There is no reason to believe that the art of the future will look and feel like anything we knew in the 20th century. - Eduardo Kac[1]

I. Preface

The creative power harnessed and expressed by visual artists has, for centuries, been likened to divine creation. From the shamanistic cave paintings at Lascaux to Michelangelo's release of *David* from within the marble slab, artists have been mankind's intercessor in the divine act of creation. While artistic creation sanctions the representation of natural forms, and artistic license allows for expressive and inventive subject matter, does artistic freedom permit the invention of new life forms? This question is at the heart of a dialogue started by Brazilian-born contemporary artist Eduardo Kac and his artwork the *GFP Bunny Project*.

This thesis will take Eduardo Kac's *GFP Bunny Project* as a point of departure to consider how artists have explored and questioned the rapidly-expanding role of science and technology in society. This thesis will examine the context in which *Alba, the GFP Bunny,* was created and analyze the reception and controversy spawned by the project. It will trace Kac's interdisciplinary approach to art-making as evolving out of early 20th century Dada and Surrealist practices, as well as the Institutional Critique movement of the 1960s.

Kac invented a new life form in the creation of Alba, so this thesis will address the ideas of "otherness" as it relates to chimerical beings, both imaginary and real, in art and in science. This thesis will also consider the ethical and aesthetic implications of Kac's *GFP Bunny Project* and its relation to the representation of the animal in contemporary art. It will look at the use of live animals by Joseph Beuys and Diana

Thater and examine how, through various approaches, they and other contemporary artists have questioned the limits of human interaction in natural processes.

This thesis will trace the history of biotechnological advancements, focusing on the development of green fluorescent protein (GFP) technology. It will consider several commercial endeavors that have resulted from GFP research, specifically the creation and sale of fluorescent zebrafish marketed as GloFish®. This thesis will investigate several biotechnological innovations, including the patenting of transgenic animals, the production of genetically modified foods and research involving human embryonic stem cells, and demonstrate how other contemporary artists have reacted to these technologies. By questioning the definition of "naturalness," artists have brought to light many ethical and controversial issues within the science and technology debate. This thesis will examine works by Bryan Crockett, Larry Miller, Christy Rupp, Laura Stein, Oron Catts, Ionat Zurr, Laura Cinti and David Kremers. Lastly, it will review the impact of the *GFP Bunny Project* on society and offer some insights into the future of transgenic art.

II. Eduardo Kac and the *GFP Bunny Project*

Trans-what? Eduardo Kac's Methods and Terminology

Currently living and working in Chicago, Eduardo Kac was born in Rio de Janeiro in 1962. He studied communications theory, linguistics, philosophy and semiotics at Catholic University in Rio. His diverse interests and fields of study have informed his multidisciplinary approach to art-making. Since words did not exist to describe the processes that Eduardo Kac was engaged in, he coined new terminology. *Transgenic art* or *transgenesis* is an art form that utilized genetic engineering techniques to create unique living beings.[2] For Kac, transgenesis was a form of *bio art,* which explored and employed biotechnological practices to create art. Transgenic creatures were genetically modified organisms (GMOs). This means that their genetic material has been altered using genetic engineering techniques, generally known as recombinant DNA technology. DNA molecules from different sources are combined into one molecule to create a new set of genes; this new DNA is then transferred into an organism, giving it modified or novel traits. For Kac, transgenic art specifically involved genetically modified bacteria, bioluminescent mammals and other organisms that carried alien genetic material.[3] As we shall see, *Alba, the GFP Bunny*, (Figure 1) was one product of transgenesis, and Kac has made several other transgenic artworks that investigate similar themes. Art historian Suzanne Anker has elaborated on the idea of a transgenic animal. She has identified a name for these new creatures which are neither nature nor culture: *biofacts*. A *biofact* is something that would never exist in nature given the limitations inherent in interspecies mating, but exists as a manipulated life form created through technology.[4]

Throughout his career, Kac has been best known for his bio art and interactive internet installations. His early work in the 1980's involved mixed-media and visual poetry, performance art and graffiti art. A pioneer of telecommunication art in the pre-internet 1980's, Kac produced radical artworks that incorporated and explored the relationship between science, technology and living beings in the early 1990's. His work tackled complicated issues, often involving new technological strategies and terms - like *transgenesis* - to describe the type of biological art he innovated.

From his first experiments online to his later conflation of digital, technological and biological techniques, Kac has perverted the norms of technological correctness.[5] By employing science and technology to question morals and values, he opened up new ways of thinking about man's relationship to these rapidly progressing disciplines. Through his artwork, Kac has explored the ways in which humans and animals interact. By integrating telecommunications, robotics, computers and sentient beings, he has been less concerned with the way the piece looked (its form), as he was with how the work affected behavior.[6] Interaction among participants (including spectators and the transgenic beings he created) was an essential element in the completion, success and interpretation of his artworks.[7]

The Bioluminescent Bunny: Alba is Born

In 1999, Eduardo Kac created a new type of art object: a fluorescent rabbit. He commissioned scientists at the National Institute of Agronomic Research in France to inject an albino rabbit egg with green fluorescent protein (GFP) from a Pacific jellyfish. The result was Alba, a rabbit that glowed fluorescent green when illuminated by blue

light.[8] Alba was not harmed during her creation, as GFP injection has long been considered a safe and harmless practice. Scientists have experimented with GFP in animals for years, but Kac's art project represented the first time an organism was created outside of a scientific, research-based context.

Kac invented Alba, a totally unique transgenic social subject, not an art object. Once born, Alba was to cohabitate with Kac in a comfortable exhibition space. During the exhibition, Alba and Kac would live together and interact with each other, as well as interact with the public who came to see their installation. After the close of the exhibition, it was arranged that Alba would permanently reside with Kac and his family in their Chicago home. Kac did not consider Alba to be an artwork per se, but part of a larger political statement. His project was designed to provoke the fears, imaginations and hopes that society has attached to new, genetically-modified life forms.[9] Kac intended to create a dialogue within society to discuss the positive and negative potentials inherent in the future of genetic modification.

Reception and Response to Alba

The *GFP Bunny Project* has been called many things, from silly and gimmicky to an outright act of violence. It has raised questions about Alba's meaning; is she a designer pet, a form of social critique or a freak show?[10] Kac envisioned the *GFP Bunny Project* as a completely integrated process that involved creating the bunny, introducing her to society at large and providing her with a nurturing environment in his home. But the project in its entirety was never realized.

The French laboratory that produced Alba refused to release her, and the bunny remained in the lab's custody. Kac was faced with a dilemma. In light of the unforeseen obstacle, Kac carried on with the project in a different way, asserting that art's legitimacy lay "in its ability to constantly reinvent itself."[11] To that end, he relinquished control of the artwork, allowing it to be entirely transformed. He shifted the focus to the public, and encouraged the concept of Alba to become part of an open-ended dialogue. Although Kac was forced to modify the parameters of his project, one important aspect remained intact. All along, Kac had intended the *GFP Bunny Project* spark a discussion about genetic modification.

In his essay, "GFP Bunny," Kac asserted that the formal and genetic uniqueness of Alba was but one component of the *GFP Bunny Project*. [12] The project was a complex social event that started with the creation of a chimerical animal that did not exist in nature. It included the following items at its core:

1) An ongoing dialogue between professionals of several disciplines (art, science, philosophy, law, communications, literature, social science) and the public on cultural and ethical implications of genetic engineering;
2) The contestation of the alleged supremacy of DNA in life creation in favor of a more complex understanding of the intertwined relationship between genetics, organism and environment;
3) The extension of the concepts of biodiversity and evolution to incorporate precise work at the genomic level;
4) Interspecies communication between humans and a transgenic mammal;
5) Integration and presentation of *GFP Bunny* in a social and interactive context;
6) The examination of the notions of normalcy, heterogeneity, purity, hybridity and otherness;
7) Public respect and appreciation for the emotional and cognitive life of transgenic animals;
8) The expansion of the present practical and conceptual boundaries of art-making to incorporate the invention of new life forms.[13]

Alba's safety and ability to look and function normally were important issues to Kac. He did not want to create an animal that was so different from its fellows that its social life would be affected. He also made sure not to harm Alba in her creation. In multiple studies, GFP proved to be the least harmful source of bioluminescence that could be transferred to animals via embryonic injection.[14] From the outset, Kac made clear his intention to love and protect Alba. He recounted, "I will never forget the moment when I first held her in my arms. My apprehensive anticipation was replaced by joy and excitement. Alba was an absolute delight to interact with…She immediately awoke in me a strong and urgent sense of responsibility for her well-being."[15] For Kac, the project was not only to create, but to befriend and interact with a new transgenic being.

