modified by technologies ranging from those used in traditional plant and animal breeding to genetic engineering” (Gessert, 2010, p. 2).

As can be understood from the above explanation, Jens Hauser has defined the art of biotechnology in a broad framework. This framework has defined life forms ranging from traditional animal and plant breeding to genetic engineering and modified by biotechnologies (Gessert, 2010).

From this point of view, considering the diagram created by Pier Luigi Capucci, we see that Transgenic art is a subset of Biotech art. It is an art field in which living components are genetically modified. In addition, Ionat Zurr and Oron Catts coined the term "Semi-living" for cells and tissues that survived and evolved outside of the organisms they used (Gessert, 2010). Therefore, to better understand this field of art, which has changed in line with biotechnologies, we need to examine these topics.

3.1.1.1 Transgenic Art

According to George Gessert, Joe Davis was the creator of the first transgenic artwork. Davis, who worked at MIT and Berkeley in 1984 - 1985, inserted a piece of DNA encoded by his work *Microvenus*, which was mentioned earlier, into *E.coli* bacteria. This work was the first living work of art to be performed with genetic engineering (Gessert, 2010). However, Eduardo Kac was the first artist to use the term "transgenic art." In 1988, he defined the term transgenic art as follows:

“is a new art form based on the use of genetic engineering techniques to transfer synthetic genes to an organism or to transfer natural genetic material

from one species into another, to create unique living beings” (Kac, 1999, p. 289).

Eduardo Kac, a Brazilian artist, and theorist has created numerous transgenic works of art and played an essential role in the development of bioart (Reichle, 2009). At the same time, these studies have raised ethical problems, but we will discuss these problems in the next chapter of our research. First, to understand transgenic art, we will examine Eduardo Kac's understanding of art.

According to Eduardo Kac, molecular genetics allows the artist to engineer the plant and animal genome. It also provides for the creation of new life forms. The nature of this emerging contemporary art is not just about the birth and growth of a new plant or animal. With these works, the artist establishes the link between the public and the transgenic organism. In this context, organisms produced under transgenic art are easily accessible by the public. They can be grown even in the backyard. One of Kac's claims is that artists can increase global biodiversity by inventing new life forms (Kac, 1999).

These cross-species hybrid creatures are also seen in Greek mythology. These creatures, called Chimera, emerged as a composite of lion, goat, and snake (Hernigou, 2014). Chimera sculptures and paintings are exhibited in many museums around the world. While Chimera as a word refers to any imaginary form of life made up of separate parts, Chimera in biology is a technical term that means an actual organism with cells from two or more different genomes. Along with transgenic art, Kac suggests that these Chimeras are not imaginary (Kac, 1999).



Figure 10-Chimera statue at Museo Archeologico Nazionale (Source: Kac, 1999)

Eduardo Kac presented his work GFP-K9, which he called the first transgenic art project, in the manifesto he published in 1998. This project was a proposal for the creation of a fluorescent dog. It can be realized by transferring the DNA sequence of a jellyfish living in the Pacific Northwest (*Aequorea Victoria*) into a dog's DNA. Kac specifically chose the genetic sequence of this jellyfish. This green fluorescent protein (GFP) allows it to emit bright green light when it is exposed to ultraviolet light of a particular wavelength (Reichle, 2009).

Every living organism has genes that can be manipulated. Recombinant DNA can be quickly passed on to subsequent generations. Under transgenic art, the artist is a genetic programmer who can create life forms by writing and modifying a specific series (Kac, 1999). Eduardo Kac wanted to create a new life form as a genetic programmer, as seen in the image. However, the GFP K-9 project was not finalized at that time, as the technology was not sufficiently advanced to allow fluorescence to be carried into a dog's skin (Kac, 2007).

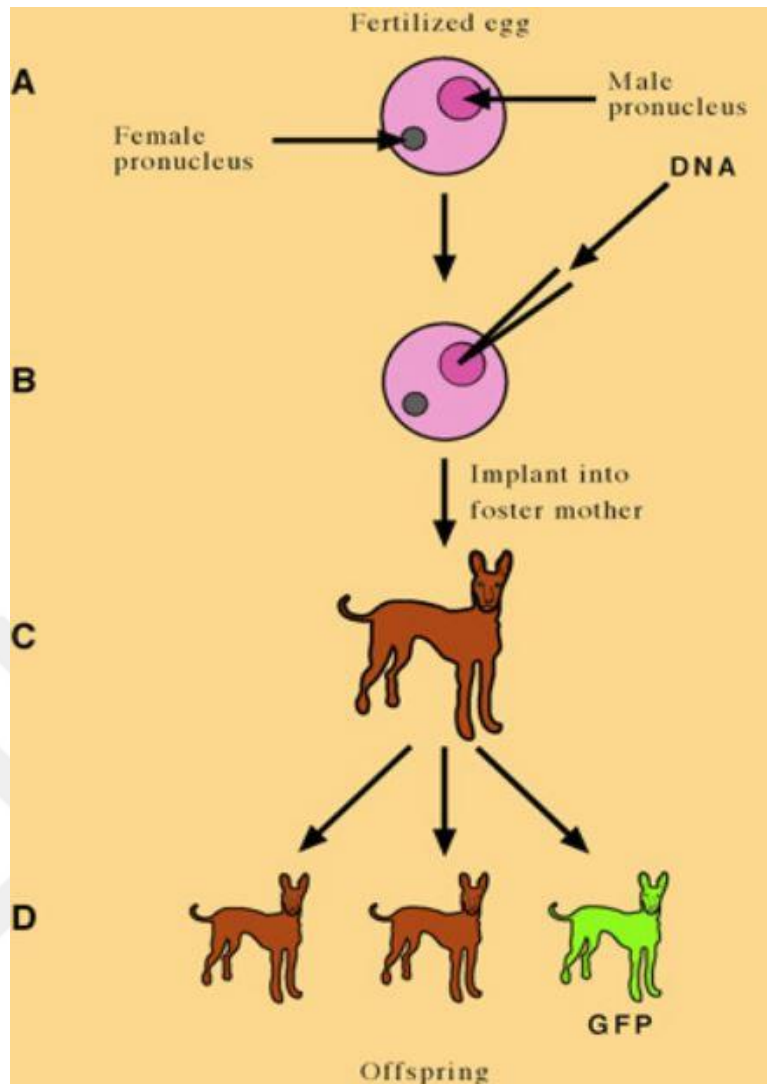


Figure 11-Production of GFP K-9 (Source: Kac, 1999)

In 1999, Eduardo Kac brought his first transgenic artwork to the audience. This installation titled “Genesis” was supported by Ars Electronica and the OK Center for Contemporary Art in Linz. Seeking to visualize genetic processes and their manipulation by humans, the artist created a synthetic artist's gene that does not yet exist in nature (Reichle, 2009).

As we have examined with examples, transgenic art is a new art form based on transferring synthetic genes to an organism to create unique living things. Genetic engineering is essential in this context, but in this section, we have not touched on the ethical issues that cause them to pose threats in the future. Many questions have arisen as a result of biotechnical interventions. Ethical questions, especially for which

answers are sought, will be examined in the next chapter of the thesis through the examples of Eduardo Kac and more artist works.

3.1.1.2 Semi-Living Art

Humans perceive the world as a giant organism that contains consciousness and self-concept. This considered resolution extends from the subatomic to the universe. Most people feel uneasy when their reality is questioned as a result of their perception. Parts of the complex bodies of organisms have been cultured since 1910. The generation of the new form of life challenged many things. For example, in vitro cellular life, the concept of death, the concept of self. In the beginning, semi-living beings existed as part of a complex living being. But then it existed outside and independently of that being. This is seldom discussed, mainly because it is constrained as a scientific entity. Semi-living beings have gone out of the laboratory environment and started to show themselves in an artistic context (Catts and Zurr, 2007).

“A new concept is emerging in the continuum of life - the Semi-Living, a new and autonomous entity located on the fuzzy border between the living and the non-living, the organically grown and the constructed, and the object and the subject” (Zurr and Catts, 2002, p. 55).

According to Ionat Zurr and Oran Catts, the semi-living being is not an imitation of humans and is not trying to replace humans. On the contrary, it is different from manufactured objects and has similarities and differences with domestic plants and animals. Despite this, they said that a semi-living, self-centered species had a connection with Homosapiens. The reason for this is that they emphasized that these creatures are the product of a human-centered activity. However, semi-living creatures never fit into the classification of a man-made object or a modified animal. These creatures came into existence by containing both. (Zurr and Catts, 2002).

In order to understand the emergence of semi-living creatures in an artistic context, it is necessary to emphasize the history of the use of living tissue outside the body and the importance of its development during this period.

The term “tissue culture” was first coined by surgeon Alexis Carrel and his assistant Montrose. In 1910 they began experimenting with in vitro tissue growth using a variety

of tissue types. These tissues included embryonic, cancerous, and adult tissue types. In addition, they sought to discover new techniques for extending the lifespan of the body. To do this, Alexis Carrel began to study cell division and growth outside the body (Witkowski, 1979). Hannah Landecker, author and professor of sociology, writes of tissue culture research:

“Central to this was the establishment of the possibility of 'permanent life' for tissues in vitro, giving rise to the possibility of an immortal or continuous experimental subject abstracted from the perishable bodies of individual animals and humans” (Zurr and Catts, 2002, p. 57).

By the 1950s, tissue culture was accepted as a discipline. As a result, the use of premixed solutions and other products has become available. In this way, it has started to be taken as a research field rather than a research tool. By the early 1990s, it was realized that cells could be grown in three dimensions. These three-dimensional cells can form implantable functional tissue to replace and support organs. In this way, tissue engineering emerged (Zurr and Catts, 2002).

Tissue engineering is concerned with constructing artificial support systems through biomaterials to enable or support injured or defective body parts to function. In this process, tissue growth is directed as desired and is under control. This field offers the opportunity to study interdisciplinary. People from different disciplines such as biologists, chemists, engineers, and artists are interested in tissue engineering (Lanza et al., 2007). Functional and living tissue engineering coming out of the body paved the way for the semi-living sculpture to emerge.

A research project called “Tissue Culture and Art Project” was set up to create semi-living sculptures. In addition, this project examines the use of tissue technologies (Zurr and Catts, 2002).

The origin of this project is to reveal an artistic manipulation of living materials using the research tools of modern biology. It deals with the level below the organism and above the cell. These semi-living beings are grown in bioreactors. These conditions are artificial conditions that mimic body conditions. Two essential names in forming the Tissue Culture and Art Project, Oron Catts, and Ionat Zurr, said the following about the semi-living sculpture they created (Catts and Zurr, 2002).

“The entities we create might become our "naturalist" companions, invading and replacing our constructed and manufactured environments. Our Semi- Living sculptures must be kept in sterile incubators and must be immersed in nutrient media. We see them as emotive objects which require care for survival” (Zurr and Catts, 2002, p. 58).

The work named Pig Wings seen in the image is an example of this. Three different colored wings grown on polymers were made using pig bone marrow cells. These wings were grown in the bioreactor for about nine months. In this study, it was created based on the myths in history that animates chimera and hybrid beings (Zurr and Catts, 2002).

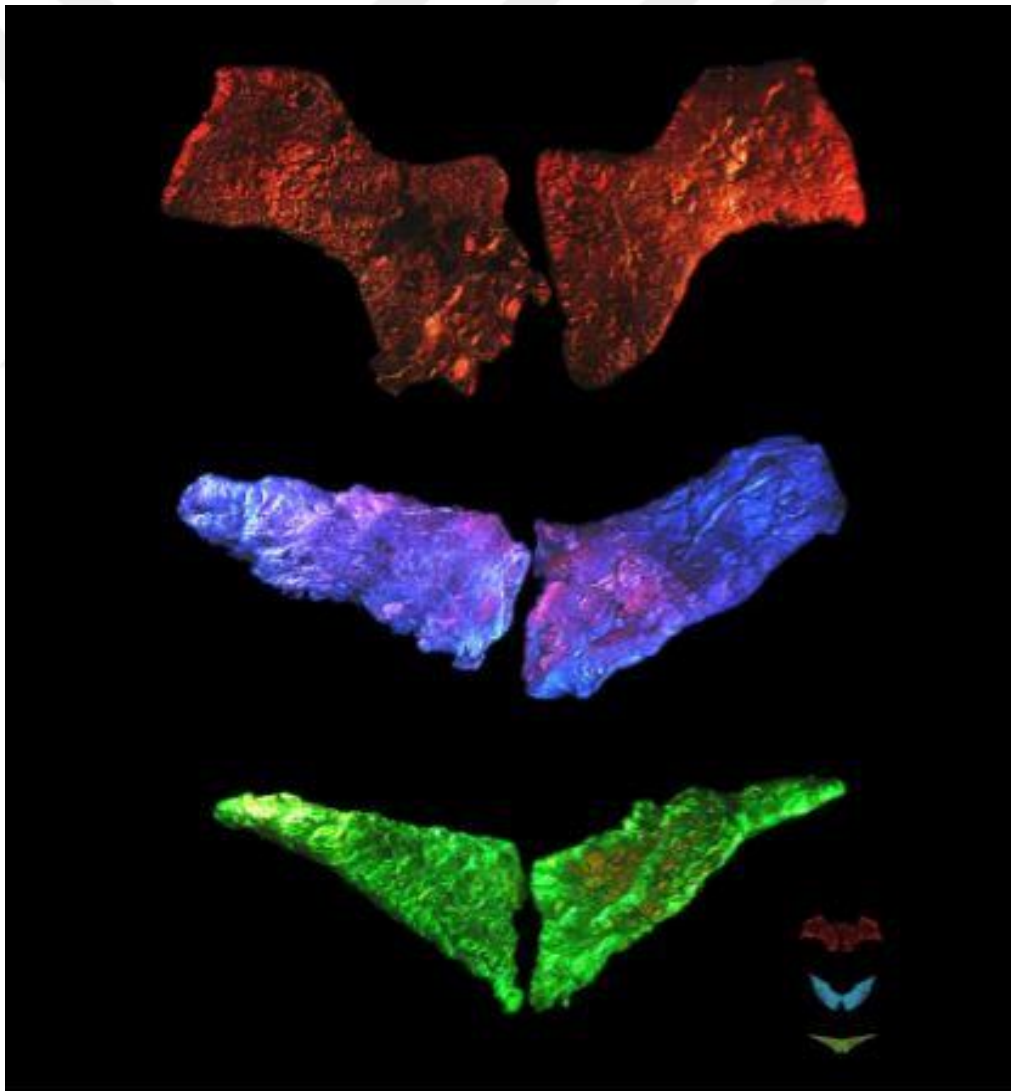


Figure 12-Pigs Wings , Oron Catts, Ionat Zurr and Guy Ben-Ary, 2000-2001 (Source: Anon., 2001)

However, the use of these semi-living beings through art raises many questions. One of the biggest dilemmas that Bioart faces is the ethical questions that arise with the use of these living systems. Like the artists we mentioned above, we will examine ethical issues through examples of other artists working with these systems in the next part of the thesis.

