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BIOMEDIA'S CONVERGENCE IN BIOART

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ABSTRACT

This study examines what meaning *biomedia* used in bioart has in the context of media. First, we look at the terms that have been discussed in the art world during last 30 years, such as *media*, *new media*, *media-specificity*, *post-media condition*, and more, which have been used with the change of contemporary art media, and afterwards, we examine the meaning of *biomedia* within these terms. The interdisciplinary, integrative feature of biomedia, which uses biological media, digital computer technology, and art media, can be explained with the "principle of convergence." The convergence of biology, digital technology, and art media, which are at the level of physical and hardware layer (wetware), code-logical and software layer (dryware), and cultural contents layer (meaningware), is actually occurring within the work of bioart. The convergence of three layers implies that all of the significations that are connoted in each layer are combined together in bioart. The phenomenon of media convergence used in bioart reveals how bioartist's works, which combine living media with various technologies, critically reveal the issues and the ideologies surrounding bio-engineering.

KEYWORDS: Bioart, Biomedia, Media Convergence, Post, Medium Condition, Moist Media

INTRODUCTION

What is media in art, and how is it different from new media? What is more, in what sense is the media of bioart new? Traditionally, people have thought of media as the material foundation and elements that allowed art works, such as painting and sculpture, to exist. However, as various technologies such as photography, video sculpture, video display, experimental film, and more, have been incorporated into art since the 1970s and have been called *media art*, media in art came to possess another meaning. Furthermore, in the early 1990s, a few curators and critics began to use the adjective "new" with reference to art media that use digital technology and to differentiate new media based on digital technology from previous forms of media art.

It is no exaggeration to say that the new-media studies, which have seen vigorous activity during the past 20 years with Friedrich Kittler, Lev Manovich, Jay David Bolter and Richard Grusin, and Mark B. N. Hansen have been focused mainly on digitation or digitalization, which have made the "new" media possible.

However, although *media* and *new media* can be generally distinguished by the technical method of digitalization, the actual boundary and context that scholars use may be somewhat obscure and multiple, respectively. *Bio-New-Media*, which have a close relationship with not only digital technology but also genetic transplant or tissue engineering technology, pose a more complex problem. As well as the method and context of bioart, the meaning attributed to it can be related to consideration of the various problems that bioworks have generated, especially ethical ones.

Actually, the term "media" (and its singular, "medium") has long been linked to the meanings of communication

and transmission, such as “printing media,” “painting media,” “television media,” and the like, for sociocultural scholars and artists. To biologists, it has signified nutritional fluid or solid matter used in experiments to keep cells or organisms alive. W. J. T. Mitchell defined the concept of medium in his *What Do Pictures Want? The Lives and Loves of Images* as “a middle,” that is, an in-between or go-between, which acts as the space, passage, or messenger that connects two things, such as sender and receiver, writer and reader, artist and viewer.

However, as Mitchell has indicated, when we try to determine the boundary of these media as a middle agent, that is, to define media’s boundaries, problems occur. This is because the boundaries of media, which can be not just a middle agent but also a connecting space, passage, or messenger, can be limited to a narrow vehicle, or on the other hand, extended boundlessly, such that everything indeed becomes media. The medium can be the material or more, and even the method that reveals and operates the material. Thus, to totally separate medium from material support and just in relation to *social practices*, which Raymond Williams insisted are associated with a set of skills, habits, techniques, tools, codes, and conventions, is not enough (Mitchell, 2005, 204).

Many opinions surrounding media cannot be determined simply or be used consistently. In the case of bioart, which uses living media, the opinions about such a using of media are much more various and complex. During the 20th century, we saw the concept and media of art had extended. However, it is not easy to understand the media of bioart, which uses living organisms, as simply as an *extension* of what contemporary art has shown. This is because when considered from the aspect of media, biomedia is not an extension of existing media but the introduction of a totally new field.

This study approaches the media of bioart, which uses state-of-the-art technology from a multi-layer context, and looks at the patterns realized in bioart from the principle of media convergence. We will see how the convergence of biology, digital technology, and art media at the level of physical layer, code-logical layer, and content layer is realized in actual works. This will help us to understand bioart, which is placed in the center of much controversy due to the idiosyncrasy of its media.