In response to the laboratory's retention of Alba, Kac launched a "Free Alba!" campaign. This consisted of intervention and public outreach projects in Paris and Rio de Janeiro, several public debates and the creation of various pieces of literature. In front of his home in Chicago, Kac erected the Free Alba Flag (a white flag with a fluorescent green silhouette of a bunny) (Figure 2) as a protest to mark her absence. In December, 2000 Kac launched an intervention against the French laboratory by displaying posters in several Parisian neighborhoods. [16] Kac posted images on the streets in an effort to intervene in the context of French public opinion and gather support for his cause to bring Alba home (Figure 3). Each poster displayed a word (*ethics, art, family, media, science, religion*) to reflect the multiple ways the *GFP Bunny Project* could be interpreted. The poster intervention took place in conjunction with several radio, print and television interviews and debates.[17] A few months after this

first intervention, Alba was featured on the cover of the French art journal Revue D'Esthétique.[18] Kac also presented *Le Lapin Unique,* a public installation at Le Lieu Unique in Nantes, France from March 14 to May 4, 2003 (Figure 4). Consisting of more than fifty images of Alba repeated in a grid, this monumental work was affixed to the side of a large building. With an average of 30,000 viewers per day, it reached a wide audience. Kac also engaged the French public directly through a series of lectures at high-profile institutions and through face-to-face conversations on the street. [19] In total, Kac's Paris interventions reached approximately 1.5 million people (about half of the population of Paris).

In the fall of 2004, Kac launched a series of public interventions in his hometown of Rio de Janeiro, Brazil. *Rabbit in Rio* was realized during Kac's solo exhibition *Rabbit Remix* at the gallery Laura Marsiaj Arte Contemporânea. The exhibition included photographs, drawings, artist's books, the Free Alba Flag and web art, as well as public interventions, including posters, lectures, street conversations, articles, and television and radio broadcast throughout Rio de Janeiro (Figure 5).

Since Alba's creation, Kac has written extensively about transgenic art in general, as well as the *GFP Bunny Project* in particular.[20] Through the written word, in both printed and digital form, Kac continued the dialogue. In 2003, Kac produced a book, It's Not Easy Being Green!, to focus on the poetic and humorous public responses to the *GFP Bunny*. The book was a kaleidoscopic montage of images and texts, including cartoons, novel excerpts, radio limericks, children's emails, television broadcasts, headlines and web postings. It exemplified Kac's continuously evolving reflection on the relationship between humans and transgenic animals.[21] Each page

included contributions from authors — from France to Australia to Russia to Colombia — and reflected the multifaceted reception of the *GFP Bunny Project*.

Kac was interested in the public's feedback on his work and utilized the internet as an interactive tool to promote further dialogue about his controversial work. His website, www.ekcac.org, encouraged the public to post their comments about the *GFP Bunny Project.* Kac collected these responses in a blog called The Alba Guestbook: 2000—2004. This multi-faceted compendium is still accessible online. Representing yet another component of the *GFP Bunny Project,* The Alba Guestbook: 2000—2004 was structured like an interactive blog.

The reactions from individuals from every part of the globe have varied immensely. Most of the responses were intensely emotional. Almost all participants wanted to see Alba released from the lab, although their stance regarding the overall *GFP Bunny Project* ranged from full support to utter disgust. Those in favor of Alba's release responded on an emotional level, stating that she belonged in a home as part of a loving family. [22] Monica Silvers' 2001 posting read, "I am not sure that I agree with genetic engineering for the sake of 'art', but since Alba already exists, she must be appropriately loved and cared for, as should all members of the animal kingdom…Please allow her to be returned to her home so she can live out her life with love and comfort." Jo Ann Caplin's words read, "I think ALBA is wonderful, and she needs you [Kac] to cuddle her." Overall, contributors expressed feelings that Kac would provide the bunny with a safer, happier and more socially-interactive environment than the scientists. "I am concerned about Alba's quality of life. Do the people at the lab love her? Do they take her outside to play in the grass, or is she sitting

idly and alone in a cold, sterile cage? Does she get to meet other bunnies or other animals? Part of the artist's concept was to interact with her and provide her a loving home; she was not created to be a lonely freak in a cage. I fear the lab is treating her as a commodity and not a living creature who deserves a full life."[23]

Those contributors who posited themselves against Kac's practice ranged from lukewarm to scathingly vehement. "You bastard! How dare you play with nature like that! I hope you NEVER get Alba back!!!!!!," wrote Laurel of California in 2001. Several writers questioned the idea of Alba as property. One blogger wrote, "Shame on you, Mr. Kac. That rabbit does not belong to you. Although you claim to be addressing the important issues regarding transgenic and other biotech created organisms, in fact, you have no respect for the serious implications of this type of research. Scientists do not sit around altering life to make artwork commissions. Contrary to popular belief, altering life requires great humility on the part of the scientists; they do not alter it for the sake of art. If you want a green bunny, buy some hair dye." And while some individuals saw true merit in the project - like James Briggs from Melbourne who wrote, "Brilliant! Has changed how I think of Art and Science" - other contributors took a more shallow approach. Some thought the concept was "cool" and wondered how they could get a fluorescent bunny for themselves. "I want a glow-in-the-blue-light bunny also. As soon as they become commercially available, I will purchase one regardless of price," wrote Cameron Siggs.

While some proponents of Kac's work have recognized positive potential in the unprecedented newness of transgenic art, critics have found the practice invasive, irresponsible, immoral, provoking, and ethically disturbing. Criticism of the *GFP*

Bunny Project has come from many different individuals and organizations. Although Kac did not wish to create or condone work that harms animals, animal rights groups have criticized his approach. In response to artworks that involved cruelty towards animals, a Minnesota-based group of artists formed the Justice for Animals Art Guild (JAAG) in the fall of 2000. They founded their organization to "oppose art that harms or exploits animals, and explore ways to support artists whose ethics and philosophies value the rights of animals."[24] The group claimed that much could be accomplished "by sensitizing the arts community to the fact that animals are sentient beings, not ideas or inanimate materials with which to create a performance or an exhibit." [25] JAAG's goal has been to prevent cruel or degrading use of living animals by contemporary artists, and they criticized Kac for his reckless treatment of life in the *GFP Bunny Project*.

Perhaps because Kac did not gain custody of Alba as he had originally intended, his work sparked a larger dialogue than it would have otherwise. The change of plans opened up the scope of responses; there was more to learn and discuss. People who otherwise may have remained unaffected by the artwork, have been impacted. The *GFP Bunny Project* has arguably been Kac's most compelling project to date.[26] This work has reached so many people and has had such a range of responses that he received support from some unexpected sources. Due to the outcry by animal activists to free Alba from the laboratory, Kac's work highlighted the plight of animals in captivity. A PETA (People for the Ethical Treatment of Animals) spokesperson stated that the *GFP Bunny Project* could prove to be "helpful for laboratory animals everywhere."[27]

As the *GFP Bunny Project* continued to rouse a debate, Kac created a series of drawings that responded to Alba's continued presence as a conceptual (if not physical) entity. In the drawing *Nature Morte au Lapin* (*Still Life with Rabbit*), 2002 (Figure 6) Kac commented on Alba's existence in the realm of memory. This pencil drawing of the Google search-engine, an image so familiar to us today, suggested Kac's literal search for Alba. Musing on his inability to gain physical access to her, the drawing indicated that Alba's presence was more palpable in a digital context rather than a physical one. Drawn with an intentionally shaky hand, a sense of loss is palpable in this touching and quirky freehand sketch. Feebly-drawn, scratchy letters emphasize the sense of Kac's personal longing. As if in homage to Alba's memory, Kac humbly and intimately tried to recapture her presence through this simple drawing. Its grainy surface appearance has a feeling of a frottage, as if the image was created by rubbing a pencil against an artifact from long ago. The lonely letters spelling "Alba" in the Google search bar were the only green elements within an otherwise stark black and white space.