3.2 Genetic Art

Genetic art is an art involving DNA. It contains works in many fields, such as regulations regarding genetically processed foods, transgenic organisms, reproduction of extinct organisms (Girgin, 2020). For example, genetic artist and flower grower George Gessert said in his 1993 article:

“We do not have to look to the future to see genetic art. It is already abundant. Domesticated ornamental plants, pets, sporting animals and consciousness-altering drug plants constitute a vast unacknowledged genetic folk art, or primitive genetic art, that has a history stretching back thousands of years” (Gessert, 1993, p. 205).

Generally, genetic art is associated with biotechnology. Still, as Gessert said above, the art of genetics originated before genetics even existed.

The best example of this idea is Shakespeare's *The Winter's Tale*. In the book, a domesticated flower from the carnation family is mentioned. Shakespeare stated in his book that reproducing things could be an art and that native ornamental plants have existed for thousands of years (Scholl, 1912).

Today, advances in data storage, increased speed of computers, and reduced cost of digital devices have enabled us to establish a closer relationship with technology or biotechnology. In addition, the increasing interest in scientific discoveries enabled art and science to meet on the same ground.

Some artists have been influenced by the development of possibilities, the genetics of the body, and genetics research. These artists use visual images and markers such as genetically oriented autoradiographs and chromosomes. In contrast, the known form of DNA has been a source of inspiration for some artists that have entered the production process with the genetic codes of a person symbolically depicted by the

letters A (adenine), T (thymine), G (guanine), C (cytosine) (Girgin, 2020). Therefore, it is crucial to know the emergence of genetics to analyze and understand why and how these artists' works have been done and the methods they have developed.

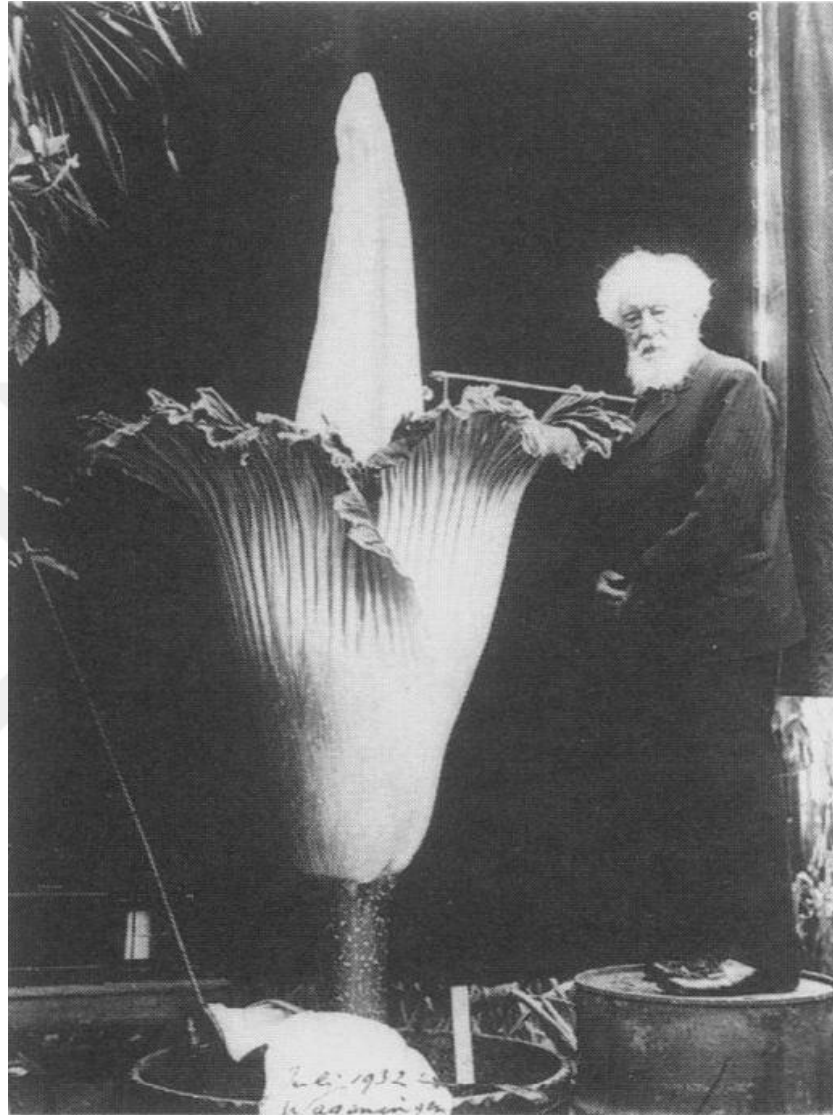


Figure 13-Hugo De Vries standing beside an *Amorphophallus titanum* (Source: Tomasula, 2002)

The branch of biology that deals with the study of genes, genetic variation, and heredity in organisms is called genetics. George Mendel, the founder of genetic science, revealed that genes are inherited in the 1860s. Mendel presented a mating scheme involving the crossing of purple and white flowering pea plants in his experiment. Each plant carries a gene copy. Genes are like packets of information that

pass on the traits of organisms to the next generation (Griffiths et al., 2015). These Mendel experiments have also paved the way for creating the world's most giant flowers in later times. Hugo De Vries was the name who rediscovered Mendel's theory of property propagation (Tomasula, 2002).

However, Edward Steichen was the first artist to claim plant breeding as fine art (Girgin, 2020). Only a few renowned artists have produced genetic art. In 1928, Edward Steichen grew the 5-acre delphinium in his country house near West Redding, Connecticut. Steichen also hybridized cleomes, nicotianas, poppies, and sunflowers. In 1936, his hybrid delphinium flowers were exhibited in the Museum of Modern Art (Gessert, 1993).

After the exhibition, critics described Steichen's work as “breathtaking”. These flowers were enormous and finer colors than ever before. The basis for this success was the colchicine drug obtained using the code for gout. He doubled the chromosome numbers by applying this drug to the plants (Tomasula, 2002). The following quote from George Gessert draws attention when we examine these plants.

“Many earthworks and environmentally informed artworks have genetic components” (Gessert, 1993, p. 205).

The components of these earthworks and environmentally informed artworks are essential. However, it is not apparent and easy to overlook. Alan Sonfist's Time Landscape began in 1965, and the artist recreated historical landscapes from New York's past. Shrubs, herbaceous plants, and trees found in Manhattan have been reintroduced in several areas within the city. This work plays many ecological roles. These are to absorb rainwater, absorb pollutants such as airborne metals and carbon dioxide from the air, and release oxygen (Umbanhowar, 2005). They were later transformed by European settlers (Gessert, 1993).

Helen Harrison and Newton Harrison are other vital names for genetic art. Their life work suggests preserving or, in some cases, creating biological systems through art (Gessert, 2010). Harrison's best-known work is The Lagoon Cycle. This work emerged from searching for new organisms that could withstand the rigors of displaying in art galleries. They studied the crab *Scylla Serrata*, an important food

source in Sri Lanka. After returning to the United States, they raised these crabs in a studio and discovered how to produce them (Gessert, 1993).

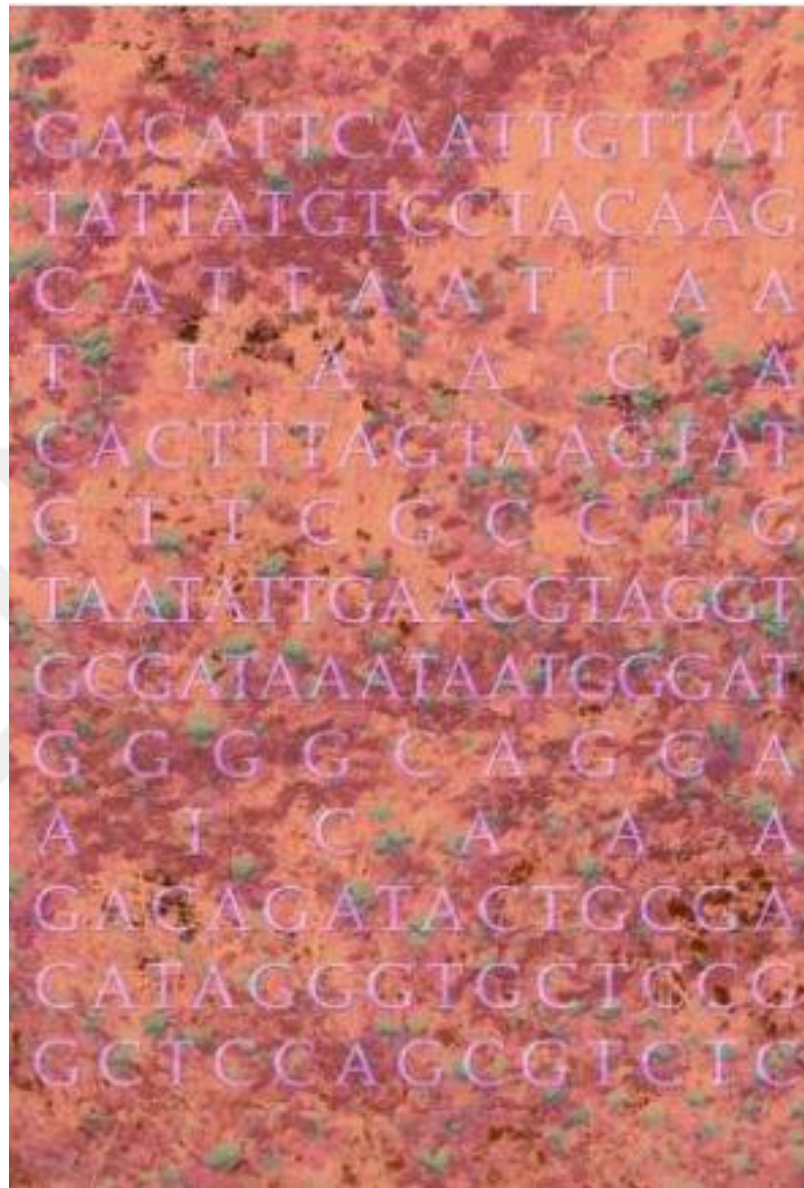


Figure 14-Kevin Clarke, Portrait of Ute Berger, 1998-99 (Source: Gessert, 2010)

By the end of the 1980s, Kevin Clarke has begun to intertwine genetic information with photographic portraits to explore identity problems. Dennis Ashbaugh, who was also one of the artists of the same period, produced works that he called “DNA paintings.” These studies are autoradiographs, which are barcode-like patterns produced by DNA (Gessert, 2010)

Until 1988, genetically modified flowers would not be shown as art again. George Gessert's Iris Project was exhibited at New Langton Arts in San Francisco in 1988. Gessert hybridized wild varieties and created artistic irises (Youngs, 2000). According to Amy M. Youngs,

“His decision to compost the flowers that have ruffled edges is both an aesthetic choice and a reaction against commercial flower breeders, who tend to breed for ruffled petals in every flower species” (Youngs, 2000, p. 378).



Hybrid 440 (Hybrid 94 x Robert Smithson)
1990. First bloom 1993. Diameter 2.5"

Flowers that are dazzling in the wild may be inconspicuous in gardens. Visual competition from domesticated ornamentals, many of which are large, colorful, and extravagantly formed, can diminish even the finest wildflowers into pretty little souvenirs, hardly worth a second glance. Sometimes the visual qualities of wildness can be strengthened through breeding. 440 is a second-generation hybrid that retains the charm and clarity of wild irises, but is more heavily veined. This intensification makes it a more successful representative of wildness in the garden than most species irises would be. Unfortunately the plant died the year it first bloomed.

Figure 15-Evolution aesthetics documented by the breeding of the iris flower by George Gessert (Source: Gessert, 2010)

The aim here is aesthetic rather than convenience. The important thing is, “*How did nature change?*” With this point of view, Gessert has adopted the Darwinist view. According to Western dualism, art and nature are different, and the two cannot come together except for landscape architecture. Until recently, this dualism is dominated western art galleries. According to Gessert, the contemporary art world is more suitable for the Darwinist view because this view maintains that every aspect of culture is an expression of nature (Girgin, 2020).

George Gessert's work on genetic art played an important role in the development of this field. At the same time, in his book, in which he wrote the development process of genetic art, he explained the historical process of genetic art as follows.

“Genetic art proliferated after 1990. An important development in representational work was what Suzanne Anker has called “the new grotesque,” freakish or malformed human figures, such as Jake and Dinos Chapman’s sculptures of conjoined children, Aziz + Cucher’s chimeras, and Cindy Sherman’s photograph of herself with a pig’s snout. Exploration of the grotesque had begun well before 1990 (it goes back many centuries), but it did not register the hopes and fears unleashed by biotechnology until roughly the last decade of the millennium. Closely allied with the new grotesque, which focused on the human figure, were monstrous animals, such as Thomas Grünfeld’s Misfit (St. Bernard) (1994), a taxidermal hybrid of a dog and a sheep. Another important development in genetic art was the expanded use of photography. Prior to the 1990s, the only role that photography played was in documentation of breeding projects and exhibits” (Gessert, 2010, p. 117).

Today, in line with the new technologies developing, the human body system turns into an electronic object that can be controlled artificially. Advances in the medical field such as plastic surgery and neuroprosthesis have expanded the boundaries of this field. With digital implants and genetic engineering, art has made invisibility to visibility. Both will have profound consequences for the future in social, medical, political, and economic spheres, as well as in the arts (Kac, 2007).

3.3 Biodesign and Designing with Living Systems

There are differences between biodesign and bioart, and William Myers attributed this to techniques and goals and explained to them as follows. Bio-designers are oriented towards the user's needs. They emerge after a training process at a design school, where they receive methods, hands-on experiments, iterations, and optimization. In addition, designers create generations, interfaces, and platforms aimed at others that are intended to be distributed and experienced. In contrast, bio-artists often engage in laboratory work where they can collaborate with scientists. Often they are interested in creating work that conveys an original aesthetic experience (Myers, 2018). Bio-artworks do not need to be used in a meaningful way. Due to its artistic nature, it cannot be expected to contain functionality such as design. When the works of the artists are viewed in terms of accessibility, it appears more preferably.

Biodesign examines new ways of applying biology outside the laboratory. This context has enabled several projects from architecture, industrial design to fashion and medicine (Myers, 2018). There are many different studies that we can evaluate in nature-inspired design. However, when we examine the content of the biodesign discipline, the definitions of design historian William Myers made a vital contribution to which studies are included.