BIOMEDIA ACCEPTING THE LIVELINESS AND DEATH

The reason why bioartist’s use of media gives a shock to people is that bioartists deal with media as a living being. However, there is a limit to artists dealing with organisms. Also, the fact that biomedia is alive indicates the destiny of an organism dying someday. Fourteen years have passed since Eduardo Kac, with his transgenic animal, the fluorescent rabbit Alba (*GFP Bunny*, 2000), raised such a scandal for using a live rabbit as an art work, so the rabbit probably will have died already.

Alba Eduardo Kac, *GFP Bunny*, 2000 was *created* to be a member of Kac’s family, who intended to play and eat with her (though the genetic engineering lab decided to keep her), but also as a work that possessed social themes and an event that emphasized “interspecies communication between humans and a transgenic mammal; integration and presentation of *GFP Bunny* in a social and interactive context; examination of the notions of normalcy, heterogeneity, purity, hybridity, and otherness; consideration of a nonsemiotic notion of communications as the sharing of genetic material across traditional species barriers” (Kac, 2000, 102). Ultimately, it was a living being with an existence that would lose its presence when it lived out its life (Causey, 2002, np).

Figure 1: Eduardo Kac, GFP Bunny, 2000

To emphasize the life of the media, many bioartists deliberately place the biomedia on the boundary of life and death. They aim to make us think about the meaning of life, to reveal technology that manipulates living beings, and to make us be aware of the hidden capital and ideology behind life technology. That is, although bioartists use bio-technology actually, they emphasize the *natural* law of *death*.

In 1998, Marta de Menezes collaborated on an experiment in Professor Paul Brakefield's laboratory at the University of Leiden, the Netherlands about the evolution and development of the pattern of butterfly wings under the project name *Nature?* In this project, through focusing on the potential that contemporary biology offers to artists by integrating biological material such as DNA, cell, and organisms with art media, she tried to examine the boundaries between the natural and the artificial, art and science, and life and death (de Menezes, 2003, 30).

She intervened in the normal growth mechanism of a butterfly and after finding out which elements influenced the appearance of the wings, manipulated them to make a butterfly with asymmetric wing pattern, not to be found in nature. This was not by changing the gene that is carried over to the next generation, nor by using artificial material, nor by inflicting an injury, but by the design of the artist. This is both totally natural and at the same time the result of human intervention (de Menezes, 2007, 218).

Through this work, she tried to emphasize the similarity and difference between what is manipulated and what is not, what is natural and what is a newly created nature. As she wrote, each modified butterfly was different from any other. The new patterns were never before seen in nature, but quickly disappeared from nature not to be seen again. This was a form of bioart that has a life span. It was a form of art that literally lives and dies. It was simultaneously art and life, art and biology (de Menezes, 2007, 220-221).

As in the case of de Menezes, the life and death state of a medium has important significance to bioartists. In the same vein of thought, Oron Catts and Ionat Zurr, who have led The Tissue Culture & Art Project (TC&A), are artists who have approached biomedia's issues of life, death, and presence somewhat seriously.

They ask, "If we can sustain parts of the body alive, manipulate, modify, and utilize them for different purposes, what does it say about our perceptions of our bodies, our wholeness and our selves?" (Catts and Zurr, 2007, 232). To manipulate a part of an organism is thought-provoking due to the inseparable relationship with the whole living being.

Figure 2: Oron Catt, Ionat Zurr, Semi-Living Worry Doll, 2000

What Catts and Zurr are interested in is the tissue that is above the level of the cell and below the level of the whole organism, *a semi-living* presence cultured in vitro. The artists and scientists of TC&A used tissue engineering and stem cell technology to culture living tissues taken from complex organisms to create a semi-living body, that is, a composition structured in 3 dimensions. These tissue culture techniques that make possible semi-living entities started from the early 20th century and developed into the discipline of tissue engineering. This refers to the culturing of an entity's partial tissue into 3 dimensions outside the body and making or controlling it into a desired form for the purpose of substituting or supplementing the function of a bodily part that has a defect or injury, originally keeping a living state outside the original presence or independent from that presence. It is their assertion that "the semi-livings are now out of the laboratories and into an artistic context. This opens up new discourses about the different relationships we might form with these new entities and sheds a different light on our perception of life" (Catts and Zurr, 2007, 231).