In *Nature Morte au Lapin* (*Still Life with Rabbit*), Kac began his search for Alba on the internet. Since the internet, as a medium, responds to a constant influx of new information, it is an ever-changing environment. By recording the appearance of a webpage on a paper substrate, Kac wanted to make permanent and tangible a digital image that would otherwise have been subject to change. Kac wanted to capture the essence of Alba's current identity; an identity which only attained via her presence on the internet. He believed that access to her was possible in this way.

Kac's personal expression to reach out for Alba was enacted upon the international, public forum of the internet. This created a dichotomy between public and private realms, memory and actual existence, truth and faith. In the essay, "Between Memory and History: *Les Lieux de Mémoire,*" Pierre Nora discussed *sites of memory*.[28] For Nora, real memory was a personal expression. True personal memory was directly opposed to history, for history was a public manifestation of an artificial collectivity that was constructed by and within society.[29] Perhaps Kac expounded upon these ideas by presenting a drawing that showed the overlap of Nora's two sites of memory: personal and public. The internet is a large, interactive societal tool; it is a forum where members of the global community go to seek information. In *Nature Morte au Lapin* (*Still Life with Rabbit*), Kac sought out a personal memory of Alba via the expression of her name within the larger, publicly-constructed internet.

The drawing's title, *Nature Morte au Lapin* (*Still Life with Rabbit),* was carefully selected for its special significance. The literal translation of the French phrase *nature morte* is "nature dead." By titling the drawing as such, Kac implied that nature had died or, that what had previously been deemed as natural no longer existed. The *GFP Bunny Project* created a new organism using an unnatural technique, so Kac's process can be seen as negating the truly natural forms of life that had existed before. The title can also be read as a pun. The words "still life with rabbit" imply that the rabbit still has life. Kac reminded us that Alba's memory was still viable and will continue to live on in cyberspace. In this drawing, Kac showed how the concept of Alba as mascot of transgenic art has persisted in Kac's personal memory, on the public internet and in the drawn image, despite her forced residency in a laboratory.

III. Art and the Animal

Fabricating Monsters: Collage and the Chimera in Art

The concept of the chimera has been central to mankind's self-awareness since the dawn of time. As an archetype of an illusion, a fabrication of the mind, a fantastic fabled hallucination and increasingly an experimental reality, the chimera has long been a source of fascination in science, literature and the visual arts.[30] When considered in terms of their social context, specific chimerical preoccupations have reflected the social, scientific and religious circumstances of their time. In Greek mythology, Homer described the chimera as a fire-breathing monster with the head of a lion, the body of a goat and the tail of a serpent. As the namesake of a long line of these mixed-species creatures, the chimera and its fellow monsters (the centaur, griffon, sphinx, satyr, and minotaur) continue to be magical and monstrous figures in the visual arts.[31] But now, in the 21st century, technological practices have permitted the actual creation of a chimera through transgenesis.[32] Altering, recombining, duplicating, enhancing, amplifying and recontextualizing are techniques that geneticists use to create transgenic creatures. In the past, artists have employed parallel methods to extend the limits of representation.[33]

The cut-and-paste character of today's transgenic artwork has its roots in avant-garde practices of the 1920's. The desire to create fantastical creatures by recontextualizing materials was evident in the early practice of collage, an artistic technique that involves cutting, pasting and reformatting fragments into alternative narratives.[34] Early modernist artists were fascinated by the versatility offered by collage and invented a host of organisms combining parts of humans, animals, plants, and machines. As Suzanne Anker has suggested, the artistic practice of collage took a

nod from the early days of the industrial assembly line and mass-production which were based on the interchangeability of product components.[35]

During the Dada and Surrealist movements, artists were invested in reconstructing the body as a combination of disparate elements. Max Ernst, a German artist involved in both movements, made collages that depicted preposterous organisms by intermingling images of species from the animal, vegetable and mineral kingdoms. In Ernst's work, *Stratified Rocks, Nautre's Gift of Gneiss Lava* (1920) (Figure 7) body parts, such as a rib cage, brain, arteries, and blood vessels were set against a ground of exotic plants and geological forms.[36] This mixed media palimpsest created an "eery world of fantastic beings."[37] In his study of Ernst, art historian Werner Spies defined the principle of collage in terms that could be used to describe transgenic experiments: two distinct and unrelated forms were made to meet, displacing their original meanings. The coupling resulted in a new entity that evoked disparate information requiring alternate interpretations.[38]

In addition to the medium of collage, Surrealist artists used another technique to creatively combine elements from disparate sources. *Cadavre Exquis,* or the Exquisite Corpse, was a parlor game adopted by artists to reconfigure the body of an artwork according to the laws of chance. The exercise required a small group of participants. The first person would create a section of a drawing on a piece of paper. He would pass it to next person and invite him/her to create something new. The second person was meant to continue the drawing without seeing what the previous person had created. He/she would then pass it on to the next person, and so the collaboration continued. The end result was always unexpected and spontaneous, and often incorporated wildly

disparate elements. In the *Cadavre Exquis 9* (Figure 8), André Breton started the drawing before passing it on to his second wife, Jacqueline Lamba, who then gave it to Yves Tanguy to complete. The drawing shows human forms melding with machines (a locomotive) and converging with animal parts (a caterpillar). In other Exquisite Corpse drawings, the resulting chimerical beasts often contained robotic elements. As concerns about the mechanization of the human grew, artists used mechanized imagery as a way to address their concern. Artists observed and made manifest the discontinuities, ambiguities and anxieties associated with scientific experiments, technological discoveries and the vast societal, economic and political changes brought on by two industrial revolutions and a tumultuous World War.

Interventions in Technology: Kac, Institutional Critique and E.A.T

Technology has come a long way since the 20th century, and artists like Kac have used the most innovative technology available in their work. To make art that addressed the cultural, material and philosophical conditions of the 21st century, he made use of one of the most significant means of our time: technology.[39] Kac's art practices appropriated the tools of technology and science in order to subvert them. His artworks were transformative because they appropriated, modified and subverted the disciplines of science and aesthetics in order to raise important questions. Does artistic creativity or scientific research permit the creation of new life forms? At what point does the idea of "naturalness" break down? Is it necessary to respect the boundaries between species? What is "otherness"? How do different animals that share genetic

information regard each other? What is the relationship between humans and transgenic animals?

Eduardo Kac incorporated a new field of works that employed the actual materials and processes of life.[40] "If we leave technology behind in art, if we don't question how technology affects our lives, if we don't use these media to raise questions about contemporary life, who is going to do that?"[41] Commenting on his transgenic works, and on the fact that one of his artistic pursuits was to "heighten awareness" of some of the generally unnoticed social transformations that were already underway, Kac contended that humans and other species have been evolving in new ways. There was a transgenic ecology already in place.

> Transgenic crops are cross-pollinated by insects that fly from one place to another. Transgenic animals are found in farms worldwide. Transgenic fish have already been introduced into the ornamental fish market. Transgenic fruit-as-vaccines are now being developed. The list goes on. We do not grasp the complexity of this cultural transformation when we drive by a corn field, when we put on a cotton shirt.[42]

In this statement Kac noted the ubiquity of transgenic organisms in our world. Because transgenic products have been incorporated into the fiber of daily life, people have not stopped to take notice of their social implications. Avoiding and/or ignoring the issue of transgenesis can cause complacency with regards to a potentially dangerous technology. Through the creation of Alba, Kac produced a bold statement on biotechnological practices. People who otherwise may have blindly accepted scientific experimentation were forced to confront the issue of transgenesis and ponder its ethical and societal complexities. Kac intended for his artwork to dramatize the existing

scientific and technological practices in order to provoke an interdisciplinary dialogue about our present and future.