Biodesign is a collaboration of science and art that refers not only to eliminating boundaries but also to create a new hybrid design for a sustainable future lifestyle. In his book *Bio Design: Nature, Science, Creativity*, William Meyer clearly emphasized that biodesign is different from other nature-inspired designs. Many examples of the combination of biology and design practice create this new sustainable lifestyle, including leather grown in the laboratory or self-healing concrete filling. Biodesign combines living organisms, air purifiers, design building blocks with material resources, energy generators, digital storage systems to gain new possibilities. Therefore, it makes sense to recognize the potential benefit of biodesign and recognize natural interactions with ecosystems (Myers, 2018).

Biodesign is a new design paradigm that includes materials derived from living organisms and their processes. A new frontier is presented with the advent of this new, bio-inspired design. Unlike biomimicry, biodesign develops a different perspective in

terms of nature and design (Esat and Ahmed-Kristensen, 2018). William Mayers explains the biodesign as follows:

“Biodesign goes further than the many biology-inspired approaches to design and fabrication. Unlike biomimicry, cradle-to-cradle, and the popular but frustratingly vague ‘green design,’ biodesign refers specifically to the incorporation of living organisms or ecosystems as essential components, enhancing the function of the finished work. It goes beyond mimicry to integration, dissolving boundaries between the natural and built environments and synthesizing new hybrid typologies” (Myers, 2018, p. 9).

As mentioned above in Myers, it is not biomimicry. Jenine Benyus has explained the term biomimicry in detail since 1997. Biomimicry is a detailed approach that encompasses design engineering on inspiration. This design field, which emerged differently from biomimicry, is defined in another source as follows:

“Biodesign in living organisms deals with the structure of the particular organism and the interactions between the biomolecules encoded in their genomes” (Yang et al., 2019).

In its broadest sense, biodesign aims to create biological behavior at the molecular, organismic, and cellular levels. It deals with the nature and properties of information and how biological systems interface with the environment and devices. It also benefits from many different disciplines such as tissue engineering by using the possibilities of biotechnology. From this point of view, it is necessary to examine the studies produced on the sub-disciplines of design.

The “Bio Concrete” is designed for the needs of the user. Hans Jonkers developed this experimental material at the Delft University of Technology. In this structure, it uses intact bacteria that naturally secrete limestone under certain conditions. These bacteria are mixed with nutrients before they dry in concrete. Cracks are formed in the concrete due to wear, and the concrete invigorates the bacterial limestone. This can increase the service life of the concrete and cause a low carbon footprint for concrete, one of the world's most common building materials (Myers, 2018). William Myers has examined the natural world and manufactural words to collect study cases that contain

organisms. These cases show that while nature is changing, our relationship with nature is broken. He questions that we will be able to fix it by using biodesign.



Figure 16-Bio Concrete by Hans Jonkers (Source: Matchar, 2015)

To collect essential ingredients, to collaborate between designer and biologist are creating new forms within the design. At the bottom line, Biodesign is somehow transferring the technology into the format, which will be helpful for everyday life. One of the biodesign projects is a fabulous example of this transfer. “Moss Table” is designed to create energy by using mosses and their natural energy.

This table design is a conceptual design example, not intended to demonstrate the potential of Biophotovoltaic (BPV) technology and how it might be applied in the future. Renewable energy and other valuable by-products arise from the photosynthesis process of living organisms such as algae and moss. Moss Table points out that hybrid objects can be used in the home between natural and artificial. Moss Table is designed to power digital alarm clocks and other small electronic devices. This technology is still under development. However, the scientists emphasize that more research like this applications are possible in the future. Low-cost BPV devices

could become competitive alternatives to traditional renewable technologies such as bio-fuels in the future (Peralta et al., 2011).



Figure 17-Bio-photovoltaic Moss Table (Source: Products, 2011)

Another example of industrial design is Eric Klanderberg's work inspired by mushrooms. In this example, Eric Klanderberg was inspired not only by the shape of Veil Lady Mushroom but also by the power of colonizing mushrooms to make the stool more solid (Bluto, 2015).

Eric Klarenbeek and Maartje Dros create a range of specialized works for private interiors and open public spaces. Some of these are making glass work, perfumes, and DIY kits for making simple LED lamps. They are also looking for ways to integrate

their ongoing studies with biology into their work ecologically. For this, they propose a polydextrose studio. One of the works of Eric Klarenbeek and Maartje Dros in the studio is the effort to transform furniture pieces such as chairs into a previously unmet shape. This study, called the Mycelium Project, uses a substrate infused with fungal spores and nutrients in a mold. Fungi are given a few days to grow. As a result, mycelium expands in the mold, increasing the density of the substrate and gaining hardness. These mushrooms usually sprout at different points on the chair (Myers, 2018).



Figure 18-The “Veiled Lady 1.0” stool demonstrates an integration of a 3D-printed casing within which rigid volumes contain mycelium (Source: Myers, 2018)

As we emphasized earlier, biodesign refers to many sub-disciplines of design, and it offers the opportunity to move the working limits of this field to a broader framework. When we transition from a smaller creature to a larger creature, we see that the use of animals is essential for biodesign. Humans have domesticated animals for thousands of years.

From the earliest humans to the present day, animals have made a place in most of our lives. Sometimes it is a food source for people, sometimes it is used for transportation, and sometimes for making progress in medicine. When we examine the

valuable part of this cooperation with animals, we see that people get help from them at many points. Most of us primarily benefit from their friendship. In the example of the next biodesign, we will see how helpful these creatures are in the physical disability of humans.



Figure 19-The dog exercises regularly on a treadmill in order to deliver oxygen to its debilitated owner (Source: Myers, 2018)

This study called Life Support consists entirely of a scenario. Here animals function as external organs. In this work, Revital Cohen Tuur Van Balen asks the following question. *“People love their animals, but is it possible that they love respirators?”* The dog we see here is a greyhound bred for track racing. Usually, these animals are euthanized by the age of five. This project proposes to prevent the death of these hounds and alternatively to train them as respiratory assistants. The dog is fitted with running gear. Through the trachea tube, the dog's chest movements will be used to pump air into the owner's lungs (Myers, 2018).

Another example is Mike Thomson's, Latro Lamp. With the development of industry and the increase in production, serious problems have emerged on the planet. With this human intervention, the essential elements of the ecosystem began to follow a path towards negative consequences such as increased morbidity and death rates. They are

caused by environmental pollution, acid rain, and ozone destruction. In addition, the reserves of fossil fuels have started to decrease gradually. For this reason, the trend towards alternative energy sources has gradually increased.



Figure 20-Latro Lamp (Source: Mensvoort, 2012)

Researchers have tried to create new possibilities for energy production. Advances in nanotechnology have facilitated these researches. As a result, the opportunity to benefit from plants in energy production and absorption is increasing. This lamp is a product that can use the seaweed plant as an energy source. Latro is a word of Latin origin meaning thief. However, the study refers to the use of electrons by algae from photosynthesis. This type of algae can quickly light a lamp. The Latro lamp operates on a solar cell that stores solar energy during the day to be used even when sunlight is

not needed. The design needs algae growth, sunlight, carbon dioxide, and water (Sepehri, 2016).

Another factor in the degradation of the ecosystem is the issue of waste. In this regard, it is necessary to raise awareness of humanity and increase sensitivity to the natural environment. The language of design is quite powerful in this regard. The study called Microbial Home allows us to look at this waste problem from a different angle.



Figure 21-Microbial Home by Philips Design (Source: Etherington, 2011)

“Microbial Home” work has a circular ecosystem and was designed by Philips. Each function's output is intended as an input to the other. In this project, the house is considered a biological machine. This machine was built to filter, process, and recycle sewage, garbage, and wastewater, which are considered waste. This design helped to raise questions about how resources were handled. Based on the project, it invites us to be closer to nature and also exemplifies the fact that the bacteria around us become beneficial without disappearing (Filippetti, 2011).

The following example is a traditional geometric tile design using the plant as the material. This tile design is made with living systems, and it is allowed to change unpredictably.



Figure 22- Growth Pattern (Source: Myers, 2018)

This work named “Growth Pattern” was made by Allison Kudla. A system that lives in the form of a model produced in this design can develop and change shape naturally. Here we see tobacco leaves in square tile Petri dishes. In the study, tobacco leaves were cut with a die in a bilaterally symmetrical pattern. Hormones and nutrients required to stimulate new leaf growth are suspended in Petri dishes. Plant cells can proliferate and differentiate, and in this example, newly growing leaves undergo morphological changes. In this way, the traditional leaf shape inspired is differentiated and expanded (Myers, 2018).

As in the work of “Grown Pattern”, designers or artists are now oriented towards the new material possibilities that a living system can create and benefit from the model form. Increasing research into the sourcing of innovative materials is opening new doors for designers and artists. As we mentioned before, although we encounter it in industrial design and architectural fields, we have started to discover it frequently in fabrication. New alternatives to old design methods, namely biomaterials, have been

developed. These materials are the developments in mediated and sensitive materials and composite materials. Therefore, a new era of material-based design has been provided in various design disciplines.

According to Neri Oxman, an associate professor at the MIT Media Lab and founder of the Mediated Matter Group, Material Ecology is an emerging field in design. Area expresses the conscious relationships between products, buildings, systems, and their environment (Oxman, 2020).



Figure 23-The Aguahoja Artifacts Display (Source: Laster, 2020)

One of the projects where Neri Oxman managed the working process is the Aguahoja project. It has been a synthesis of many materials. This project is explained as the discovery of nature's design field. It is an example of the robotic fabrication of molecular components found in tree branches, insect exoskeletons, and human bones. These alternative materials on display reflect the diversity of the range of use of materials such as chitin. Examples of these are the exoskeleton of shells, and the way fungi form their cell walls. Unlike concrete and steel, these materials are composites and have constant dialogue with the environment (Royo et al., 2015).

Many designers and artists worldwide are searching for alternative materials, such as Neri Oxman and her team. The series of works by Nergiz Yeşil called “Lorem İpsum II” with living organisms is an excellent example of the fact that these searches are also realized in Turkey.

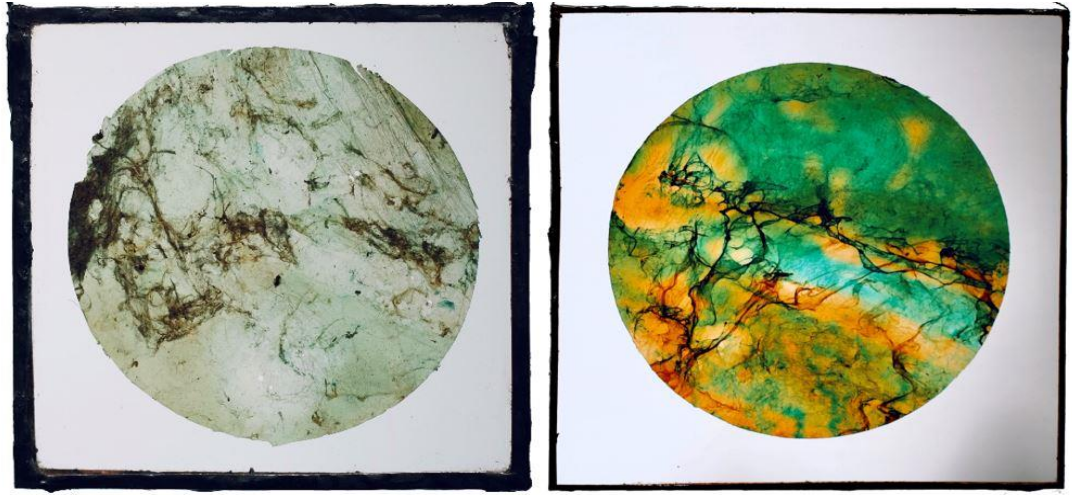


Figure 24-Nergiz Yeşil's series “Lorem İpsum II”, created using Manchurian mushrooms and food coloring, 2019-2020 (Source: Galerinev, 2020)

The artist created an experimental working environment with Manchurian mushrooms (Kambucha) and turned her workshop into a laboratory environment. As a graduate of the sculpture department, the artist comes from art practice. The adventure of finding form, which started with these living organisms, has brought her studies closer to bioart (Türkmen, 2021). However, as it is clear from here, due to the existence of this interdisciplinary transition, these studies have contributed to the investigation of a strong material possibility for biodesign.

The search for new materials with these rapidly developing living organisms is most common in Fashion. Fashion futurist Suzanne Lee started a research series called BioCouture in 2003. This series, an essential step for fashion, obtains a cellulosic material in cooperation with bacteria and yeasts. The designer, who calls her work “*the use of living cultures of microorganisms (yeast and bacteria) to grow biomaterials like cellulose into sustainable, compostable clothing*” (Collet, 2020), benefited from the

possibilities of Kambucha mushroom just like Nergiz Yeşil. As a result, Suzanna Lee started to create a leather-like and fabric range by following different methods.

Continuing her work rapidly, Lee has set an important milestone for textile and fashion in the field of biodesign. The BioCouture Shoe, which she exhibited in collaboration with Liz Ciokajlo-Squire in 2013, set a good example for this situation (Collet, 2020).



Figure 25- The BioCouture Shoe (Source: Alive, n.d.)

The field of biodesign has a wide range, as we have seen with examples. The nature that started with biomimicry as a model has left its place to nature as a co-worker and then to nature as a hackable system. This new evolution of design provides a synthetic nature model (Collet, 2020).

With the increasing frequency of interdisciplinary transition in line with the new possibilities brought by biotechnology and partnership with living systems, it becomes

difficult to separate the works created under the headings such as design or art. However, while exploring this complex world of working with living systems, nature's transformation into a synthetic one brings aesthetic and primarily ethical issues to the surface. In order to understand this better, we will examine these discussions on art and design in more detail in the next chapter.



CHAPTER 4: THE ETHICS AND AESTHETICS OF BIOART AND BIODESIGN

The growing interest in biology with other disciplines raises multiple questions about the confusion and overlap of aesthetics and ethics. However, when we conduct a study of history, ethics and aesthetics have been discussed but maintained in a relatively isolated way. In other words, systematic investigation of aesthetics as a sub-field of philosophy has been delayed until Baumgarten's book of the *Aesthetica* was published in the 18th century. Until that time, aesthetics has been discussed with studies of existence and knowledge in classical books, either mentioned in a few sentences or wholly ignored. This lack of reviews written on them has led to studying intensely from his book, then was established as a new field called “the science of the senses” (Schweizer, 1988).

Although the aesthetics seem more striking, it has recently been more in the background. Recent scientific advances include reproduction, cloning, organ transplantation, sexuality, etc. It has helped to open new doors in many areas. With the rapid increase of scientific advances, significant social results have emerged.