After culturing a monolayer, which was made from epidermal cells and connective tissue, into a small form in 1998, Catts and Zurr suspended it in a tissue culture flask with a sterile string and named it *B(W)omb*. The cells and tissues used in this process are from the remains of animals that have been killed for scientific research or food consumption. The idea of *scavenging* was of importance to them for ethical reason (to reduce animal suffering) and from a philosophical perspective (to enhance the idea of tissue culturing as an extension of life). Some of the cells they cultured were taken from animals killed more than twenty-four hours prior to any treatment they gave them. Using tissue culture, they successfully extended the life of parts of organisms for up nine months (Catts and Zurr, 2007, 234).

As Hanna Landecker illustrated through her studies, "Animals apparently could also live without themselves. It is possible to continue to grow the cells forever by transforming them into a cell line. Cell lines are cells that have been transformed by using viruses that ultimately cause the cells to grow indefinitely in culture. Primary cells are explanted directly from a donor organism. They have a finite number of divisions in culture and, given the right conditions, can survive for some time" (Landecker, 2002, 669). Catts and Zurr's semi-living entities grew in artificial conditions, which imitated body conditions, in bioreactors. However, to keep this state, a sterilized environment, nutritious media, appropriate temperature, continuous care by humans, and intervening of technology are needed (Catts and Zurr, 2007, 232). Although semi-living presences were the extensions of life, they are designed by humans,

unlike plants or animals raised at home, and as they are material existence that can be manipulated by humans, ethical concerns and philosophical issues are generated from the stage of manipulation. That is, semi-living existences are placed between the obscure boundaries of living and non-living material, cultured and structured, born and manipulated, and object and subject.

As a result of their collaboration with Harvard Medical School, Massachusetts General Hospital, the TC&A project team presented their artwork *Semi-Living Worry Doll* as part of *The Tissue Culture & Art(ificial) Wombs* installation at the Ars Electronica Festival in 2000. The display space, which had a tissue culture room installed, was a space to grow and care for the tissue. In this installation, they had handcrafted biodegradable/bioabsorbable polymers (PGA, PLGA, P4HB) and surgical sutures to create an iconic semi-living entity they called a worry doll (Catts and Zurr, 2007, 237).

In addition, after 9 months of culturing, they exhibited *Pig Wings* (2001) for 10 days, and since there was no one who would take care of it, they went through a killing ritual of letting it die naturally. They emphasized that the death of semi-living presences reinforced the concept of the temporality of living art, which is bioart, and made us become aware of "the responsibility which lies on us (humans as creators) to decide upon their fate" (Catts and Zurr, 2007, 239). Their purpose was to create for themselves semi-living presences and deliver their conditions of existing through the form of art to the public. The *life* of media enforces a certain sense of burden and responsibility upon artists. The artists are related to the technology dealing with organisms, the form and content of artistic expression, and the message that they want to deliver. The *life* of biomedia is evidently a new and special part when seen from the perspective of media. This also not only influences the convergence of other media, but also acts as the crux to burden the viewer, who must understand bioart as a whole.

BIOMEDIA BETWEEN BIOLOGY AND SOCIAL COMMUNICATION

If digital technology and the internet were the new media in the 1990s, bio-media, which uses biological state-of-the-art technology, can be said to be the newest of the new media in the 21st century. However, the *newness* of the media presents difficulties for including it in the discussion of the linear scheme of innovation and obsolescence ordinarily applied to media and new media. This is because bioart uses *new* media, such as cells, tissue, or the fluids needed for their survival, which is innovative for art, but if seen from the perspective of biology, they are *old* media that have existed since the 19th century (Mitchell, 2010, 123-124).