Kac's interactive and investigative approach to art production was rooted in the "institutional critique" movement of the 1960's and 1970's. Artists who engaged in institutional critique launched an inquiry into or criticism of the workings of a particular institution. Most often, the institution targeted was a museum, gallery or other major component of the art world. In his important essay, "Conceptual Art 1962-1969: From the Aesthetic of Administration to the Critique of Institutions," art historian Benjamin Buchloh outlined the legacy of the institutional critique movement. He declared that art was more than the sum of its materials, techniques, surfaces; there was more to consider than its context, placement or location in which it was seen. Artworks operated within much larger conventions, including economics, language, culture and society. So, too, should these larger conventions be accounted for when creating and interpreting an artwork.[43] As the movement evolved, the conception of what constituted the "institution of art" expanded. No longer restricted to museums, galleries and other sites of art production, distribution and reception, institutional critique targeted the entire field of art as a social universe.[44] In the works of artists associated with institutional critique, it came to encompass all the sites in which art is shown, from museums and galleries to corporate offices and collectors' homes, and even public spaces. It also included the sites of the production of art, such as studios and offices, the sites of the production of art discourse, such as art magazines, catalogues, art columns in the popular press, symposia and lectures, and the sites of the academic production of art and art discourse, namely studio art, art history and curatorial studies programs.[45]

Buchloh wrote about the conceptual artist Daniel Buren, whose interventionist practices have informed Kac's own methods. In the 1960s, Buren produced unsolicited public artworks using striped awning canvas common in France. He drew public attention through the use of billboards and hundreds of posters throughout Paris and in more than 100 metro stations. Using the trademark stripes as a visual instrument, he invited the public to challenge traditional ideas about art.[46] As Buchloh wrote, Buren's displacement of the traditional sites of artistic intervention resulted in a "multiplicity of locations and forms of display that continuously played on the dialectic…traditions within the discourse of the museum and the studio."[47]

Kac's public "Free Alba" interventions - in the nontraditional form of public and private interviews, posters and installations - were rooted in the institutional critique method and specifically informed by Buren's practice. The work launched an inquiry into the scientific community's ethical practices and responsibilities by engaging the public through the various interventionist means. The influential artist and provocateur Marcel Duchamp famously stated that an art object became complete and significant when the public viewed it: "All in all, the creative act is not performed by the artist alone; the spectator brings the work in contact with the external world by deciphering and interpreting its inner qualification and thus adds his contribution to the creative act."[48] Kac's work, as well, gained significance when the public participated in the dialogue. Whether the viewer was an artist, critic, curator, art historian, student, dealer, collector, casual museum visitor or blogger on Kac's webpage, each played a role in the *GFP Bunny Project*.

Kac's collaboration with scientists comes out of another art historical precedent: that of the collaboration between engineers and artists started in the 1960s. During the Renaissance it was common for artists to be skilled in art, engineering and the natural sciences; the figure of Leonardo Da Vinci exemplified this approach. But as scientific progress expanded and the disciplines of art and science separated, it became increasingly difficult for artists to engage with complex technological practices on their own. In 1966, Billy Klüver founded Experiments in Art and Technology (E.A.T) to forge effective collaborations between artists and engineers. In *The Engineer as a Work of Art*, Billy Klüver discussed the collaborative and synergistic role between the two groups: engineers helped artists realize their aims, and in doing so furthered a dialog and advanced understanding for all involved.[49] Visual, performance and mixed-media artists, including Robert Rauschenberg and Robert Whitman, relied on the collaborations afforded through E.A.T to bring their art and ideas to fruition.

During the early days of E.A.T, Klüver could not imagine a similar collaboration between artist and scientists. In 1968 he stated, "I have yet to meet a scientist who would collaborate with an artist – or who could….The engineer and the artist deal with the physical world and work for direct solutions of problems. The scientist is not trained to deal with and handle the physical world. His goal is to understand it in terms of a specific language of little interest outside science…They simply cannot understand each other. A relationship between an artist and a scientist would be incestuous today."[50] But today, much private and public collaboration exists between artists and scientists. The Wellcome Trust, the world's largest medical research charity, offers a program to foster partnerships between artists and scientists. In 2004,

NASA welcomed Laurie Anderson as their first artist-in-residence. Other international organizations, including SymbioticA, c-lab and V2_Organisation, encourage the artists and scientists to work together.

Beuys and the Role of the Animal in Contemporary Art

Contemporary art practices have rapidly expanded. In addition to moving out into the social realm, artists have also begun to use live animals as subjects or participants in their work. The role of the animal in art has changed dramatically over the course of history, never more quickly as in the past thirty years. Traditionally, artists had used animals in painting and sculpture as remote ciphers for human meanings. A dog curled up in a wedding portrait symbolized fidelity. A military figure commemorated in sculpture as seated upon a steed encoded not only the power and dignity of the general, but the position of the horse's legs indicated information about the general's biographical background as well.[51] Dead animals were splayed out as foodstuffs in still life and *vanitas* paintings, and artists selected subject matter to showcase their own technical talents. These paintings permitted artists to demonstrate their ability to render complex objects and diverse surfaces and textures like rabbit fur, chicken feathers and fish scales.

In contemporary art, the proximity of artist and animal has come closer. Artists have investigated themselves and their animal counterparts as living beings caught up in each other's affairs willingly or otherwise.[52] A notable milestone in art history's changing consideration of the animal was German artist Joseph Beuys' 1974 action, *I Like America and America Likes Me* (Figure 9). In this performance piece, the artist

interacted with a wild coyote for several days in a confined space of a New York gallery. Through a series of ritualized actions, shamanic techniques, his own characteristic tools and a widely syncretic symbolic language, Beuys engaged the coyote in a dialogue. He aimed to get at, "the psychological trauma point of the United States' energy constellation," namely, the schism between the intelligence and spirituality of Native Americans and Western mechanistic, materialistic and positivistic values.[53]

Beuys paid tribute to the interrelationship between aboriginal peoples and animals. Interested in myth and folk stories since childhood, Beuys' commitment to native people was fueled by a personal experience from World War II. When his plane was shot down in the Crimea in 1943, Beuys landed in a region between the Russian and German lines populated by Tartar nomads who saved his life. In *I Like America and America Likes Me*, Beuys explored Native American creation myths. In these stories, the coyote taught man how to survive and the incredible survival of the coyote, both mythologically and biologically, has long served as one of the great American mysteries.[54] Like Kac, Beuys also used rabbits and rabbit imagery in his work. He repeatedly identified himself with the hare, and developed an iconography of the hare as a symbol of birth and incarnation. Though traditionally known for its fecundity, Beuys saw the hare as representative of the vulnerability and finiteness of humankind.

Art historian David Levi Strauss saw Beuys' dialogue with animals as standing out against the more prevalent modern relation to animals as inferior pests, pets, monsters or medical spare parts. He conjectured that Beuys, the animal communicator and founder of the Political Party for Animals, had a profound influence on the animal

rights movement.[55] Beuys, while an artist first and foremost, was also an activist, professor and public lecturer. His intention was not to reduce art to just another discourse, but to act socially as an artist and to break down the barriers between art and social life.[56] His famous proclamation, "everyone is an artist," implied that people should function as creators, not just consumers, of culture.[57] Kac, and other contemporary bio artists, picked up on and pushed the boundaries of Beuys' statements. Acting socially, they tried to break the barriers between art and social life. Going beyond Beuys' call to create culture, Kac and other artists created life.