Art and design have a long history of dealing with ethical issues. Design ethics is about moral behavior and responsible choices in design practice. The development of scientific knowledge and technology has deepened awareness of the ethical dimensions of design. Designers integrate new forms of technology into their products. In addition, they have become more aware of their products' results due to their analysis of the natural environment, people, and societies (Verbeek, 2008).

However, due to current research on bioart, they differ fundamentally in how these disciplines construct and manage life and place it in new contexts. Moreover, biological phenomena are not only combined with unnatural (works of art) objects but unnatural such as galleries and exhibitions. They are presented in environments. Therefore, concerns arise about the safety of displaying living objects (Catts and Zurr, 2003).

In this section, after examining ethics and aesthetics under different headings, the possibilities and difficulties of working with living systems in bioart and biodesign disciplines will be discussed in the context of bioethics.

4.1 Historical Background: Aesthetic Values in Art

Aesthetics is the branch or discipline of philosophy that deals with sensory value and beauty (Cevizci, 2012). For centuries, many different answers have been given to the question of what constitutes beauty. Many theorists have expressed beauty as the property of the object that evokes pleasant experiences in any person. This approach is object-based. In addition, beauty is considered a concept that depends on the physical quality of the object. Many other theorists argued that beauty occurs in the viewer's eye; that is, something can be beautiful as long as it is pleasing to the senses. This approach is subject-based, and beauty has been defined as a function of one's unique characteristics (Tekel, 2015).

Aesthetics emerged as a field in itself in the 18th century. In this century, aesthetics is seen as an invention that manifests itself in Europe and is somehow created by modernity. The aesthetic thinking style has come to encompass all art theories. Throughout history, people have tried to make art in an aesthetic form, an example of proportion, harmony, and unity. Although the art and aesthetics roots are based on the Greeks, they have become fields of study in the 18th century. Retrospective readings covering historical processes have cut aesthetics and art from their context and turn them into something anachronic (Şener, 2015).

In the 18th century, the concept of beauty began to be considered together with the concept of aesthetics. The underpinning of this idea was the German philosopher Alexander Gottlieb Baumgarten. Alexander Gottlieb Baumgarten is known as the founder of modern philosophical aesthetics in the history of philosophy. While Baumgarten sees aesthetics as logical knowledge, he associates beauty with perfection, which appears to be the perfection of logical knowledge. In this context, Baumgarten is a representative of the rationalist tradition. He sees logical knowledge as intuition or inferior knowledge as a problem. In his opinion, things are known as objects of logical knowledge through superior abilities. On the other hand, rational things arise through sub-abilities as sensitive or aesthetic science (Keskin, 2018).

Although the concept of “aesthetics” was started to be used by Baumgarten, the subjects of interest of aesthetics first appeared in Greek Philosophy, then flourished in Renaissance and Romantic periods. As we mentioned in the first chapter of the thesis, the concept of beauty was presented and discussed by two influential philosophers, Platon and Aristotle (Kavuran and Dede, 2013). In order to better comprehend the changing aesthetic perception from the past to the present, we see that it is essential to refer to these two philosophers, who were the first thinkers on this subject.

Plato can be said to be the first philosopher to explain what art is and its meaning. In addition, he studied the social and political aspects of art not only as art but within social practices. When we look at Plato's understanding of art and aesthetics, the theory of ideas is essential. According to this approach, ideas are considered an idea of the original. Facts are copies of their originals in the field of ideas (Yılmaz, 2021).

As we mentioned before, mimesis (imitation) theory is an imitation of the world of ideas for everything in this world. According to Mimesis, art emerged from the emulation of life. According to Plato, fundamental ideas are not what we perceive with our senses. What lies outside of these senses is a (formal) world of ideas that we can only perceive mentally. What we perceive with our senses reflects our mental perceptions. In this context, the artist's production is nothing more than imitation, and natural beauty is not achieved by imitation of imitation (Yılmaz, 2021).

Aristotle did not establish a dual world like Plato. The answer to the question of what existence is, he goes in the universal and unchangeable way. According to him, there is no world of ideas outside of the world (Şener, 2015). Another important concept that should be emphasized in Aristotle's understanding of art is catharsis, which means “purification, cleansing” (Can, 2006). When we consider art with the concept of catharsis, art is a pleasurable activity and a type of knowledge acquisition and educational activity. With this thought of Aristotle, the function of art is glorified (Yılmaz, 2021).

In Aristotle's thought, the artist is inspired by nature. However, it does not copy nature as it is. Instead, the artist creates an independent object that includes his own creativity while copying nature. At this point, we see that there are differences between Plato and Aristotle's concept of mimesis. Mimesis is used here to represent (promote and

inform) nature rather than copy. It imitates nature, and the being itself is more important. According to Aristotle, existence wants to reach an end by constantly evolving. In this respect, in the Aristotelian sense, art gradually derives from the idea of abstract beauty, from tangible beings that are beautiful (Yılmaz, 2021).

In Plato, the aesthetic concern in art is based on the world of ideas, but for Aristotle, he tries to determine that beauty as mathematics. It expresses as “order, symmetry, and certainty.” Another point in Aristotle's other definition of beauty is that he evaluates beauty with a specific size. While explaining beauty, Aristotle regarded the things that are outside the power of man as non-aesthetic. What Aristotle considered to be this non-aesthetic was discussed by Kant in the 18th century under another aesthetic category, the concept of “supreme” (Yılmaz, 2021).

After Aristotle, a Roman-Greek philosopher, Longinus, discussed the notions of beauty and the sublime. According to Longinus:

“Sublimity refers to a certain type of elevated language that strikes its listener with the mighty and irresistible power of a thunderbolt. A sublime passage can be heard again and again with equal pleasure” (Encyclopedia Britannica, 2014).

Sublimity is a result of an artist's works which were provoked ecstasy in people's minds (Encyclopedia Britannica, 2014). According to Kant, aesthetic experience is imagination. When an object is displayed, the watcher or observer firstly has to understand the object. Then a feeling of enjoyment or sense of appreciation must arise from the harmony between them. That harmony is created by the evaluation of the beauty of things as judgments of taste. Thus, admiration is the ability to evaluate and judge beauty (Kant, 2000).

In this respect, his aesthetic theory can also be seen as a criticism of taste, in other words, beauty. People judge objects to what they like or dislike based on their feelings. For example, when a person says “This is beautiful” to evaluate an art object, they want other people to find it beautiful. Thus, aesthetic judgment is based on a sense of taste which is a familiar taste found in every human being (Kant, 2000).

When people turn to an object without self-interest, they will see the same beauty. Therefore beauty is a value that the thing carries. Taste for beauty is an unsparing pleasure (interest loses Wohlgefallen). Every person will see the same beauty and reach ordinary aesthetic judgments. In addition, he adds that beauty has a limited size and is connected with the form of the object. In contrast, the sublime has an unlimited size like the universe and is found in a formless object, so people get excited about perceiving beauty, but they admire and respect the Almighty (Kant, 2000).

In order to understand his aesthetics judgment, he explains the term of Sublime, which is a notion, unlike beauty, involves our minds and divides them into two terms; the mathematically sublime and the dynamically sublime. The first one is the feeling of absolute greatness, and the next one is fearfulness without fear (Kant, 2000).

What Kant systematizes in the Critique of Judgment is a new type of experience. For him, aesthetic experience means a certain detachment from the habitual conditions of the experience of the senses. What he sums up is a double negation. Kant sees the aesthetic appraisal of a form as a lack of concept. According to Kant, the artist does not give form depending on a specific subject or the function of knowledge (Rancière, 2006).

In Hegelian aesthetics, the function of art is to present the idea to human consciousness in sensible form. The presentation of the idea creates the experience of beauty. 'Beautiful' is the sensation of perfect righteousness. The Idea is the 'absolute idea,' not an isolated and abstract thought content or idea, but a dialectical at the same time. Thus, for Hegel, 'aesthetics,' which is a philosophical discipline or it can be called 'philosophy of art.' According to Hegel, art could not express whole universal truth or truth. Only philosophy can grasp the universal truth or the entire idea and richness and complexity (Hegel, 1975).

“Now, in this its freedom alone is fine art truly art, and it only fulfils its supreme task when it has placed itself in the same sphere as religion and philosophy, and when it is simply one way of bringing to our minds and expressing the Divine, the deepest interests of mankind, and the most comprehensive truths of the spirit. In works of art the nations have deposited their richest inner intuitions and ideas, and art is often the key, and in many

nations, the sole key, to understanding their philosophy and religion. Art shares this vocation with religion and philosophy, but in a special way, namely by displaying even the highest [reality] sensuously, bringing it thereby nearer to the senses, to feeling, and to nature's mode of appearance” (Hegel, 1975, p. 8).

Nietzsche approaches art outside of classical aesthetic categories. He sees it as an important achievement of human life. The creativity of aesthetics is the center point of his philosophy of aesthetics. He constantly glorifies the artist that is overflowing with power and happiness, transforms reality. The artist transforms the rough material into something which is created in his image (Middleton, 1969). According to him, the artist, *“In this state one enriches everything out of one's own fullness: whatever one sees, whatever wills is seen swelled, taut, strong, overloaded with strength. A man in this state transforms things until they mirror his power - until they are reflections of his perfection. This having to transform into perfection is – art”* and the art is a way of protecting man from the brutal realities of life (Megill, 1985, p. 82).

“Nothing is beautiful, except for man alone. Nothing is ugly except the degenerating man. His feeling of power, his courage, his pride - all fall with the ugly and rise with the beautiful. Only as an aesthetic product can the world be justified to all eternity” (Nietzsche, 1911).

On the other hand, L. Wittgenstein emphasizes that aesthetic judgments are common and unchangeable for all people who depend entirely on experiences rather than the tastes of individuals.

“Aesthetic questions have nothing to do with psychological experiments, but are answered in an entirely different way” (Wittgenstein, 1966, p. 17).

In other words, emotionality or feeling of enjoyment is removed from the basis of aesthetic judgments, intellectuality, and knowledge are placed. Therefore, according to him, logical accuracy of assessments based on knowledge and general validity of aesthetic judgments based on conformity with rules are the most vital elements of understanding aesthetics. Similar to Wittgenstein idea, Arthur Schopenhauer describes art as a type of truth knowledge or “true thing,” which is objective and subjective coincidences.

“...concerned with that which is outside and independent of all relations, that which alone is really essential to the world, the true content of its phenomena, that which is subject to no change, and therefore is known with equal truth for all time, in a word, the ideas, which are the direct and adequate objectivity of the thing in itself, the will...” (Schopenhauer, 1966, p. 185).

While Heidegger describes the object of art as truth is the “revealing of what is.” In other words, what exists as what it is as what occurs by the removal of the veil in which it contains, *“aesthetics is that kind of meditation on art in which humanity’s state of feeling in relation to the beautiful represented in art is the point of departure and the goal that sets the standard for all its definitions and explanations”* (Thomson, 2011, p. 47).

Both philosophers have defined art as a real thing and presupposing the subject/object dichotomy. Therefore aesthetics is posited as a fundamental divide between the art “object” and the experiencing “subject.”

With modernism, developments in the field of art took place. It started with Impressionism and Post-Impressionism, especially in the second half of the 19th century. The “beautiful” and other aesthetic categories, which are purely subjective, start to change to the individual's sensations that are not subject to any objective conditioning. In this century, the role of the subjective moment in aesthetics has begun to emerge (Çerņiřevskiy, 2018).

“A spider conducts operations that resemble those of a weaver, and a bee puts to shame many an architect in the construction of her cells. But what distinguishes the worst architect from the best of bees is this, that the architect raises his structure in imagination before he erects it in reality” (Marx, 2013).

Karl Marx does not defend any aesthetic model, but he thinks of art as a constitutive element of man. For him, artistic creation is primarily considered as a social activity which leads to two other issues: first, the issue of labor in the capitalist mode of production, and secondly, the issue of the development of individual faculties free from alienation after capitalism is overthrown and overcome. Thus, artistic creation is first and foremost a social activity of man, which is a social reorganization of the

individual labor in accordance with his aspirations. Like all other types of labor, artistic labor is dependent on the organization of the whole production (Marx, 1977).

The 20th century is an era of changes in reality due to scientific revolutions in different fields. Such as relativity and quantum theories, psychoanalysis approach and symbolic logic, etc. (Wölfflin, 2012). Also, in that period, a huge number of aesthetic concepts have revealed. Thus, the world has constantly been changing, and the artists have been affected by those changes.

The conflict between modernism and realism shaped the concept of art in the 20th century. This conflict also affected Marxist aesthetics and divided it into opposing arguments that started in the 1930s between Georg Lukács and Ernst Bloch. Later, Brecht, Benjamin, and Adorno gradually shared new horizons on the autonomy and sociality of art (Adorno, 1997).

“Art becomes social by its opposition to society, and it occupies this position only as autonomous art...it criticizes society by merely existing.” (Adorno, 1997, p. 225).

Art is not a matter of pointing up alternatives but rather resisting, solely through artistic form, the course of the world, which continues to hold a pistol to the heads of human beings (Adorno, 1991). According to him, the pistol is a culture of the modern and postmodern society that generates personal and social transformation in art.

Artistic practices that transcended traditional boundaries began to increase in the 1960s and 1970s. Innovative approaches led to new perceptions. New perceptual features in art emerged thanks to innovative applications. The canvases broke away from the frame, and admirable experiences set aside traditional audience separation. However, art did not just combine new practices and materials. New topics come to the surface, and all art disciplines began to enter the formerly sheltered area of the audience and demanded participation in the appreciation process. Audience participation was necessary for the visual arts and the realization of art (Berleant, 2014).

“Aesthetics was in a quandary and, for a time, became obsessed with the problem of defining art that had far exceeded its customary bounds. Moreover, traditional ways of characterizing appreciative experience, in particular

a contemplative, distancing attitude joined with Kantian disinterestedness, seemed inappropriate and irrelevant to the world of art that had emerged” (Berleant, 2014, p. 17).

Art forms have undergone a radical change in the 20th century. The theoretical approaches used to explain art have been insufficient. These approaches had to accept changes. In this sense, art history, aesthetics, art theory, and critics had to reformulate their concepts and theoretical frameworks (Valerio, 2012).

The definition of art has expanded by adding lived experience of the artist and the viewer, which includes their cultural and contemporary social norms, perception of their aesthetic engagement, and qualities. In the meantime, new challenges inspire artists to seek new forms of aesthetics in art, creating artworks and displaying and exhibiting under these frameworks. The result of this expansion is Somaesthetic, Ecological aesthetics, installation of cross-disciplines, contemporary art (Bukdahl, 2014). Ecological aesthetics means people can appreciate things aesthetically and ecologically.