The origin of the use of *medium* in the cultural and biological sense can be found in the 17th-18th-century natural philosophy. In Francis Bacon and Isaac Newton's works, the term "medium" denoted the material space that enabled the transmission of something between two points. Bacon described how different media, such as air or water, propagated sound, and he considered the effect of various media on the propagation of magnetism and "odours," while Newton discussed the effects of "rare" and "dense" media on the refraction of light (Mitchell, 2010, 95). In the late 18th century, medium was used in a more extended sense as a means to "deliver" or "communicate" by writers who described psychological, pathological, and social phenomena. Afterwards, at the end of the 19th century, biologists and pathologists became interested in infected tissue and needed an external medium that could be used to maintain a bacterial group. The "Pasteur's fluid," composed of yeast ash, ammonium salt, sugar, and water, is such an example. From the 20th century to now, such types of artificial medium have been used basically in all biological laboratories. But the meaning of medium

in biology has changed, for although the medium used in the laboratories plays the role of delivering nutrition at the level of the molecule, the term "medium" has lost the sense of "transmission" and "communication" that it had in the 18th century. In other words, as biology became developed after the mid-19th century, "medium" in the biological sense came to have a different characteristic from the economic, political, and cultural sense used by writers of a social science or humanities background. Although biological media and sociocultural media both have their origin in the media concept of the 17th century, they have since separated and taken different paths (Mitchell, 2010, 96-97).

The divergent meanings of media in two such distinctly separate fields meet once again as bioart uses the media of the biological laboratory while also emphasizing the sociocultural meaning accompanying digital media technology. Such phenomena can be seen in the attempts of social science fields such as evolutionary psychology to combine the biological meaning with the communication meaning that media has acquired during the recent 20 years. Robert Mitchell holds that the reason why the media of bioart that uses organisms generate difficult problems is because bioart brings together both the sociocultural and biological meanings and uses these in the context of art (Mitchell, 2010, 93-94). However, this is the very point that also legitimately endows biomedia with its newness.

American bioartist Paul Vanouse's 2002 installation, *The Relative Velocity Inscription Device* (*RVID*), is a good example of a kind of biomedia that is biological yet contains the social meaning of transmission and communication. To doubt "DNA fingerprinting" or "genetic portrait," and to rethink the slippery yet authoritative analogies of eugenics and similar potentials for abuse in contemporary genomics after the Human Genome Project, he installed a molecular biological device that applied state-of-the-art technology (Vanouse, 2008, 185). In order to address the tense space of contemporary genomics, situated between the utopian pole of post-race and the historic racist pole of eugenics, he utilized an early publication by the American eugenicist Charles B. Davenport titled *Race Crossing in Jamaica* (1929). Davenport sought to disprove the theory of "hybrid vigor" by showing the ultimate inferiority of black/white hybrids (Vanouse, 2007, 278).

Vanouse extracted DNA from his family members of octoroon blood, Jamaican family members descended from mixed European-African ancestry. After he amplified specific genes understood to influence skin color and cut them by enzyme, he employed a process called "gel electrophoresis" that allows one to discern the different rates at which fragments of his family member's DNA move through an electrically polarized gelatin (Vanouse, 2007, 279). The following are Vanouse's words explaining this work:

> Gel electrophoresis involves first pouring a thin (agarose) gel of about one cm and allowing this gel to set. This gel is placed flat in a container and voltage is applied across the length of the gel. DNA is placed in small holes at the negatively polarized end of the gel. The gel is composed of microscopic pores, which allows the DNA to slowly diffuse through the gel -- however, all DNA is negatively charged and is electrically drawn toward the positive voltage at the far end of the gel. Thus, over a given time period, the DNA samples migrate toward the electrically positive pole of the gel at consistent speeds that depend upon their molecular size (Vanouse, 2007, 279-280).