Watching the Animal "Other": Art, Philosophy and the Human Gaze

As Beuys's work explored man's relationship to animal, contemporary philosophy has also investigated how man perceives and interacts with the animal "other." Martin Heidegger proposed that, through an imaginative transposition of the human into animal, understanding (or empathy) could be achieved. This self-transposition required that both beings remained themselves. Man was to "go along with the [animal] other while remaining 'other' with respect to it."[58] Through this process, Heidegger proposed that a true empathetic understanding could be reached.

Contemporary philosopher Jacques Derrida agreed that the animal was "other," but thought that mutual understanding occurred through looking. The encounter with animals began, said Derrida, with a reciprocal gaze, from human being to animal and from animal to human being. This revelation came to the philosopher during an experience of being naked and looked upon by his cat. "The animal looks at us, and we are naked before it. Thinking perhaps begins here."[59] Man sees the animal looking,

sees himself looking at the animal looking, and sees himself in the look of the animal, naked.[60]

In the *GFP Bunny Project*, Kac called into question the concept of observation – who was viewed; who was viewing. He used Alba, a live transgenic creature, to address man's relationship to an animal "other." In other artworks, like *The Eighth Day* and *Darker than Night*, he placed human viewers in the position of observing the animal and, at times, directly in the vantage point of the observed animal. Via telerobotics, Kac granted viewers "something very close to that most difficult and privileged perspective: that of the animal itself."[61] He explored the viewpoint of the animal and presented as close a perspective as he could of man occupying the animal's point of view and experience. In this way, Kac engaged with Heidegger's idea of transposition and empathy via a concept of *tele-empathy*. "I'm interested in when different sentient beings and different subjectivities come together and become shared. In these moments, we can even entertain from the point of view of imagination what it might be like to occupy these different subjectivities."[62]

Through the *GFP Bunny Project*, Kac sought to provide for humans a vehicle of insight and empathetic engagement with Alba as animal, transgenic "other" and yet a related form of life. He explained,

> I do not think that artists are above any sense of morals or ethics. The question is more complex. When we speak of ethics, what exactly are we speaking of? Ethics and aesthetics are branches of philosophy. If we look at how the Western philosophical canon has looked at animals… we see bias and prejudice.[63]

What troubled Kac about the philosophical canon was that the idea that humanness has largely been based on the differences between the animal and the human. He even coined the term *transphobia* to signal societal fear of the transgenic other. While his method of engaging with his animal subjects was through biotechnical techniques that have struck people as invasive, meddlesome and unethical, it was Kac's intent to always treat the animal and society with respect.

As art subjects, animals can literally return the human gaze, but their inability to participate in our human-based communication of language places them out of our realm of understanding. Animals and their behaviors remind us of own human existence. But without a means of communication, the animal's viewpoint remains elusive, impossible and unimaginable.[64] Man has always found the familiar trait of self-awareness in the animal counterpart. This type of self-awareness does not exist in other objects, whether they be plants or sophisticated computer programs. In his writings on the animal, Marcus Bullock has suggested that, at this moment of present history, man has begun to formulate his relationship to animals differently than from all other times.[65] This may have come about because, for the first time, he can imagine a world without animals, since his powers of destruction have grown so monstrously. Another reason, however, may be that he have learned to observe his own observations more clearly. To see animals as less the expression of a transcendent rationality and ever more the expression of a quality rooted in our nature, Bullock suggested that this understanding allowed us to describe ourselves as "the animal that speaks."[66] Since animals do not have access to the faculties of language, they remain incapable of reflection[67] and therefore out of our realm of understanding. But an absence of speech

does not necessarily imply an absence of thought. Artist Diana Thater stated, "Art is a moment of grace that is not tangible but is felt and thought simultaneously…Just because it is speechless does not mean it is mindless.[68] Although about art, this quote can easily be applied to man's viewpoint on the status of animal consciousness.

Animals and the natural world are recurring motifs in Thater's films and videos, particularly with regard to the man/animal gaze. A pioneer of video projection and installation, her vision combines literature, animal behavior, mathematics and sociology. She has focused her lens on a wide variety of wild animals including zebras, tigers, bees, dolphins, wolves, horses, and birds of prey, and her work attempts to erase the lines that separate humans from animals. Thater's video installations describe a technologically-mediated nature while revealing the mechanics of media representation. Her work straddles opposites; she juxtaposes wildlife with domestication and records nature through the high-tech medium of video. Though she has been a devoted activist for the environment and wildlife, Thater's work is not meant to arouse sympathy or empathy for animals, but instead to propose observation as a mode of understanding.[69] Thater's work encourages viewers to look <u>with</u>, and not just at, the animals on the screens. She explains, "Art changes the world by changing the way you see…we have to realize that the way the world is depicted also changes the world. That's what's interesting...There is a certain percentage of people who will say, 'Ah! That's beautiful! What is that?' And you can change the world that way."[70]

The subjects of Thater's 1998 video installation *The Best Animals are the Flat Animals - the Best Space is the Deep Space* (Figure 10) are animals behaving in a seemingly human fashion. Filmed and taped at three locations, Thater has spliced

together an evocative narrative. Issues, including modes of perception, nature's interaction with culture, the role of the artist in constructing illusion and the interrelationship of real and constructed space, are raised as the artist questions the methodologies of artistic and filmic representation.[71] Thater contrasts animals and nature with un-natural environments and conditions. With her multi-screen imagery, she presents viewers with an opportunity to be surrounded by and practically engulfed in, animal imagery.

Culture and DNA: Addressing the Intersection of Art and Science

In the recent past, several galleries and museums have mounted exhibitions that have figured heavily in the critical discourse artists have had with technology. Personally, I have been involved in the organization of an exhibition that explored science and technology's impact on the arts. At Silvemine Guild Galleries, in the spring of 2006, I worked to present *Culture and DNA: Science Meets Art*. Myles Axton, a geneticist and the editor of *Nature Genetics Magazine* served as the juror of the exhibition, which featured artists whose work explored the interaction of art, science, technology and society as a way to envision and critique possible futures. Among the artists presented was John Arabolos, who took photographs of natural objects and subjected them to digital algorithms that distorted the image based on chaos and string theory. Another artist, Nash Hyon, depicted the natural elements and the genetic code in encaustic works according to the laws of science. A collage artist, Rita Valley, re-imagined the periodic table according to new laws of nature that she invented.

From the exhibition, several artworks were purchased to be displayed in *Nature Genetics Magazine* offices and reprinted in the magazine for a featured article about the interaction between art and science. The exhibition showed the opportunity for collaboration and mutual affinity between the two disciplines. To further the discourse, we hosted a panel discussion featuring a selection of individuals. Among the panel members was Myles Axton, Suzanne Anker, artist, curator and author of The Molecular Gaze: Art in the Genetic Age, Alexis Rockman, artist, and Steven Henry Madoff, contributing art critic for the *NY Times* and former executive editor of *ArtNews*.

The discussion began with Myles Axton describing his work as a genetic engineer who studied fruit flies using GFP technology. At that point, Steven Henry Madoff used Axton's work in genetics to launch a discussion of Kac's *GFP Bunny Project*. He spoke specifically about Kac's work in the midst of a heated moment in the art world, when scholars tried to define what art was in the 21st century.[72] Madoff continued that since art had begun to intervene in natural processes, its legitimacy became a question of ethics. He recalled that during the late 1990s, ethical concerns arose regarding what was appropriate, natural and relevant in art making. Madoff cited the National Endowment on the Arts' (NEA) outrage and uproar regarding Robert Mapplethorpe's graphic photographs. Referred to as the "culture wars of the arts,"[73] Madoff felt the case exemplified the blurred the intersection of ethics and culture. Another example of ethical questioning at this moment in time was the *Sensations* exhibition at the Brooklyn Museum in 1999. New York's mayor, Rudolph Giuliani, called the exhibition "sick stuff" and threatened to withdraw the annual $7 million City Hall grant from the Museum. He maintained that the Museum did not deserve

"government subsidy for [exhibiting work that was seen to be] desecrating somebody else's religion."[74] At this same moment, at the brink of a new millennium, Kac's work questioned the intersection between ethics, nature, natural selection, genetics and biotechnology.