“Ecological engagement is based on the ontological assumption that everything within a community enjoys connectivity and continuity (the continuity between mind, body and world) with each other. Community may vary according to different geological and spatial scales, from a small pond to a mountain area, from the planetary earth to the entire universe” (Xiangzhan, 2013).

The ontological assumption refers to how the human being can appreciate nature, why it should be, and what should be appreciated in nature. According to Aesthetician Peng Feng,

“The incompatibility of aesthetics and contemporary art seems to become a consensus of both art world and aesthetic society. Can aesthetics and contemporary art meet each other when they go beyond their boundaries?” (Feng, 2014, p. 156).

As mentioned above, the definition of art and the definition of an object keeps changing day by day. The philosophy of art takes these definitions seriously, but it

falters. The change and proliferation of artists make this very difficult. Movements that took art beyond itself allowed it to transcend itself and escape an attempt to define and limit it. What art is today is an essential question for aesthetic philosophy. The permeability of these interdisciplinary concepts has made the aesthetics more flexible. Aesthetics is now mentioned with a different use than before. This nascent aesthetic is considered trans-aesthetic (Valerio, 2012). According to Maria Antonia Gonzalez Valerio:

“Transaesthetic is used to define an art movement that insists on breaking every possible frontier that has to do both with its self and with its other” (Valerio, 2012, p. 328).

Baudrillard coined the term trans-aesthetic in 1980. He stated that painting artistic creativity is exhausting or anything new is impossible because all that can be done in art has been done already. He also argues that the realization of art in everyday life, art itself, as a transcendent phenomenon, has disappeared. Baudrillard calls this state “trans-aesthetics” and associates it with situations where everything is political, sexual, and economical, such as “trans-politics,” “transsexuality,” “trans-economics”; Like art, these fields also lose their specificity, boundaries, and distinctiveness (Richard and Smith 2009).

The artist has produced various art forms using different aesthetics approaches to merge humans with non-human, living organisms with non-living. The world and nature are mingling with replication and high technology. According to Wolfgang Welsch ;

“Artists no longer take human exclusivity and alterity as guiding-line. They no longer follow the perspective of the human standing as a special entity in opposition to the world and nature. Accordingly, they no longer try to create an autonomous world through artworks – with artworks standing opposed to the real world. They rather try to bring to view the deep commonality of humans with other things – living and non-living aesthetics beyond aesthetics is fully put into practice” (Welsch, 2014, p. 152).

Finally, it can be said that *“History doesn’t stop, however. Over the nineteenth and twentieth centuries, the main site for the ambiguous experience of the sublime has*

gradually shifted from nature to technology” (Mul, 2014, p. 220). Therefore, new aesthetics frameworks are interwoven with technology as this quote refers that “We have created technological environments and structures beyond which we cannot survive. The idea that we could return to nature and natural religion is an unworldly illusion. In fact, because of its Janus-faced powers, “living technology” itself has become the sublime god of our (post)modern age” (Mul, 2014, p. 221).

4.2 Biotech Aesthetics

“ aesthetics is not the theory of the beautiful or of art; nor is it the theory of sensibility. Aesthetics is a historically determined concept which designates a specific regime of visibility and intelligibility of art, which is inscribed in a reconfiguration of the categories of sensible experience and its interpretation” (Rancière, 2006, p. 1).

In the 20th century and onwards, technology has offered people unlimited possibilities. With the hand of technology, humanity has reached a divine power that creates and recreates ideas, new species, and replicas of living creatures. These developments in technology are reflected in the understanding of art with a new dimension. The canvas is replaced by installations, performances, video art, and body art as a new form of sculpture. These have been essential revolutions in the art/design and technology that have affected the general aesthetic rules that began to collapse, and modern values began to lose their validity against the postmodern values and aesthetic practices. Postmodern discourse has been questioned the understanding of art and aesthetics brought by modernism since 1960. Many of the postmodern discourse components define the understanding of art and aesthetics. It started to transform the experience of art that has begun to blend with the technology and new practices.

“One can say that modernism, as an institutionalized model in academies, museums, and art galleries, opposes a new discourse launched in the offensive of conquering cultural authority: postmodernism” (Rațiu, 2001, p. 87).

Developments in technology and mixing with biology has created a new term is called biotechnology. Anne Byerley and Derrick Chong wrote an article in 2015, connecting with the past to better understand the 21st-century contemporary art practice, which is

bioart. In the article “Biotech aesthetics: Exploring the practice of bioart,” they tried to determine the limits of the aesthetic values created by biotechnology. Starting with the example of Duchamp's use of ready-made objects and taking them beyond the ordinary, they established a connection between bioart. Then, they discussed how bioart could be read and interpreted through this connection. This past and present relationship established with leading bioart practitioners are essential data for studying the interdisciplinary progress of artists (Byerley and Chong, 2015).

Bioart has embraced unorthodox tools, materials, and ideas. The worlds of science and technology inspire practitioners of this field. Therefore, it is essential to refer first to Marcel Duchamp to build a bridge between contemporary art and bioart practitioners. Duchamp is a pioneering artist with an original and resistant vision of the 20th century.


Contemporary theorists such as Alexander Alberro, Benjamin Buchloh, Arthur Danto, Hal Foster, and Lucy Lippard are helpful figures in interpreting and evaluating the developing and changing bioart field (Byerley and Chong, 2015).

“By stripping bio-science of its pragmatic function and contextualizing it as aesthetics, gene artists reanimate issues Duchamp could have appreciated, especially those of authorship and originality, and the nature and purpose of art” (Tomasula, 2002, p. 137).

Steve Tomasula reinforces this idea again in his article with the work of Duchamp, which we saw above. Here the tradition is dismissed by putting a mustache on a replica of the Mona Lisa. However, what is more, important here, in Tomasula's words;

“Today the avant-garde seems to have relocated to the biotech lab, ushering in an age where science will be able not only to copy the actual model, but also to modify her genes so that she could grow an actual mustache” (Tomasula, 2002, p. 137).

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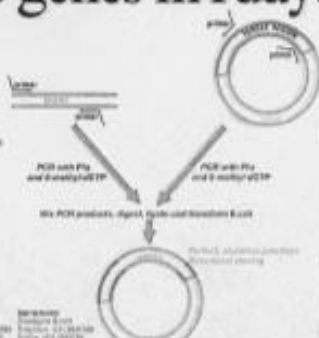
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Figure 26-Stratagene ad in Nature, 1996, Marcel Duchamp (Source: Tomasula, 2002)

Duchamp played an important role in art history as he transformed ordinary objects into works of art. Duchamp's Fountain (1917) is the most fantastic example of this. This urinal, bought by the artist, continues to be the most well-known ready-made production.

“Danto (1981) recognized that Duchamp’s work was not the urinal at all but the gesture of exhibiting it. Similarly, Duchamp, for Foster (1985), renounced so-called retinal painting and exhibited readymades in such a way as to debunk the transcendental pretensions of the art object. Forty years after Fountain, Duchamp (1957) would describe ‘the creative act’ as to how ‘the

artist goes from intention to realization through a chain of totally subjective reaction” (Byerley and Chong, 2015, p. 203).

Arthur Danto was against Plato’s art theory of mimesis. Art is an imitation activity; the mirror image of an object must also be a work of art. An artist would rather than create a “product” and pleasure that appeals to the eye of the buyer, and they must create a concept and meaning that will appeal to their mind before making an object; that way, the art is settled and should attack minds and thoughts of everybody. Therefore imitation of imitation must be an art. For Danto, the main problem was what the term artwork/art includes, how the term could expand in postmodern discourse.

“In our narrative, at first only mimesis [imitation] was art, then several things were art, but each tried to extinguish its competitors, and then, finally, it became apparent that there were no stylistic or philosophical constraints. There is no special way works of art have to be. And that is the present and, I should say, the final moment in the master narrative. It is the end of the story” (Danto, 1998).

When we look at today, with the increasing frequency of interdisciplinary transition, it differs in forcing across borders, and borders disappear entirely. At the beginning of the study, we talked about Anne Byerley and Derrick Chong's article (Byerley and Chong, 2015). They tried to define the limits of biotech aesthetics. New aesthetic concerns in this article in line with biotechnological possibilities, or when we look at it from today within the framework of aesthetics, the end has already ended, as Danto stated, are two different perspectives.

One of the best examples of this is Yoko Shimizu, a researcher, and artist with a biology and chemistry background at the Electronica Future Lab. Her work with the photosynthesis technique was developed to print a graphic image on plants. Here, photographic techniques and the possibilities of plants to perform photosynthesis are combined, like in the old analog machines, and films are adhered to the leaves of plants and exposed to LED lights. These works of the artist are called “Photosynthograph” (Shimizu, 2015).

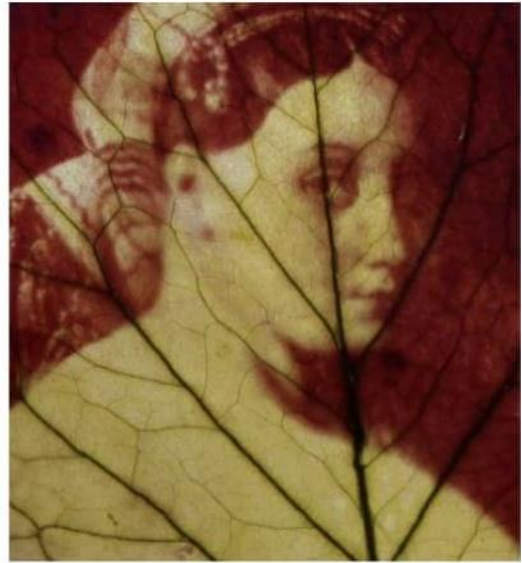


Figure 27-Ingres' Grande Odalisque printed on a leaf with photosynthesis (Source: Shimizu, 2015)

When we look at the artist's work, we see a technological reference to the aesthetic understanding of the 19th century. With this example, it is clear that the aestheticization of some essential masterpieces in history and their place in the memories still maintain their importance today. Another example is the works of Suzanna Lee (Figure 24), alternative leather samples she designed with biomaterials on fashion in the opportunities of biotechnologies continue the popular formalism of style, for example, shoe form, leather jacket, etc.

As we can see with works, today's aesthetic understanding varies according to how a person shapes aesthetics. For example, to Jen Hauser, who pioneered the creation of Biotech Art, when asked the question, “*Do aesthetics even matter in this kind of art(Bioart), and if so, to what extent?*” (Hauser, 2012). He replied as follows:

“That depends on how one defines aesthetics. Aesthetics has something to do with perception; accompanying or constituting discourse may in itself already be a sort of anaesthetization. Everything that claims “Duchamp-ism” in this sense is basically an anaesthetization, conceived as a shift of the aesthetic to the discourse. This has a lot to do with self-reflectivity and self-reflection, which is inscribed in the modern era. Even in the conceptual art of the 50s and 60s, aesthetics has lost importance when focusing on realizability rather than

on the realized, on latent aspects, so to say. This can also mean that objects which can be aesthetic are so decentralized that they cannot even be limited to a spatial installation” (Hauser, 2012).

Just as Duchamp's “Stratageme ad in Nature” draws attention to the change in genetic engineering, Orlan started to redesign itself with physical intervention in the same years. However, Orlan, who has been working with plastic surgery since the 1990s, defers a different framework in biotech aesthetics. The contemporary artist, who is the pioneer of sexual art, has adopted a new body shape by distorting the person's appearance. She underwent a series of plastic surgeries in front of audiences while reciting poems in the operation room. The Reincarnation series aim is to confrontation with ideas of beauty in the Western world. It discourages women from having a surgical operation to resemble art historical models of beauty, such as Leonardo’s Mona Lisa. By constantly deforming and changing her body and face, she breaks the standardized face-identity overlap and questions social, moral judgments. She refers to postmodern identities with her operational performances. In addition, she criticizes the transformation of the female body into a commodity within the capitalist system (Cashell, 2009).



Figure 28-Photo of the plastic surgery series Orlan called The Reincarnation (Source: Pescarmona, 2009)

As we have seen in the example of Orlan, the rapidly changing aesthetic perspective of the postmodern period and its aftermath opens the door to different and unprecedented new possibilities. The rapid increase in biotechnological developments allows the change of a living being or system to take place. If the person wishes, they can combine the tail, horn, or any other fashioned tissue shape with their body. These technologies, operating in the socio-economic environment, may cause a lot of speculation. These are the wealthy and the more advantaged, such as the human species and the animal kingdom. *“As all of these technologies will become more available in different forms and different prices, the idea of Organ Farms (for replacement, modification, and enhancement) might become a reality. Body parts made out of different animals tissues might become objects of desire”* (Zurr and Catts, 2007).

Many examples such as these contain studies that have been carried out in line with the new possibilities of biotechnology. However, as we have examined above, these studies have started to point to ethical issues rather than aesthetic issues. Especially with the advancement of genetic engineering, these issues continued to maintain their importance from different perspectives. For this reason, we will examine other works of design and art that include these discussions under the last title of this chapter.

4.3 Historical Background: Ethical Criticism of Art

“Ethical criticism – the art critical practice of considering a work’s ethical status or value in the assessment of its artistic worth – is a practice as widespread as it is controversial amongst literary critics” (Giovannelli, 2007, p. 117).

Ethics is a concept of behaviors on a societal scale and shapes people’s actions and thinking processes. The relationship between art and ethic has been an important issue for ages. Ethical values have been influential in the perception of art and have also formed ethical criticism of art. The importance of the societies set the rules of how the art will be received. These values, which are related to all disciplines, have become a philosophical process for critics. Both ethics and the concept of art have been around for centuries. They have been discussed and compared their norms with the norms

available in society. In the 21st century, art has offered the artist certain freedom to express their ability. However, at the same time, they limit their freedoms with borders that are underlined with universal ethical values (Cevizci, 2015).

Understanding ethical criticism of art has to be investigated how and why universal ethical values have emerged in human history. According to the historical foundation of Ethic / Ethos, a Greek word means custom or character derived from the word “Ethikos”. In Greek philosophy, both terms are related to ethical behavior. Therefore the field of ethics or moral philosophy has involved concepts of right and wrong behavior. Heraclitus and Xenophanes, Presocratic philosophers, were criticized for their times, custom, and convention regarding right or wrong/ good or bad. They concluded that only Divine law is pure, and whoever follows that does good deeds as he stated; *“To God, all things are fair and good and right, but men hold some things wrong and some right”* (Forte, 1998, p. 222).