As he explains, the RVID is not a simple device, it is an apparatus. A steel workbench holds a number of things. These include the various devices seen in the photo, such as the gel electrophoresis chamber, a power supply and switcher, a computer, a fluid circulator and cooler, and an interconnecting set of tubes, cables and wires, and valves

(Vanouse, 2007, 280). The location of DNA samples in the gel are captured by a specially contrived digital camera and then analyzed with a camera while *the race process* is disclosed to viewers through a touch screen monitor and a wall screen. To conclude, the velocity of DNA has no relation to skin color; rather only the size of the DNA molecule determines whether it moves quickly or slowly. Hence, despite Davenport's insistence, Vanouse shows that insofar as a race is concerned, skin color confers no advantage. Vanouse uses the word "race" in two meanings, "ethnicity" and "competition." This work, which satirizes genetic racism through the result of an experimental DNA race, is worth noting on the point that the artist moves away from the passive attitude of an amateur experimentalist who needs the assistance of scientists and doctors and moves toward the active attitude of a professional who can himself create a previously non-existing experimental apparatus and even show creativity in the experiment as well.

Figure 3: Paul Vanouse, the Relative Velocity Inscription Device, 2002

This work shows a new, unprecedented world of media by grouping three different fields of state-of-the-art biological devices, digital computer technology, and art expression and communication. In other words, Vanouse's bioart combines (1) biological media such as DNA and fluids for experimenting with them, (2) molecular biological technology that separates and amplifies them, (3) digital computing function that extends over both biological content and artistic expression, and (4) the (conceptual) artistic role of delivering and accumulating thoughts, data, images, sounds, color, texture, and so on into one.

The characteristic of biomedia that mix digital technology with biological and artistic media can be explained through the "Post-Media Condition," suggested by Peter Weibel in 2006. The term "post-media," used first as the concept of "post-media era" by Félix Guattari, later was used in the singular form of "post-medium" by Rosalind Krauss. To exclude the conventional meaning related with traditional aesthetics or with certain materials that the term "media" has, Krauss used the expression "technical support." This is to negate the "medium-specificity" that modernism theorist Clement Greenberg asserted as the single condition of media for the purity of art from the formalist viewpoint, which cannot be shared with the media of other arts. Krauss saw the "Post-Medium Condition" as the contemporary, technical mechanism that neither invalidates traditional aesthetic media nor claims intrinsic properties or idiosyncrasies but just supports artists work (Krauss, 1999, 289-305; 2006, 55-56). However, Weibel claims that thanks to the post-media computer, the universal machine that stimulates all media, art came to possess the post-media condition and a total availability that does not require intrinsic properties or idiosyncrasies within (Weibel, 2006, np.). That is, there is not just one kind of media that is dominant, but all forms of media influence each other, and what is more, in the case of art that uses technical media, as the media comprises all aesthetic experience, the art cannot diverge from or transcend media.

According to Weibel, such a post-media condition can be divided into two phases. The first phase is about achieving the equivalence of the media, establishing the same artistic recognition for the new media as has been enjoyed by the traditional media. The new, second phase is about mixing the media-specific idiosyncratic worlds of the media. What Weibel focused on is the second phase, and the present world of art, which shows that the mixture of media from digital innovation may be explained by the post-media condition (Weibel, 2006, np.).

Biomedia definitely lies under *the post-media condition*, which evidently transcends media-specificity, and idiosyncratic media show aspects of converging. Thus, instead of considering what each of the contents of biological or technical media has as matter or material, we must capture the total context in which bioart is newly received. Furthermore, if we look at biomedia in the perspective of it being *new*, it does not lie in the particularity of the newly used biological material or the digitalized DNA codes. That is to say, since the various media used by bioartists are not those that have suddenly appeared as certain media lately but are based on the developed technology (biology, genetic engineering, bio-technology, and more) and the transformation and accumulation of media as time passed, as Jay David Bolter and Richard Grusin claim, they must be understood according to the "principle of remediation," which commonly occurs in the relationship between media and new media through repurposing, reusing, absorbing, remediating older media (Bolter and Grusin, 2000, 44-47).