To this, Suzanne Anker retorted that Kac's work was little more than a "Photoshop construction. There's no way a bunny with fur could glow green."[75] Even if she considered Kac's practice a sham, Anker still felt that his artwork was valid and relevant. "It doesn't mean it's not a great work of art…what art does is deal with what I call 'critical fiction,'" she explained. "Art doesn't need to have truth value for it to have meaning."[76] She continued to clarify that the task of artists is to engage in the "cultural imaginary."[77] That is, they work in a free zone of play making use of all the tools of humanity at their disposal (science, cognition, emotion, technology, data, imagination, etc). Then, via their artwork, they put their fears and fantasies out into the public to interface in social space.[78]

For Anker, it wasn't about whether the art was true per se; it was about whether the art was effective. In defense of artifice, she claimed that "lying is part of art's practice." When we look at a work of art, we are not looking for the Truth, we are looking for someone's framed definition of the truth – a "mediated response." She continued, "in today's world of blurred boundaries, seeing is no longer believing."[79] Madoff agreed that the definition of art as truth has been a slippery topic. "One can say art has never been about truth values."[80] But he disagreed that all contemporary art has been concerned with artifice. He showed how some contemporary artists have appropriated the language and practices of scientific studies to present as close to the

truth of a situation as was possible. He mentioned the artist Mark Dion, who conducts anthropological digs and presents and labels his finds according to the practices of a natural history museum. Madoff also referred to Sara Oppenheimer, an artist who conducts sociological studies to record human behavioral patterns. In examples such as these, he said "artists are concerned with truth-telling."[81]

Anker maintained that the best definition of art is Aristotle's *poetica episteme*, or the sensual portrayal of an idea.[82] Sometimes the concept of beauty gets confused as being part and parcel of the characteristics of visual art, and while Anker thought beauty could be a component or art, it was not necessary. "To look good, doesn't mean it is good."[83] She said in art as well as genetics, "there's much out there that's too good to be true."[84] To complete the point, Axton picked up on the essentialness of both perfection and deformity in scientific study. He mentioned how Goethe first saw the value of imperfect systems as sources of understanding when compared against normal systems.[85] Axton continued to stress how important art was to scientists because it allowed them to expand their imagination. He made his point by comparing a work of art to a scientific illustration. An illustration of a scientific concept is static and represents the biased view of the illustrator; it is subject to revision as soon as new discoveries are made. Art, on the other hand, has multiple interpretations and, by virtue of that fact, can expand and inspire thought. All *Culture and DNA: Science Meets Art* panel members agreed that imagination was an inherent and essential element in both disciplines of art and science.

IV. Bio Art and Bioethics

Genetics, Genomics and Transgenics: A Brief History

Despite their therapeutic potential, transgenic experimentation has been viewed as controversial. Transgenesis seems to contradict the very concept of species, violating assumptions about what is "natural" and what constitutes a reasonable breeding barrier. Experiments that involve human genes raise especially difficult questions. If one introduces human elements into a mouse or a pig, could the resultant animal share any attributes with human beings? If a transgenic animal is ever sold as meat, could this be a form of cannibalism? By scrambling the traditional demarcations of living systems, transgenic experiments threaten species integrity, undermine our concepts of nature and raise disturbing ethical dilemmas.[86]

Despite ethical concerns over the course of human history, countless people have intervened in the natural selection process to varying degrees. When agriculture developed approximately 10,000 years ago in the Yellow River region of China and the Fertile Crescent, selective breeding techniques emerged as well.[87] Farmers, scientists and amateurs all over the world have modified crops and animals for human use. Kac himself pointed out that, from the sixth to tenth centuries, monks in southern France domesticated and bred rabbits under restrictive conditions to produce a variety of fur colors and sizes that were distinct from wild breeds.[88] Selective breeding practices continue today and can be seen in the forty-five breeds officially recognized by the American Rabbit Breeders Association (ARBA).[89]

In 1859, Charles Darwin published his book *On the Origin of Species,* which has formed the basis of modern evolutionary theory.[90] Darwin proposed that all species of

life have evolved over time from common ancestors through a process he called natural selection. In many instances throughout history, man has intervened in the natural selection process through selective breeding practices, and now, as a result of advanced scientific methods, through genetically modifying organisms.

The invention of the microscope in 1840 established cell theory and formalized our modern concept of biology. For the first time, scientists were able to identify and observe cells in order to study their structure. In 1866, Gregor Mendel published his observations on the inheritance of variations in strains of peas. He observed predictable hereditary patterns, now called "Mendel's Laws," and identified the existence of genes. Mendel's early experimentation methods led to the further discovery around the turn of the century that his laws applied to numerous traits in a variety of plants and animal species. The study of "genetics" had begun.

In 1929, Phoebus Levene discovered nucleotides, which formed the molecular building blocks of the structure of DNA. Fifteen years later, scientists proved that DNA was the molecular basis for genetic information. James Watson and Francis Crick deduced the three-dimensional structure of DNA in 1953. Their double-helix model made the function of genes understandable at a molecular level, proved that genetic information was carried by DNA and proposed that "semi-conservative replication" was the mechanism for genetic replication. In 1972, Paul Berg used restriction enzymes to cut and splice DNA fragments from different organisms. He and his colleagues created the first molecule of recombinant DNA, ushering in the era of genetic engineering.[91]

A 1980 U.S. Supreme Court decision allowed genetically modified organisms to be patented, and the first patent was awarded to the General Electric Company for a

bacterium designed to help clean oil spills. Two years later, Eli Lilly Pharmaceutical Company marketed the first genetically engineered drug – a form of insulin grown in genetically modified bacteria. Less than a decade later, Ashanti DaSilva was the first recipient of human gene therapy for a genetic immune deficiency disorder.

In 1981 mouse embryonic stem cells were derived from inner cell masses by scientists Martin Evans, Matthew Kaufman, and Gail Martin. In 1998, James Thomson derived the first human embryonic stem cell (hESC) line. Stem cell research offered the possibility of a renewable source of replacement cells and tissues; its application could be used to treat a myriad of diseases, conditions and disabilities including Parkinson's and Alzheimer's diseases, spinal cord injury, stroke, burns, heart disease, diabetes, osteoarthritis and rheumatoid arthritis.[92] However, since it was thought to be limited to human embryonic studies, stem cell research has remained a highly controversial topic in the political and ethical spheres since its early days.

The Human Genome Project, an initiative to sequence the entire human genome, began in 1987 and was completed in 1999. The National Institute of Health (NIH) took on a related project in 1998 to map single nucleotide polymorphism (SNP) sites in the human genome. The following year, a collective of ten private pharmaceutical and biotechnology companies undertook an SNP mapping project parallel to the effort begun by NIH. The race to complete the genome projects grew fierce. In a truce, completion of the human genome sequence was jointly announced on June 26, 2000, allowing future cooperation and complementary analysis between public and private organizations.

Biotech research has emerged as a potential solution to some of medicine's greatest challenges. Scientists have inserted human genes into animals (including goats, mice, cows and chickens). Some of these animals secrete substances in their milk, making them living biotech factories for drugs that have no other way of being produced. Others provide advanced platforms for discovering and then isolating molecules that might someday become remedies for diseases ranging from cancer to rheumatoid arthritis.[93]

The History of Green Fluorescent Protein (GFP)

Over the years, bioluminescence has had multiple applications ranging from the frivolous to the practical. Nearly 2000 years ago, the first written account recorded by the Roman naturalist Pliny the Elder, was in reference to a phosphorescent clam. The glowing clam was a culinary novelty in the 1st century as Romans hosted feasts and showed off fluorescent green mouths.[94] Luminescent click beetles were worn as hair adornments by ladies in the Caribbean. During World War II, Japanese soldiers used the residue of luminescent crustaceans to read maps at night.[95] Today, glow-in-the-dark toys, paint and other objects hold great appeal.