Plato became the first investigator about art and ethics discussed in his works. *“The unexamined life is not worth living”* is a very famous dictum said by Socrates in Plato’s book of Apology. In the book, Socrates cross-examines Xenophon in front of Athenians to criticize their society's traditional values. Athenian citizens of his time were self-indulgent towards wealth, seeking power, and lack of public morality. To examine their lifestyles, Athenians have to have virtues that lead to their social skills, characters, and attitudes. Socrates declares that no human being knowing commits evil, the virtues keep them away from bad, and virtues are knowledge, not emotions (North, 1966).

In Republic, he describes the balanced citizen who is a wise person using his mind and knows how to control his emotions. Plato says that the mind is the most crucial feature that makes a human being, and he rejected sentiment as it is the weakest aspect of man. Literature takes us away from reality. The function of art in Plato's time alienates and drags people into endless emotional swamps; therefore, it is terrible (Turgut, 1993).

“Plato in The Republic famously attacked almost all kinds of mimetic art for undermining reason at the expense of the unseemly stimulation of emotion and the advancement of a mere simulacrum of knowledge. A great deal of the subsequent debate about the value of art has been shaped by this seminal

attack, so that the issue of the relation of art to ethics has been of recurrent and central interest both to philosophical aesthetics and to literary theory” (Gaut, 2000, p. 341).

Aristotle argues that reason is distributed equally to every human being, but to some extent, he states that whether to use it or not, it is in the person's hand. With this thought, he considers ethics to be based on knowledge and reason along with the practical side (Aristoteles, 2015). Their ideas have become pioneering others up to the industrial ages.

According to Noël Carroll:

“philosophers from Plato through Hume supposed that the pertinence of ethical criticism to art was unproblematic. It is only since the late eighteenth century that the view took hold that the aesthetic realm and the ethical realm are each absolutely autonomous from the other” (Carroll, 2000, p. 350).

In the late 18th century, Diderot promoted benevolence, self-sacrifice, tolerance, and humanity in the ethical field. In this respect, he has never been close to the materialist approaches of the century. He argued that there was no essential relationship between ethical ideals and belief in a spiritual soul (Diderot, 1966).

“The poet, the novelist, and the actor make their way into our hearts by indirect means. They touch our souls all the more strongly and the more surely because we are relaxed because we offer ourselves to the blow. The sufferings with which they move me are imaginary, I agree, but they move me all the same. Every line rouses an impulse of concern in me for the misfortunes of virtue and moves me to expend my tears on them. What could be more pernicious than an art that instilled in me a feeling of complicity with an evil man? But, by the same token, what art could be more precious than the one that imperceptibly makes me feel concern for the fate of a good man, that draws me out of the quiet and comfortable situation I myself enjoy in order to accompany him ?” (Diderot, 1966, p. 104).

Traditional art and moral considerations have begun to change in the Age of Enlightenment and afterward. It was the process of “breaking from the holy,” and in this process, the concepts mentioned above and the criteria on which it began to be

questioned strictly and changed after, So “good-bad, beautiful-ugly” tried to impose new meanings on the concepts. The concepts of "innovation" and “authenticity,” which constitute an essential aspect of modern thought as criteria in parallel with progressive logic, art with “beautiful and ugly,” morality with “good and bad,” were formed as the primary concept poles of history of humanity. In addition, they have been discussed throughout, have shaped societies, and have taken sides around them. At the same time, these have been significant value judgments in living and perceiving life (Andi, 2018).

Karl Philipp Moritz attempted to unite all the arts in one of his first writings, “The Concept of Self-Completion” (1785). He stating a genuine manifesto about the purpose of art like Castelvetro or Corneille is to entertain and give pleasure and that pure beauty, just like pure love and once more like God. According to him, its “raison d'etre” (reason for existence) is not in the satisfaction of its users (creator or consumer) but in itself. “The pleasure it gives is genuine For beauty to exist, it must approach disinterested love” (Moritz, 1995).

According to Kant, the source of morality is neither an external principle that transcends man nor is God; the source of morality is human. This person sets the moral principles himself and obeys this principle voluntarily. That is, the source of moral values is the human mind or the intelligent person. This criterion put forward by Kant, namely the law, is a principle that “preserves value” and protects the value of human beings. “Goodwill” is the will determined by the pure mind and the will that preserves the value of the human being. Or, well, it wants to preserve human worth (Bezci, 2005).

Utilitarianism or Utilitarian Ethics is a philosophical movement that argues that the best and suitable action is appropriate for action. If the majority benefits, a small number of people can be harmed. From the utilitarian perspective, the value of an effort is determined by the utility it provides (Bentham, 1962). What makes an action right or appropriate is that it brings the highest level of happiness to as many people as possible. In Bentham's words, “*only if an action increases one's happiness in general and, more specifically, one's current pleasure, or if it somehow reduces one's current suffering, then it conforms to the principle of utility*” (Bentham, 1843, p. 143).

Although hedonism is a philosophical concept, it is also a scientific concept of psychology and social psychology. In order to understand hedonism, they gave an example of the “carrot” and “stick” approaches. For example, in business life, people get pleasure (in the form of money or praise), or they are also motivated by the expectation of avoiding pain (such as underpaying or losing a job). Hedonism, feeling good, achieving rewards (carrot), and avoiding pain (stick) are associated with motivation. Peaceful coexistence of community members should be ensured that they adopt common values to live in a way. Therefore values that will operate the principle of justice to balance the hedonistic tendencies of individuals system is needed. Hedonistic tendencies shape human behavior more than ascetic values (MacMillan et al., 2006).

As Bauman points out, postmodernity is true, which is the reverse of central values of modernity such as uniformity and universalism. Ideally, all forms of life are allowed in principle in the pluralistic world of postmodernity. In this sense, the focus of coexistence can replace the principle of universalization. On the other hand, the proposition of tolerance can replace conversion and subordination. Therefore, postmodernity has a different understanding that accepts lifestyles and firmly rejects the melting of these differences in the pot of universality. While freedom, equality, and fraternity are the slogans of modernity, freedom, difference, and tolerance are the truce formula of postmodernity. The postmodern ethical approach is not abandoning concerns of moral issues. Still, it rejects the modern ways of addressing them (Bauman, 2016).

As a result of the relationship between art and ethics, several questions need to be resolved. The question that most often arises in the contemporary debate is: *Does exposure to ethically dubious art morally corrupt the audience?* (Violence, sexism, etc.). This question is empirical and causal. It can occur as a result of many sociological and psychological experiments to answer. The second question is about censorship: *Does the ethical badness of particular works of art justify their suppression?* This question addresses political philosophy and should develop a general theory of freedom of expression for a clear answer. The third question is about the moral rights of works of art: *Do we have moral obligations to works of art to protect them?* The fourth question is about whether there is a parallel between moral judgments and

aesthetics: *Is there a structural parallel between aesthetic judgments and moral judgments (whether they are objective or subjective)?* This question was of great interest to 18th-century philosophers, including Hume and Kant. Finally, another question is: *Are artworks' ethical flaws and merits at the same time aesthetic flaws or merits?* (Gaut, 2000).

“The greater part of all the art criticism that has ever been written has been moralistic in tone or content; often vehemently moralistic, dealing quite freely in adjectives like 'noble' and 'exalted' or 'base,' 'vile,' 'corrupt,' 'sordid,' and 'vicious.' A nearly unanimous practice like this on the part of critics could not very well be based on a complete misconception of their calling. It makes us hesitate to say that works of art are something wholly "amoral" and in principle exempt from the type of stricture so commonly applied to them” (Isenberg, 1973, p. 266).

4.4 Bioethics in the Biotechnology Age

Biotechnological techniques and methods have been used more for non-scientific and non-corporate purposes. Examples of these are citizen science, biohacking, art, and design. Hundreds of artists worldwide use biotechnology techniques such as genetics, tissue culture, or synthetic biology. Especially for art, this new media presents a different ethical debate that has not been opened up to now (Vaage, 2016). Jen Hauser explained these works of the artists as follows:

“It's now a reality artists are in the labs. They are intentionally transgressing procedures of representation and metaphor, going beyond them to manipulate life itself. Biotechnology is no longer just a topic, but a tool, generating green fluorescent animals, wings for pigs, and sculptures molded in bioreactors or under the microscope, and using DNA itself as an artistic medium” (Zurr and Catts, 2004, p. 167).

With this new field of art, ethical issues have been opened to discussion by many artists. On the other hand, these artists sometimes produce ethically problematic artworks that open the door to these debates (Vaage, 2016). In this context, it is imperative to define bioethics.

In general, bioethics is a branch of ethics that explores the controversies surrounding the medical, clinical, or other practical applications of new biotechnologies such as embryonic stem cell research or genetic engineering. In the 1950s and 1960s, the field of modern bioethics emerged (especially in terms of codes of practice) as a response to the biological experiments revealed during the Nazi Party's Nuremberg trials. In addition, the term 'Bioethics' was first used by biologist Van Rensselaer Potter in the early 1970s. Potter referred to the use of bioethics as a new field devoted primarily to human survival and improved quality of life. But then he made references to moral problems arising from the life sciences and their spread to non-medical fields (Stracey, 2009).

Bioethics became a discipline in universities in the late 1970s, and its scope has continued to change. It is included in the curriculum of many fields, from forensic anthropology to philosophy, and with the development of bioart, to art history and visual culture programs. As a result of this expansion in bioethics, cultural historians have raised new questions about life and the similarities and differences between humans and other animals. In this way, the meaning of bioethics was re-examined. Some academics have established a human-centered model of bioethics that makes reasonable and limited discrimination against non-human animals (without cognition, consciousness, culture, and communication). As a result, bioethical rights have emerged for all living and semi-living organisms (Stracey, 2009).

While academics questioned these ethical values through bioart, bio-artists also made these inquiries. As we mentioned before, Eduardo Kac, Marion Laval-Jeantet, Benoît Mangin, Marta de Menezes, George Gessert, and Paul Vanouse, who published a manifesto on Bioart, clearly expressed the importance of ethical inquiries for bioart as follows:

“We trust art audiences to recognize that because Bio Art is alive, all Bio Art has political, social, cultural, and ethical implications, whether or not these are made explicit by the artist” (Kac et al., 2017).

As Kac et al. mentioned above, to better understand the evaluation of bioart through bioethics, it is necessary to mention how bioethicists approach the limits of bioethics. Bioethicists generally discuss studies according to one of three ethical logics. These

are divided into virtue ethics, deontology (duty ethics), or consequentialist ethics (Vaage, 2016).

In some institutionalized settings, such as the United States, the most common argument is utilitarianism. In Europe, bioethicists have tended more towards virtue ethics, which supposes that an action is good if it is performed for the right reasons, grounded in the notion of the common good. Deontology believes that universal principles, not the consequences of your actions, determine what is right, is not uncommon in religious bioethics and is sometimes presented in philosophical perspectives on bioethics, but rarely to be found in applied institutionalized settings (Zylinska, 2009).

Viewed as a philosophical tradition, the spectrum of bioethics is broad. In particular, the subjects such as the patenting of human genes in societies and how society should relate to gene therapy. In addition, the result of biotechnology includes many topics such as the purification of embryos and the possibility of the new eugenics. Organ donors, cloning, genetic use of animals, manipulation in agriculture, and more constitute the items of this broad-spectrum (Vaage, 2016).

Deontological ethics is more based on Kantian terms. However, consequentialist and virtue ethical perspectives are considered important enough to justify some purposes, violating existing norms (existing laws, behaviors) in line with ethical behavior. Such targeted goals include, for example, the treatment of unforeseen diseases, food, water, and energy, which have an impact on quality of life. In short, in such cases, testing toxins on animals, manipulation of life, and use of human stem cells can be observed to achieve a better result. (Vaage, 2016). This can change the degree of priority according to the determination of risky and damage standards. According to William Myers:

“Designers face an unprecedented urgency to alter their methods and reprioritize their goals to address the accelerating degradation of the environment. This new pressure—intellectual, ethical, and regulatory—demands recognition of the fragility of nature and our responsibility to preserve it for future generations” (Myers, 2018, p. 10).

Although it is not directly expressed in Myers' quotation, the discussions on bioethics in a general framework continue over bioart. In general, the design aims to provide a solution method for integrating life, which is disrupted by the intervention. This promising way of design, which has built a bridge that offers an embrace with nature, can cause debates at some points, just like bioart. Especially the examples of design involving genetic interventions are one of them.

4.5 Living Systems and Bioethics

With the advancement and development of biotechnological techniques and methods, their use has increased gradually for scientific and non-institutional purposes such as civic science, biohacking, art, and design (Vaage, 2016). In addition, many artists and designers around the world use tissue culture and genetics or synthetic biology. Especially for art, this new media has created ethical debates that have not been brought up until now. However, to better understand these ethical issues, we need to examine these studies in the field of art and design.

“Nature has long been a source for art. In bio-art, however, nature is used not as a model to copy, but as a living, malleable material to sculpt and mold”
(Stracey, 2009, p. 498).

One of the examples to be given to this statement above is the work of Marte de Menezes. Portuguese Artist Marta de Menezes prefers a butterfly or a caterpillar that turns into a butterfly pupa in 2000. Menezes enlisted the help of biologist Paul Brakefield to create this work. They changed the patterns and eyespots of a butterfly wing to an artificial human design. The magnified area in the image shows the interference state. Indeterminate species formed during the transition of the caterpillar to butterfly have interfered. Microsurgical needles, micrografting, and red-hot cauterization needles were used in the conduct of this study. The wounds are minor, and the pre-wing discs heal without any problems because they do not have nerves. (Stracey, 2009).



Figure 29-Marta de Menezes, “Nature?” ,2000 (Source: Stracey, 2009)

In this study, the borders, similarities, and differences between artificial and nature were examined, and while trying to determine the ethical boundaries, the following was stated for the study.

“Playing with scarified color patterns has the potential to reveal evolutionary insights, thus producing good scientific practice as well as controversial art. The presumption that these humanly modified butterflies carry out a ‘normal’ life remains untested” (Stracey, 2009).

However, this study brought up many questions. For example, *what are the rights of these creatures used for art? What would happen if this new species made with human intervention is left to nature? And who benefits from this life-shaping process?* (Wolfe, 2003). Another example is the Malformed Amphibian Project by artist Brandom Ballagé. In the creation of this project, the artist received help from the scientist Stanley Sessions.