BIOART AS MEDIA CONVERGENCE

Biology and the Computer Meet

In his "What is Biomedia?" article, Eugene Thacker writes that "the primary definition of biomedia -- as the informatic recontextualization of biological components and processes -- is broad enough that it can cover a wide range of practices" (Thacker, 2003, 58). This signifies that concepts related to biological material in contemporary biology are in some manner computerized, while data is transformed into biological material in some manner. According to Thacker, the traditional wet lab of contemporary molecular biology is becoming extended, reinforced, and mediated by the dry computer lab. In fact, it can be said that the bio-technology, genetic engineering, and molecular biology of today could not have been possible without computer technology. First, the convergence of computer engineering technology and molecular biology can be seen in two related fields that use DNA. The first is bioinformatics technology, which uses numerous computing tools for protein prediction or to find out about a protein's structure, and another is the biological computing or biocomputing technology, which makes possible the (re)combination of DNA, and both developed rapidly after the 1990s. Both such technologies provide real examples of biology becoming media. However, although both use DNA and are computer utilizing methods related to DNA, they are each other's opposite. The output of bioinformatics is always biological: its point of reference is always the world of the biological cell, the DNA molecule, and various proteins in the body. By contrast, the output of biocomputing is not biological (despite its media) but rather computational (Thacker, 2003, 51). With these two techniques -- gene and protein prediction in biominformatics, NP complete calculations in biocomputing -- both premises "biology is computational" (for example, the essence of DNA as a code can be easily used in the digital field) and "computation is biological" (similar to Roy Ascott's moist media, dealt with below) are possible. In other words, there is a fundamental intersection between genetic and computer "code," between the biological and informational fields, as they are interchangeable in both material and function. Therefore, rather than technology as simply a tool, the technological reconditioning of the biological becomes more important (Thacker 2003, 51-52).

The convergent characteristic of biomedia originates from such premises. The media and the technology used in biomedia are structured by placing priority on the biological areas (a series of constituents that interact with molecular biology, bio-sciences, and so on). The reason why biomedia is new and special derives from the use of technology to influence biological areas in new contexts. In such a sense, "wet-dry cycles" (Thacker, 2003, 74), two-fold tendencies resulting from the reciprocal crossover between computer and biology, and the role of digital code in molecular biology, and more, become the fundamental characteristics of biomedia.

We should consider Roy Ascott's concept of "moist media," which earlier on focused on the meeting of digital technology with biology in a similar context. Ascott, who discovered the creative potential of interactive art through the feedback principle and variable systems of cybernetics in the 1960s, attempted to pursue the convergence of digital interactive technology and psychoactive complexion, and bridged the seemingly harder cybernetics with the softer mental system area mainly through *Technoetic Arts*, which he himself published. In many of his writings, he emphasized that especially "moist media" will bring about a greater shock than computer technology. The moist media that he refers to is the media area where the dry and hard area of digital computing based on silicon and the wet biological world of living systems meet. He claims that not only will moist media form the strata of 21st-century art but that it is appearing in the work process of designers, performers, and architects, along with "bio-telematics," biotechnology, and nano-engineering technology (Ascott, 2001b, 9; Ascott, 2004, np). He presented the "Declaration of Moist Media" in many writings in which he asserted the potential of the moist media concept to connect the artificial area with the natural and transform the relationship between the conscious and material world (Ascott, 2001a, np). Such logic of Ascott somewhat overlaps with creating new art methods through bioart and biomedia in that it brings the wet system of biological organisms to the area of technology. In other words, they are similar in that the co-existing manner of digital computing technology and biology can be examined as undergoing convergence. However, Ascott focuses more on dry technology acting like organisms, the transformation of expression patterns according to consciousness and mentality's inner structure and mechanisms, and the transition of the conscious toward creative emergence. Also, he does not directly refer to biomedia as moist media but rather focuses on the general biological understanding of culture.

Biomedia's Convergence

In contrast to Ascott, I want to focus on the manner by which biology, computer technology, and art expression converge in the experimental site of bioart, where they directly meet. Referring back to Weibel's concept of "post-media condition" based on the mixture of media, we may discover a similar and interesting link between the convergence of bio-media and today's media practice manner. This is similar to the concept of "media convergence," which was the focus of new media theory. The principle of digital convergence, which asserts that previously separated media became convergent through digital technology, has a direct relation with computer-based digital technology. However, the term convergence is not a concept just applied to the digital-based computer. As claimed by Henry Jenkins, who wrote *Convergence Culture: Where Old and New Media Collide*, it is a concept that can be examined not only in the convergence of technology but also in the aspect of cultural convergence. Jenkins uses the term convergence to refer to the phenomena that encompasses the flow of content across multimedia platforms, the socioeconomic interaction related to multimedia industry, production, and consumption, and the transformation of behavior patterns of media consumers as its result, describing technological, industrial, cultural, and social change. Media convergence is more than simply a technological shift. Convergence alters every kind of relationship, but it refers to process, not an endpoint