For decades, scientists have used bioluminescence and animals in laboratories to study human disease and potential remedies. GFP research has had myriad applications over the years as phosphorescent markers allow researchers to peer inside living cells to see how diseases develop and evolve. Because jellyfish with GFP emit a fluorescent flash when they become agitated, scientists have used the green glow to illuminate cells in experiments and observe how they function in disease or health. Scientists have

found ways to watch nerve cells develop in the brain and learn how cancer cells spread. Researchers have used the glowing marker to show how HIV travels from infected to uninfected cells. Reproductive biologists have used GFP in pigs to show genetic alterations in order to modify the animals to use as gene-banks for humans. “Essentially you can paint or color the part of the body that you want. That was simply impossible before GFP," said Mikas Vengris, a senior scientist at Vilnius University in Lithuania who has extensively worked with the protein.[96] Leonard Zon, a stem cell scientist at Children's Hospital in Boston, has used the technique to track proteins that stimulate stem cell production in fish. “Before this discovery, there was almost no way to track these proteins without killing the cell or the organism we were looking at. Now we can tag these proteins and follow them in a fish or a cell.”[97] Zon’s work has developed drugs that multiply blood stem cells and aid children who need bone marrow transplants after cancer treatment. Many private biotech companies have used GFP technology. The company Viragen engineered chickens that made human proteins in their eggs. Chickens that contained the gene were engineered with GFP protein to make it glow green and distinguish it from the non-gene-carrying chickens. This fluorescent marker allowed the scientists to confirm that their technology for inserting transgenes was working (Figure 11).

GFP research has been such an important part of recent scientific practice that in October, 2008 the Nobel Prize in Chemistry went to three chemists for the discovery, expression and development of green fluorescent protein over the past forty-six years.[98] Osamu Shimomura, now professor emeritus at the Marine Biological Laboratory in Woods Hole, MA, was credited with first isolating GFP in jellyfish in 1956. He

experimented with thousands of crushed jellyfish before he found a way to extract the GFP protein. In the late 1980s, Martin Chalfie, a Columbia University professor, showed that the protein could be used in cells by inserting GFP's biological blueprint into roundworms to make them glow. Roger Tsien of the University of California, San Diego, developed different colors of the protein to allow several processes to be followed at the same time. Tsien established a wide range of bioluminescent colors, including the rainbow hues: mPlum, mCherry, mStrawberry, mOrange and mCitrine.[99]

Today scientists follow the same procedures that these pioneers followed. They add GFP's genetic information into the organism they want to study. Cells then use that information to build proteins, such as nerve or tumor cells, and produce the glowing marker, letting the researcher locate and evaluate the protein. [100] The innovation of GFP technology "has made our lives so easy and convenient," said Oliver Griesbeck, a biologist specializing in cell dynamics at Germany's Max Planck Institute of Biochemistry, who worked in Tsien's lab from 1997 to 2001. "You can see how immune cells invade tissue, and you can visualize the structure of nerve cells."[101] GFP technology has been so revolutionary and appealing that it has not stayed limited to the medical field.

As we've seen, artist Eduardo Kac appropriated GFP technology to create Alba and launch a dialogue about science and technology via the art world. Several commercial endeavors have capitalized on the scientific discoveries of GFP research. In 2000, a team of postgraduate students at Hertfordshire University in England proposed the creation of a Christmas tree that lights up on its own. They described how to genetically modify a Douglas Spruce, and even included a business plan for a

company to produce and market the glowing tree.[102] The biotech company Prolume bases its core business on the genes of bioluminescent creatures. Having broad applications for biomedical research, drug discovery and entertainment several subsidiaries of Prolume, including BioToy®, NanoLight Technology™, BioLume and BioLight, have been created to cater to diverse commercial sectors.[103] Prolume and its subsidiaries hold various patents on the use of bioluminescent proteins in consumer products, including foods and beverages, toys and novelties and entertainment and education applications.

Frankenpets: Commodifying GFP Research

While several products have emerged from GFP research, Alba was not the only fluorescent animal to have entered the public sphere. When bloggers on Kac's website wished for a bioluminescent pet of their own, little did they know that their dream was soon to become a reality. GFP technology has been incorporated into fish which are now sold at pet stores across the country as pets. These fish, marketed as GloFish®, (Figure 12) have been touted as "hardy and beautiful, perfect for both hobbyists and beginners."[104]

For the past decade fluorescent zebrafish have been relied upon by scientists to better understand important questions in genetics, molecular biology and vertebrate development. They have been particularly helpful in understanding cellular disease and development, as well as cancer and gene therapy. [105] In 1999, researchers at the National University of Singapore extracted the green fluorescent protein (GFP) gene from a jellyfish and inserted it into the zebrafish (*Zebra danio*) genome, causing the fish

to appear to glow. Their goal was to develop a fish that could detect pollution by fluorescing in the presence of environmental toxins.[106] The scientists from the National University of Singapore met with and granted worldwide rights to Yorktown Technologies of Austin, Texas, to market the florescent fish to the public.[107] The result was GloFish®, the self-proclaimed "hottest, most talked about, most beautiful new fish in our lifetime."[108] The company's marketing materials hype that consumers can now *Experience the Glo!*™ in three stunningly beautiful colors - Starfire Red™, Electric Green™ and Sunburst Orange™!.[109]

Shortly after the research in Singapore, a team of Taiwanese researchers at the National University of Taiwan created a medaka (rice fish) with a fluorescent green color.[110] Their original intent was to develop a way to make fish organs easier to see when studying them.[111] A separate deal was made between the Taiwanese scientists behind the green medaka and Taikong, the largest aquarium fish producer in Taiwan. Taikong gained the rights to sell the fluorescent medaka as *TK-1*® or *Night Pearl*® in the Taiwanese market. In spring of 2003, Taiwan became the first county to authorize sales of a genetically modified organism as a pet.[112]

In December 2003, GloFish® were made publicly available to the U.S. market after two years of extensive environmental research and consultation with Federal and State agencies and risk assessment experts.[113] The definitive environmental risk assessment was made by the U.S. Food and Drug Administration. The FDA has jurisdiction over all genetically modified animals, including fluorescent zebrafish, since they consider inserted genes to be drugs. Their official statement was as follows:[114]

> Because tropical aquarium fish are not used for food purposes, they pose no threat to the food supply. There is no evidence that

> these genetically engineered zebra danio fish pose any more threat to the environment than their unmodified counterparts which have long been widely sold in the United States. In the absence of a clear risk to the public health, the FDA finds no reason to regulate these particular fish.[115]

Marketing of the florescent fish was met by protests from a non-governmental U.S. environmental organization called the Center for Food Safety. They were concerned that approval of the GloFish®, based only on a FDA risk assessment, would create a precedent of inadequately scrutinized biotech animals. To prevent this, the group filed a lawsuit in U.S. Federal District Court to block the sale of the GloFish®. The lawsuit sought a court order stating that the sale of transgenic fish was subject to federal regulation beyond the FDA's charter, and as such should not be sold without more extensive approvals. In the opinion of Joseph Mendelson, the Center for Food Safety's legal director:[116]

> It's clear this sets a precedent for genetically engineered animals. It opens the dam to a whole host of nonfood genetically engineered organisms. That's unacceptable to us and runs counter to things the National Academy of Sciences and other scientific review boards have said, particularly when it comes to mobile GM organisms like fish and insects. [117]

The Center for Food Safety's suit was dismissed on March 30, 2005. The court determined that, under current laws and guidelines, the FDA was not required to enforce the production or sale of GloFish® since they were neither food nor drug, but a benign commercial product.[118]

While the original scientists developed the transgenic fish by adding a natural fluorescence gene to eggs before they hatched, the current GloFish® are bred from the offspring of these original fish.[119] This means that GloFish® inherit their unique color directly from their parents and pass the color to their offspring. The fertility of

GloFish® differs from their Taiwanese counterparts. The *TK-1*® fish were engineered to be sterile, which meant they were incapable of reproduction (including cross-breeding with natural fish).[120] The implication of this is that the fluorescent GloFish® can penetrate the environments of and reproduce with natural fish.