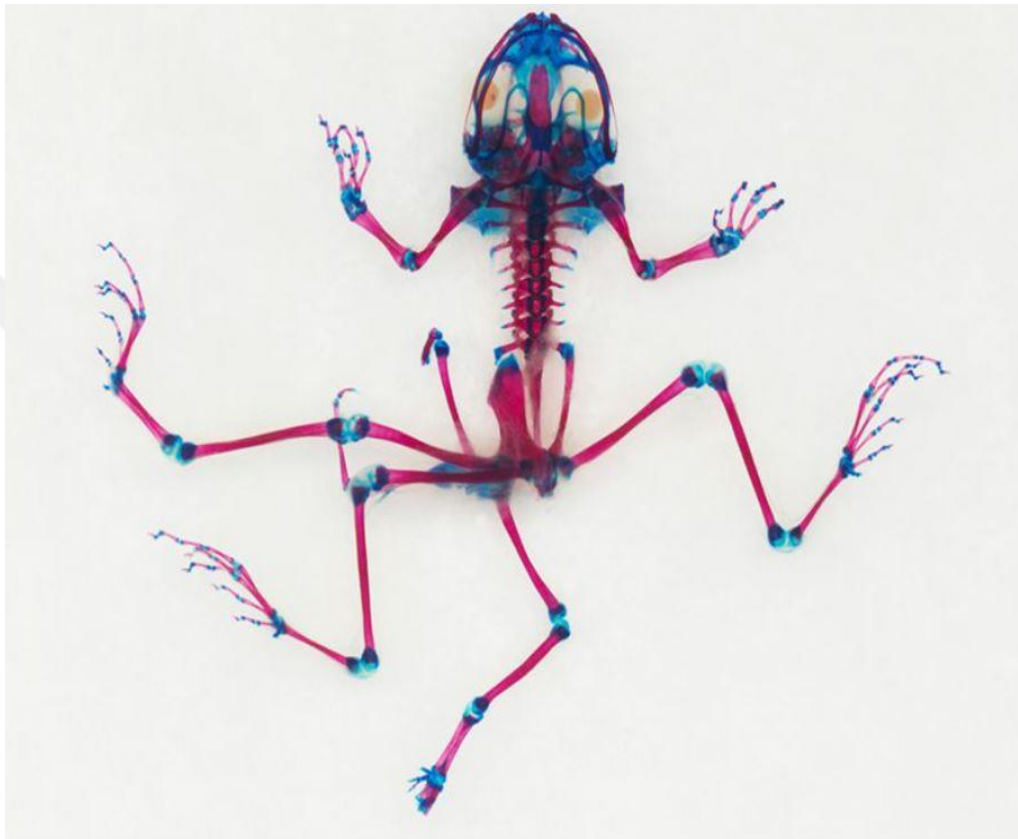


Figure 30-Scanner photograph of cleared and stained multi-limbed Pacific Tree frog from Aptos , Brandom Ballengée, 2008 (Source: Fessenden, 2016)

These studies on frogs disrupted the embryonic forelimbs, physically halting the development of amphibian limb buds. The result was a frog with extra limbs. In the artist's view, the purpose of this malformed piece of art is to help inform the audience. *What can be done to prevent such mutations that may occur due to the pollution of nature?* (Stracey, 2009).

Another aim is to investigate what can be done to prevent such mutations. However, this study still contains uncertainties and inconsistencies. The most outstanding example of this is that it is not clear enough how a physical intervention-induced

malformation relates to abnormalities caused by parasites and pollutants. Therefore, responsibilities and concerns about what happens to these malformed frogs are still not much discussed (Stracey, 2009).

The creation of transgenic life forms is the most controversial form of bio-art in the context of bioethics. As we mentioned before, a transgenic organism is formed by combining its genome with other DNA. This DNA from animals, bacteria, fungi, and viruses creates a new organism, and this change is hereditary. To understand the debates in this area, we must begin by looking at the pioneer of this art, Eduardo Kac.

In 1999, Eduardo Kac brought his first transgenic artwork to the audience. This installation titled “Genesis” was supported by Ars Electronica and the OK Center for Contemporary Art in Linz. (Reichle, 2009). This study explores this complex relationship between information technology, biology, belief systems, dialogic interaction, ethics, and the internet. Also, a synthetic gene was formed by translating a sentence from the Biblical Book of Genesis into Morse code and converting this code into DNA base pairs (Kac, 2007). The sentence mentioned in the book is:

“Let man have dominion over the fish of the sea, and over the fowl of the air and over every living thing that moves upon the earth” (Kac, 2007, p. 164).

The reason for choosing this sentence is that it is related to the dubious notion of humanity's supremacy over nature. Morse code was chosen because it represents the birth of the information age and global communication (Kac, 2007). The audience entering the exhibition area stands in front of a petri dish enlarged by projection. Like Joe Davis's Microvenus study, these bacteria bodies are written in the same genetic language as our bodies (Tomasula, 2002). Genesis study consists of a petri dish, micro video camera, UV lightbox, and microscope illuminator. The gallery screen is open to local and remote attendees (Kac, 2007).



Figure 31- Eduardo Kac, Genesis, 1999 (Source: Paterson, 2011)

Genesis work is a work that can be visited at home via the internet or accessed via the internet. There is a trained ultraviolet light on the Petri dish, and it can be operated by anyone. This creates a community. When people do this, the petri dish will flash blue, and the bacteria will start to glow. Steve Tomasula explained Kac's Genesis work as follows in his article published in 2002:

“Those bacteria that carry the text of Genesis as part of their bodies give off cyan light; those without it give off yellow. More importantly, as viewers activate the ultraviolet light they become Kac's co-authors by accelerating the natural mutation rate of the bacteria, changing both bodies and encoded message as Kac demonstrates when at the end of the exhibit he translates the synthetic DNA code back into English” (Tomasula, 2002, p. 147).

According to Jeremy Rifkin, founder and president of the Foundation for Economic Trends in Washington DC, this is the beginning of a digital age, and with this revolution, it is possible to process biological information and open it to genetic trade on an unprecedented scale. This new synthetic creation revolution may enable individuals to shape their own physical futures, reschedule their lives, and even conceive their unborn child with an artificial womb (Rifkin, 1999).

On the contrary, Rifkin emphasized that for this synthetic age, a series of moral, political and ethical problems that cannot be ignored have come to the fore. Interventions that can be made to prevent fatal diseases may create some irreversible results in humans, for example intelligence, and physical and behavioral changes. He connected with Dr. Ian Wilmut, who made the cloning of Dolly the Sheep, and the Frankensteinian nightmare of human cloning, drawing attention to many other problematic issues resulting from patenting this cloning face the risk of irreversible damage to the biosphere (Byrne, 1999).

The Eighth Day, another transgenic artwork by Eduardo Kac, fulfilled the promise of the artist's previous works. This study, created between 2000-2001, consists of a series of transgenic and fluorescent organisms. After two years of preparation, it was presented to the public in Tempe in 2001 at Arizona State University. In this work, the artist again referred to the Book of Genesis (Reichle, 2009). In the book, it says:

“The God of the Old Testament created heaven and Earth in six days and rested on the seventh. Now, on the eighth day, humanity is setting out to create the world according to its ideas, in its own image” (Reichle, 2009, p. 130).

This study combines a biological robot (biobot) and transgenic life forms in a space under the Plexiglass dome. Entering the gallery space, the viewer firstly encounters a glowing blue hemisphere against a dark background. This sphere is a dome that glows with a blue light. The viewer also hears the repetitive sounds of the water hitting the shore. This image reflects an image of the Earth seen from space. These sounds serve as a metaphor for life on Earth. The blue image is to strengthen this metaphor function. For this work, the audience is invited to walk on water (Kac, 2007).

Visitors can see the terrarium with transgenetic creatures both from inside and outside of the dome. Someone outside the dome and looks inside can perceive the local audience and the transgenic environment with the possibilities offered by the biobot. The online computer in the gallery provides local viewers with an idea of the experience is likely remotely on the Internet (Kac, 2007).



Figure 32-Eduardo Kac, Eighth Day, 2001 (Source: Kac, 2001)

Undoubtedly, Eduardo Kac's most controversial work was GFP Bunny, which he completed in 2000. Eduardo Kac's project would not realize in the GFP K-9 study appears with this rabbit named Alba (Kac, 2007). The Latin origin of Alba's word means white, and this rabbit is an albino animal (Gessert, 2010). Nevertheless, he managed to transfer the green fluorescent gene carried by the Pacific Northwest jellyfish to the rabbit. Thus, this newly created rabbit turned into a glowing green rabbit under a particular special light.



Figure 33-Eduardo Kac, GFP Bunny, 2000 (Source: Gessert, 2010)

Eduardo Kac describes himself as:

“I am interested not in the creation of genetic objects but in the invention of transgenic social subject” (Kac, 2003, p. 98).

Alba rabbit is not as much an art object as the bacteria in the Genesis study, an art organism he hopes to integrate into society starting from his own family. Despite all his extraordinary results, Kac emphasized the importance of creating this rabbit, that our domestic life has become a part of genetic engineering (Tomasula, 2002).

Since this study is an artificial mutation, it sparked social, cultural, and ethical debates. As a result, the 'Free Alba' campaign was launched and spread rapidly in newspapers, television, and radio. Kac has proposed: *“create forums where conversations about “consensual domain” between ourselves and other creatures can take place; interrogate the motivations behind such projects; develop ethical discourses to help*

honestly evaluate the effects of such experiments and art endeavors on those other humans, part-humans, posthumans, and nonhumans with whom we cohabit and whom we will increasingly seek to perfect and control” (Becker, 2000).

However, Kac and his supporters do not foresee and do not discuss the cell damage that GFP and other fluorescent molecules can cause in the imaging. While these fluorescent proteins are not deadly, they are risking toxicity (Stracey, 2009). Instead of creating a new transgenic animal, other artists choose the opposite and carry out their work with already existed transgenic, such as Kathy High.



Figure 34-Kathy High ,Embracing Animal, 2006 (Source: Aristarkhova, 2010)

Adopting bioart as a style in her artistic production, the artist has produced a series of works under *Becoming Animal*. In her work included in this series under *Embracing Animal's* name, three transgenic laboratory rats, model HLA-B27, were provided with a particular shelter for them and presented to the public. These rats are currently used in the study of human health as they are physiologically close to humans. The living space prepared for rats in the laboratory was ample. It aimed to create an opportunity for experimentation in communication with humans. Regularly controlled and fed by a lab technician, these rats are designed as playgrounds to make people feel the tension of the trans-game. High spends time with them, nurturing them and taking care of them (Aristarkhova, 2010).

The structures that create another ethical problem are semi-living beings. They are magnified in three dimensions, and artificial conditions are created by bioreactors that mimic body conditions. These semi-living beings establish a new entity-object relationship in the continuity of life (Catts and Zurr, 2007).

“While the semi-livings rely on the vet/mechanic, the farmer/artist, or the nurturer/constructor to care for them, they are not human imitations and do not attempt to be human replacements. Rather they are a new class of object/being that is both similar to and different from other human artifacts (humans’ extended phenotype) such as constructed objects and selectively bred domestic plants and animals” (Catts and Zurr, 2007, p. 232).

In 2004, *Victimless Leather* was studied by *The Tissue Culture and Art* (Oran Catts and Ionat Zurr). As a result, it was raised in a techno-scientific body; this prototype jacket was said to be produced as an alternative to traditional forms of leather making (Stracey, 2009).

The work is generally referred to as the prototype of the toothless coat grown in a techno-scientific body. This work, exhibited at the John Curtin Gallery, was created to shape the future of textiles and fashion. A bioreactor was used to grow these semi-living fabrics, and optimum growing conditions (nutrient supply, waste removal, and temperature) were kept under control. This leather, which can be considered a miniature, is located on a biodegradable scaffold (Sharma, 2014).

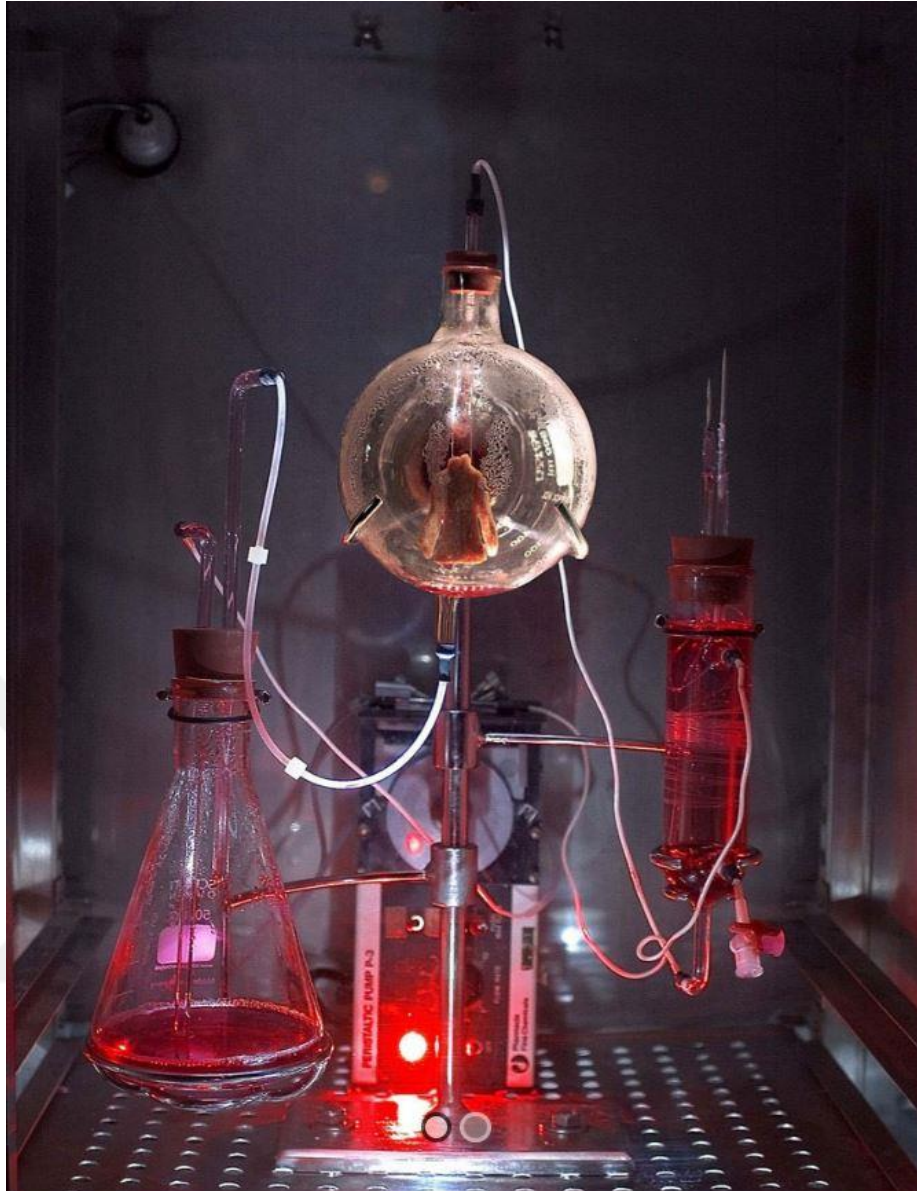


Figure 35-Victimless Leather is a prototype for stitchless leather jacket grown inside a ‘technoscientific body’ ,2004 (Source: Catts and Zurr, 2004)

Working at SymbioticA, the world's first Biological Arts Center of Excellence, Catts and Zurr must present their proposals to an ethics committee while planning a new project. This committee typically consists of medical professionals, philosophers, ethicists, or a few biologists. In the early 2000s, artists sought the approval of the ethics committee to realize their first significant project, but as a result of this work, the committee was uncertain about how to position themselves in the face of unforeseen possibilities. As a result, this and similar studies, which initially aimed to be reduced to scientific values , were based on artistic reasons and led to discussions on the use of

animals. As a result, artists have requested a new committee for this and other related issues, including artistic experts. However, studies are still subject to a series of protocols by the same ethics committee. They consider this as 17 ethical clearance processes (Vaage, 2016).