(Jenkins, 2006, 15-16). Here, I will try to explain the principle of the converging of biological patterns, computer technology, and aesthetic meanings, which had been previously separated. Biological media can be revivified into language codes or information. That kind of revivification results from the convergence of each layer, which generates sociocultural meaning and content closely associated with each other.

To explain the convergence principle of biomedia, I refer to three layers of digital convergence related to the questions of "What is converging?" and "What happens through convergence?" Convergence phenomena layers can be divided as the physical layer, the code-logical layer, and the contents layer (Benkler, 2000, 561-563; Lessing, 2001, 23) proposed by Yochai Benkler and Lawrence Lessing, or the hardware layer, the software layer, and the meaningware layer (Liestøl, 2007, 167-170) as proposed by Gunnar Liestøl. These refer to the convergence principle, which can be commonly divided into physical layer (or hardware), code-logical layer (or software layer), cultural contents layer (or Eduard Kac, *Genesis*, 1999 meaningware layer), and so on. However, I will substitute "wetware" for the physical layer, "dryware" for the code-logical layer, and "meaningware" for the cultural contents layer. "Wetware," that is, seen as the biomedia of the physical layer, refers to biological media, including the tissue, cell, and bacteria as organism and all experimental apparatus. "Dryware" is the biocomputing technology aspect of biomedia seen from the code-logical layer, which combines language, information, and logic with DNA nucleotide codes. Finally, "meaningware," the biomedia of the cultural layer, refers to the content and meaning expressed through the work. The three layers "wetware, dryware, meaningware" of biomedia are converged and integrated into bioart, which makes communications at each layer.

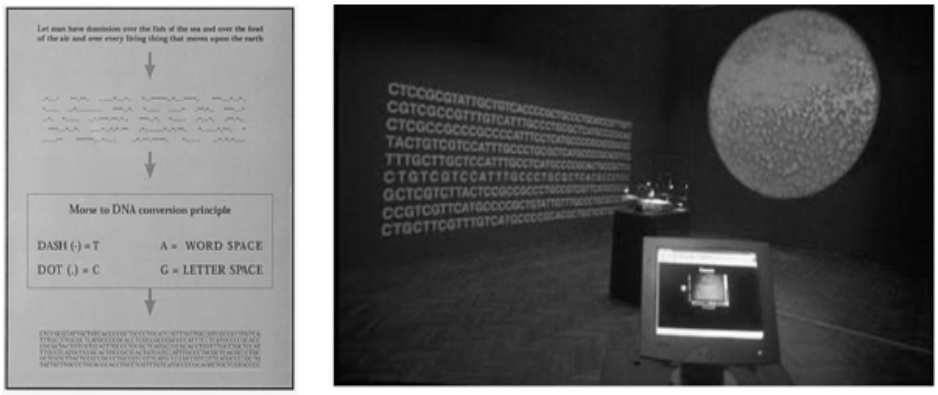

Figure 4: Eduard Kac, Genesis, 1999

In fact, we may see the various aspects of convergence generally occurring in bioart through Eduardo Kac's first transgenic artwork, *Genesis.* This work is an example of biomedia convergence in which the layer of biological experiment based on molecular biology and living media, the layer of DNA data that can be translated into language and text by computer technology, and the sociocultural content generated through such media all converge into one.