Despite this, some ethical issues remain at the center of these semi-living studies. For example, if we compare this Victimless Leather work with Suzanna Lee's BioBomber jacket (Kambucha), which of these works produced as an alternative material presentation to fashion and textile will be more beneficial to us?



Figure 36-BioBomber jacket, Suzanne Lee (Source: Fairs, 2014)

Another important example is the work of Alberto T. Estévez from the field of Architecture. Earlier, we talked about the connection between Eduardo Kac's

genetically engineered rabbit, Alba, and Alberto Estévez, the genetic architect room. He introduced genetic and bio-digital projects as an alternative to the unsustainable danger of the planet. Furthermore, Alberto T. Estévez proposes an alternative sustainable architecture for the future, based on Salvador Dalí's definition that "the future of architecture will be soft and furry" (Estévez, 2014).

Alberto T. Estévez says that human life can change drastically due to digital techniques and the new bio. Depending on the millennial action of the "Surface" order, humanity can make a transition to the "molecular" order.

"...humans can work on an intra-molecular level, towards the knowledge of the genetic orders of order, when the general visible order of bio and digital beings is controlled by bio and digital information's chains" (Estévez, 2010, p. 168).

These studies allow the "emergence" of structure, form, and skin through biological or digital processes to become an architectural structure. These self-organizing biological and digital systems can be made from sustainability materials. These materials can be stand-alone "growing" systems. Alberto T. Estévez sees DNA and software as the same. Information chains generate orders (order) for natural or artificial, self-organization, autonomous growth, processes of emergence, structure, form, and skin emergence (Estévez, 2010).

He investigates the creation of bioluminescent plants and adding the bioluminescent protein gene to the DNA of trees. As a result, he and his team have created energy for illuminating cities ecologically without harmful waste in the Genetic Barcelona Project. In one of his articles about genetic architecture plans and designs, he pinpointed that his projects' ethical implications and scientific aspects were blurred. According to him, ethical rules in genetic engineering in biodesign are far less debatable when the benefits are taken into account (Estévez, 2010). Although the architect and his team suggest a sustainable design style, the use of genetics in such different disciplines, especially architecture, creates unpredictable concerns about the creation of human and non-human or super-human living conditions, our communication with our environment.

According to Jeremy Rifkin, studies of the genetic basis of human behavior provide a cultural context. These works, which expand the boundaries of the widespread acceptance of biotechnology, are being questioned by researchers, and the formation of genetic disorders that will cause mental illness has already begun to be predicted as a result of these inquiries. Some scientists have even suggested that various forms of antisocial behavior, such as false entropy and guilt, maybe evidence of malfunctioning genes. At this point, the following question remains important. *“Should humanity even begin the process of engineering future generations?”* (Rifkin, 1999).

Not all artists working with living systems have ethical issues. In this context, it may be suitable to refer to the works of Turkish artist Selin Balçı. The main element of her work consists of living microscopic organisms.

“The diminutive life forms harmonize to create a colorful array of actions, counter-actions, and conflicts where they are metaphors for various human conditions. In my work, the living entities are interactive elements and recreate observable conflicts” (Balçı, 2012).



Figure 37-Bordered World (Source: Balçı, 2014)

The artist, residing in America, stated that she touches on ecological and social problems worldwide in her works. She uses microbes isolated from the soil and air in the region where she lives (Balci, 2012). In line with the possibility that the change in the geography of endemic species will cause other negative consequences, she continues her studies in this ethical framework following the geography of the place where she lives.

As we have examined with the examples above, as a result of working with living systems, the creation of new living beings, especially as a reflection of genetic engineering, and the unpredictable growth of technology, the future concerns are sometimes tried to be resolved in a positive way, and sometimes it brings new uncertain issues to the schedule. It is observed that some areas whose boundaries have been determined from the past until now, such as bioethics, do not contain many borders. Especially when examined the field of art, or that art does not make an effort to prevent these limits.

CHAPTER 5: CONCLUSION

This paper has clearly shown that art and design have become two indispensable main elements in our lives, from the first tool analysis or the first cave painting to the present day. They have witnessed many different techniques and forms. Until recently, Western standards' artifacts with relatively low technology were labeled as primitive as a subcategory, free from their social and historical processes. New experiments and pioneering productions in technique and form have determined these forward or backward categories. However, these kinds of initial conditions of art and design make projections for the future.

While humans maintain their dominance over nature with the abstract concepts objectified, they have created works that strive to secure the limits of life. Art and design also impacted them getting to know nature more and starting to dominate it, which led to the shaping of art and design, aimed to reach reality in line with humanity's act of knowing, and these action-based movements have enabled the development of technical possibilities. When examined together with the return of philosophy (such as Plato and Aristotle), which emerged with the questioning attitude of humans, it was revealed that nature was the primary source of inspiration for them.

The relationship of art and design with nature has changed over time, just like human beings' changing relationship with nature. The emergence of different techniques and forms in art and design objects is sometimes the cause and sometimes the result of this change. For this reason, the individual who communicates with their environment to produce has tried to develop new forms of production to continue their vital activities. In this context, new structures have been discovered, and different forms of expression have been created. Knowledge, science, technique, technology, industry have become gradual reflections of it. In the act of shaping the art in line with the individual's needs and beliefs, the object has received its share of aesthetic values. When humans have sought the truth with science, they gather helpful information with a technique that makes them eligible to create beauty and new forms within the art.

With the Industrial Revolution, science and art, previously equipped by a craftsman, were reshaped and institutionalized as a profession. With the reshaping of technology

and science, the patterns have completely changed. In this context, the place of art in society has changed. For example, the 19th-century Theory of Evolution raised many questions about traditional beauty and the values it represents. In this period, great ideas were produced to solve problems related to nature by using a new branch of science such as biology, chemistry, zoology, and botany. Ernst Haeckel's introduction of ecology into terminology and his work in this field directly affected art and design. This bond established between art and science has undoubtedly paved the way for forming these biology-based sub-disciplines today. The most important example of this is the Germ Paintings created by Alexander Fleming with bacteria at the beginning of the 20th century. The discovery of antibiotics due to this study clearly showed that the role of art in shaping science is undeniable.

From the research that has been carried out, it is possible to conclude that scientific and technical developments increased rapidly with the industrial revolution, but it also caused negative reflections, some of which is the emergence of the working class, the increase in the population, and especially the beginning of environmental problems. Artists have strengthened the language of art in order to express these results of the industrial age. This radical change of the century has completely removed the traditional, historical, academic forms and patterns that were crumbling. Thus, in the 20th century, art was reshaped with different styles.

This change, which started with modern art, reached its highest point with the Postmodern period. Surrealism, Expressionism, Dadaism, Futurism, Constructivism, Cubism, Pop Art, Conceptual Art, Land Art, Fluxus, Minimalism, etc., many artistic movements emerged. Some of these movements heralded radical changes beyond borders. Especially with Duchamp, the ready-made object positioned as a work of art outside of traditional forms. With Land art, the boundaries of the gallery space have been exceeded, or the human body has become an art object with Performance art. These new transformations in art have changed the aesthetic point of view completely. It has been found that aesthetics, which emerged as a branch of philosophy in the 18th century, began to lose its dominance over art.

The changing borders and aesthetic categories other than beauty after modernism accepted different art forms with the Postmodernism period and led to reasons such as

the elimination of art. Contemporary theorists such as Rosalind Krauss, Artur Danto, and Lyotard, wholly disintegrated the aesthetic understanding. With the reflection of science and technology, this radical change in aesthetics has led to debates on whether aesthetic knowledge has been tried to be classified in line with biotechnologies. When we look at the history of aesthetics, the concept of "sublime" expresses a moral action, has been used in an unusual sense, and has undergone distinctions according to periods. It has been observed that the development of science and technology directly affects other disciplines.

From the outcome of our study, it is possible to conclude that, as Jos de Mul stated in 2013, we see that the concept of nature has left its place to biotechnology. In this period called the age of secularization, he expresses that the age of humanity is on the verge of a superior technological revolution. Society takes control of nature with technology, and divine nature power is reduced to humans. From this point of view, biotechnological developments have become a tool used by art, design, and science and have enabled the production of works that push the boundaries. As a result of this approach on the axis of art, science, and biotechnologies, an alternative form of contemporary art such as bioart has emerged.

Although bioart took its place in terms of terminology towards the end of the 20th century, when its historical adventure was examined, it was observed that artists created their works by using different techniques. At this point, it has been observed that bioart is divided into subheadings in terms of terminological classifications and techniques. Pier Luigi Capucci's bioart terminology diagram, which is included in many sources, has shown these distinctions. However, when we look at this diagram created for bioart, it is seen that it will become more challenging to determine the boundaries. New sub-headings were included in a short period of three years (2007 – 2010) from the first version of the diagram to the next version. This research has clearly shown that this field is still very new and continues to evolve.

Biodesign is a newer field compared to bioart. The relationship between nature and art and design has changed over the centuries. Approaches such as imitating nature, using nature as a model, and "*Naturaleza muerta*" (Still-life) have been replaced by hacking nature. In today's Anthropocene era, many issues such as the emergence of

environmental problems and the depletion of natural resources due to the emerging cross-urbanization and economic development have come to the fore. At this point, the design has been started to search for biology-based alternative solutions. Biodesign aims to cooperate with many living things in nature to provide a better ecological cycle by combining design with biological systems, creating sustainable, functional products from the power and potential of organisms while using nature together is beneficial for the ecosystem. However, based on the results, it can be concluded that bioart has no such concern.

When we examine these two areas with examples, we see that they are quite different from each other. However, as a result of the literature research, it was observed that the boundaries of these two areas were not clearly drawn in line with the sources obtained in these two areas. William Myers, who made both titles into a book with examples, also mentioned these differences but did not directly put a conceptual classification. The biggest reason for this is that the relations of the fields with each other are getting more frequent day by day. The best example of this is the approach of the genetic architect Alberto T. Estévez. The architect plans to implement the designs of genetic engineering and tissue culture studies on urbanization on a larger scale, as in semi-living art and transgenic art.

Although these artists and designers argued that this interference with living systems did not cause ethical problems, they still could not escape these discussions. Genetic research for art and design requires precautions such as avoiding accidents and contamination as in traditional medical research. Science requires responsibility, and strict procedures must be established for testing in hermetic environments. Asking ethical questions for art and design studies has gained importance due to the problems of the Anthropocene age and environmental crises. Likewise, future works will involve discussing the values of these disciplines as bioart and biodesign to which provide the opportunity to explore what kind of future world we want.

Working with living systems raises many questions such as different ethical issues, exhibition space, and definition of art. Firstly, the artist has become the main subject of ethics because of their bio-artworks. They have been subjected to complaints because the work produced or the technique used is unethical, which indicates that the

art is debatable and destroys its immunity. As ethical and aesthetic approaches mentioned in the fourth chapter, the function of art or design was different, so discounts are not related to art other than social sciences.

These changing perspectives in art and design in the 21st century cause us to question where and how these disciplines will take shape in the future. Likewise, these rapidly increasing new aspects of genetic engineering lead us to consider unstoppable scenarios of human-centered changes in the biosphere. Notably, in this Anthropocene era, it is not impossible to foresee new versions of this interdisciplinary transition in order to design utopian and dystopian worlds, and the next stage of research will be to question the possible establishment of life on other planets.

However, several other questions remain to be addressed and should be considered at the current time. Genetically modified organisms (GMOs) have made their way into almost everyone's refrigerator, shelf, and shop. Based on the results at this point, making the ethical discussion of bioart and biodesign is not more destructive than the destruction that is already in place, or when we consider the Alba rabbit, it is not possible to say that it is more harmful than the rabbits used as test subjects in the cosmetic industry. Further research into ethical classification still will be needed before obtaining a definitive answer can make approaches to these areas more pragmatic. In addition, changes in existing structures, especially art, necessitated the renewal of art education in the adventure of history. In this context of future research, I intend to concentrate on new methods with this contemporary approach to art education that can be introduced and developed more. On the other hand, when the findings suggest that biodesign could be more helpful in creating a sustainable world model that benefits the ecosystem based on the studies done so far.

Humanity began to develop a sensitivity because humans understood what they had destroyed and now inevitably faced extinction. Today, many reasons will cause the world's ecosystem to collapse, such as carbon emissions, destroyed forests, plastic heaps in the oceans, and the melting of glaciers much faster than expected. In addition, with the Covid-19 pandemic epidemic of the period we live in, humanity has come under a different threat, and many lives have been lost. For this reason, Bioart and biodesign have been demonstrated that they will draw attention to the destruction of

nature, environmental problems, the preservation of historical nature / natural life remains, and sometimes integration with nature, for a new thought on the necessity of form.

There may be very critical points waiting for the humanity in the future. The planet's balance is changing day by day, and behaviors must be classified accurately and precisely. From the outcome of our investigation, it is possible to conclude that education is at the forefront. Bioart and biodesign approaches can be used successfully in interaction with living things. With the Z generation, studies can be started from the primary school period. Although the information is given within the scope of science and biology courses, the increase in applied studies will help to train the architects of the smart cities of the future. However, while laboratories and many educational institutions in the world are working on these issues, More experiments/calculations will be needed to verify whether there is less awareness and uncertainty on these issues in Turkey as a result of our research.

To sum up, taking scientific developments out of its scope, for example, putting the theoretical knowledge into a visual and auditory language through art and design can make it easier for people to learn scientific information. The practical approach obtained through design and the methods applicable in the home environment can help create conscious behavior in many subjects such as energy saving and waste management. Moreover, art and design will initiate to increase the viable potential of these interdisciplinary cooperation fields and improve the existing physical and technical possibilities which will enable us to become ecologically, culturally, politically, and socially empowered in the future.

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