Kac translated Genesis 1:28, "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," into Morse code and then translated it into a genetic alphabet, that is, codes of A (adenine), G (guanine), C (cytosine), and T (thymine) through an arbitrary rule that he had made. Transformation was possible through the sequence of "art genes," a new combination of genes. In the next stage, an art gene combined with the plasmids is inserted into a bacterial species similar to *E. coli* to produce a mutated gene. To distinguish the art gene visually, Kac combined it with a green fluorescent protein (GFP) that becomes green when receiving ultraviolet rays. Viewers visiting the gallery or remote viewers who visit this work through the internet can

control the ultraviolet ray to shine on the culture dish. The bacteria of the art gene, which holds the Genesis phrase, will then selectively give off the green light, while those that do not will radiate the yellow. In the display area, the huge round screen image that magnifies this brings to mind a photograph of space, filled with the stars of the galaxy. This work, in which biological technology using DNA and the issue of language communication met, is a synthetic gene manipulated by an artist and realized by bacteria, a newly rewritten Genesis about the fish of the sea, fowl of the air, and every living thing (Tomasula, 2000, 85-96). At the same time, this is a work in which converge the genetic data of making a new art gene and its new combination and transplant process within the context of biological technology, computer technology, and language communication technology. Kac's *Genesis* emphasizes as well the feedback loops that continually reconnect "dry" information with "wet" biology within contemporary biological research and biotechnology (Mitchell, 2010, 47). The viewers and internet participants of this work may repeatedly oscillate between dry data and wet biology. The way of communication between Kac's work and spectators can be explained by the convergence principle, reflecting Jenkin's "collective process" (Jenkins, 2006, 3).

Since the Human Genome Project, there has been concern from the humanities that the genetic data that has been informationized or coded may lead to a disembodied, dematerialized understanding of the human. However, as can be seen from the bioartists, molecular biology not only *disembodies* genetic data and transforms it to computer language but also *re-embodies* the computer data into a living organism at the same time. In other words, new digital genetic data about the body (dryware) does not remain as itself but becomes a new wet experiment for curing cancer, that is, it returns to the experimental layer of a new wetware (Mitchell, 2010, 47).

Although the work of the bioartists in the above example uses biomedia, the reason why it cannot be considered just as a biological experiment is that these bioartists have information-conceptual content that transcends corporeality. On the other hand, the reason why their work is not simply the executing of software, though it utilizes program language or coded genetic data, is because it necessitates a strict producing process related to "wet art" composed of organisms. In addition, their work is based on image but not limited to it because a biological process transcending image is included, and while texts are utilized, likewise, their work is different from conceptual art based on language (Pandilovski, 2008, 3). All these characteristics may be understood through the principle by which digital, biological, and artistic media converge into bioart within Peter Weibel's Post-Medium Condition.

CONCLUSIONS

Biomedia, which can be said to be the convergence of 21st-century state-of-the-art digital technology and biological technology, is the newest form of media among new media. Seen from the history of art media, biomedia is a very special and unprecedented case, and in the context of contemporary art, it not only transcends the extension of media but in the aspect of ethics, it is the main culprit causing much controversy. As outlined above, while DNA molecules are both media and message, biomedia has a complex significance in which various layers of media have converged. In addition, biomedia transcends the message that bioartists attempt to deliver and rather connotes the political logic of biotechnology or the ethical issue of genetic engineering already inherent in itself. The living characteristic of biomeida is the fundamental crux in studying biomedia, but this study has tried to understand biomedia from the perspective of media through the principle of media convergence. In the perspective of the media, although biomedia connotes various layers of meaning difficult to understand through traditional media concepts, it is necessary for us to continue aesthetic and

humanities discussion on the existential significance and life and death issues that must necessarily be considered for living media.

I hope to conclude my study by presenting what bioart tried to emphasize through biomedia, that is, the importance of DNA and genetic information that genetic engineering has brought, the insight into both the bright future of the new world accompanying it and the negative and apocalyptic latent scenario, and discussion about what attitude humans should have towards other people as the other and the ecosystem in general. Many of bioart exhibitions and artists using biomedia try to make viewers take their own critical stance by making them aware of how much scientific research has developed in the field through scientific, experimental, and converged media and by highlighting the various criticisms and opinions of artists on such development. Moving away from just understanding the characteristics of biomedia, we may further ponder how we are to receive the new type of object or existence formed from the new types of living entities created through genetic engineering technology, what kind of relationships humans should have with them, and how we are to solve the new ethical and epistemic needs generated by such issues.

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