A portion of the proceeds from sales of GloFish® go to the lab in Singapore where the fish were created, in order to further research what they hope will "help to protect the environment and save lives."[121] GloFish® are currently available in forty-nine U.S. states and internationally. Australia, Canada and Europe are exceptions, as these countries prohibit the marketing of genetically modified animals. The only state where sale and/or possession of GloFish® is illegal is in California. This is due to a regulation against genetically-modified fish that was implemented due to concern about biotech salmon, before the introduction of GloFish®.[122]

The OncoMouse® and the Right to Patent Genetic Information

Although laboratory use of animals is nothing new, the breakneck speed of recent scientific advancement has dramatically changed the role of animals in research. Now more than ever, scientists have the capacity to create, manipulate and experiment with life. The increased experimentation possibilities have engendered even more ethical debates among the general public, artists and the scientific community.

The OncoMouse® is a laboratory mouse that was genetically modified to carry a gene called the oncogene. This activated oncogene made the mouse susceptible to cancer, which made it suitable for use in cancer research. The rights to the OncoMouse® are owned by DuPont. In the mid-1980s, patent applications were filed

in numerous countries through the European Patent Office. The FCC considered an oncomouse a "composition of matter" according to Patent Claim 1, since it is a mouse in which one has introduced an oncogene sequence. Although the FCC permitted the patentability of a living organism as "composition of matter," this decision specifically excluded the patentability of human beings. A patent is a form of ownership of property, and the possession of a human being has been deemed impossible according to the Charter of Rights and Freedoms. Today, the rights to the OncoMouse® "invention" are owned by DuPont. On August 3, 2000, the Federal Court of Canada (FCC) defined the word *invention* as "any new and useful art, process, machine, manufacture or composition of matter, or any new and useful improvement in any art, process, machine, manufacture or composition of matter."[123]

Artist Bryan Crockett investigated the OncoMouse® and its transgenic identity. In a large marble sculpture, *Ecce Homo Rattus*, (Figure 13) Crockett linked the OncoMouse® to the tradition of allegorical, mythological and religious figures. Like other chimeras, he saw the OncoMouse® as the literalization of a cliché of man and mouse. Crockett's sculpture acted as a monument to the OncoMouse® as test-object of modern science. This laboratory mouse was sculpted with the pathos, contrapposto stance and exacting human proportions of Classical sculpture. It was presented in heroic nude; its thin, stretched flesh convincingly rendered in pale pink marble. *Ecce Homo Rattus*' monumental scale and use of the precious, traditional art material of marble elevate the status of this work to fit within the traditional canon of art-making practices.

Crockett also reinterpreted the ultimate figure of salvation, Christ, through the ultimate actor of contemporary science, the OncoMouse®.[124] *Ecce Homo* were the Latin words used by Pontius Pilate in the Vulgate translation of the Gospel of John (19:5), when he presented Jesus Christ bound and crowned with thorns to a hostile crowd shortly before his Crucifixion. The King James Bible translates the phrase into English as "Behold the Man." This scene was widely depicted in Christian art, particularly during the Medieval and Renaissance eras.[125] In Crockett's sculpture, the artists invited viewers to reconsider this new chimera; to "Behold the Man Mouse." Crockett's work appropriates the forms of religious imagery to enact a query into the appropriateness of the creative act. When taken within a religious context, is this new chimerical OncoMouse® to be esteemed as the realization of man's dominion over nature? After all, in the Book of Genesis God said, "Let us make man in our image, in our likeness. Let him rule the fish in the sea, the birds in the sky, the domestic animals all over the earth, and all the animals that crawl on the earth."[126] Alternatively, should true creation be left to God alone? Should people eschew new life forms, like the OncoMouse®, for they imply that man respects neither the Creator nor a natural order?

Artist Larry Miller responded to the idea that genetic material and new life forms, like the OncoMouse®, could be patented. The artist produced works that viewed genomics as an art form that bridged his interest in issues of art, science and theology.

> When the patenting of animals was approved by the Supreme Court in the 1980s, I reasoned that if DNA was to be commodified in the Genetic Revolution then humans would need legal rights to their personal genomes. Anticipating a widening debate on issues raised by genetic engineering, I proclaimed copyright of my own genome in 1989. I then initiated a public action by publishing and

> distributing my Genetic Code Copyright forms internationally in eight languages to foster thousands of other such claims.[127]

On his website, Miller invites participants to copyright their DNA. Just click a button to download a PDF *Genetic Code Copyright* certificate and "join the thousands of protected Original Humans"[128] (Figure 14). In addition to copyrighting one's DNA, there is another document that certifies a transaction between buyer and seller of genetic material. The certificate allows an individual to sell and transfer his unique genetic code to a buyer. The DNA may be used "for any purposes of reproduction, regeneration or facsimile duplication, whether in whole or part, whether physically manifested or technologically represented."[129]

Miller's pioneering work on issues of human lineage, identity and the coding of DNA, has continued to evolve. In a series called *Genesthetics* Miller continued to "explore ambiguities in science and art methods as well as the ethical and financial interests poised around the notion of the DNA molecule."[130] The body of work concerned itself with the artist's own originality and reproducibility. Miller used his genetic material as a medium for the fabrication of the ultimate, unique work of art. He gathered genetic specimens, photographs and legal documents representing himself and others, and offered these for purchase and revivification at a moment convenient to the collector.[131] In two works, *Revivified Self-Portrait No. 3 (20th-Century Romantic),* 1966/1999 and *Revivified Self-Portrait No. 4 (Anxiety),* 1971/1999 Miller featured photographic portraits of himself as a young man. Exhibited alongside the photograph were DNA specimens and tableaux that restaged the events recorded in the original photograph, minus the representation of the artist himself. Miller intended for the

collector to be photographed in the position once occupied by the artist and assume the same legal rights as the "original human" (i.e. Miller). A camera on tripod stood ready to document the reconstructed scene.[132]

In this way, artists Crockett and Miller have questioned the legitimacy of creating new life forms in the genetic age. In a time when patents are offered on new life forms, how does one maintain the integrity of genetic material? How far should genetic modification go?

Attacks on the Killer Tomato: Artists Respond to Genetically Modified Foods

One of the most compelling debates regarding genetically modified organisms (GMOs) has occurred with regard to genetically modifying agricultural products that people ingest as foods. Over the years genetically modified plants have been developed for various purposes. They exhibit stronger resistance to pests, herbicides and harsh environmental conditions, they have a longer shelf-life and in some cases, they are engineered to have increased nutritional value. Since the first commercial cultivation of genetically modified plants in 1996, these super-plants that tolerate strong herbicides and produce their own insecticides have dominated the agricultural seed market for corn and other crops. While a new generation of genetically modified plants has promised benefits to consumers, many people oppose the idea of their food being tampered with on a molecular level.

A specific example of a genetically modified plant is the “frankenfruit” tomato. Researchers at the University of Toronto and the University of California created a tomato plant that could grow in saltwater, while still producing edible fruit. Since

sodium greatly degrades cellular processes, it was believed that the production of a saltwater-tolerable plant was next to impossible. Scientists, however, managed it by changing just a single gene.[133] Into normal tomato plants they introduced a gene that regulates the movement of sodium ions. The gene produced high levels of a "transport protein" that moves sodium into isolated chambers in the leaves. The plants were basically equipped with their own internally-regulating salt pump. With the salt stashed safely away in the leaves, the tomato plants could grow normally. Fruit quality was virtually unchanged and modified plants were able to grow in salty water where non-transgenic tomato plants either died or were severely stunted.[134]

Monsanto is a large agricultural company that has received much attention regarding their genetic modification of food. It is a lead producer of seed brands in large-acre crops like corn, cotton and oilseeds (soybeans and canola), as well as small-acre crops like vegetables. It also produces cutting-edge, in-the-seed trait technologies for farmers that are aimed at protecting their yield, supporting their on-farm efficiency and reducing their on-farm costs. "Using the tools of modern biology," Monsanto claims "to help farmers grow more yield sustainably so they can produce more and conserve more. Afterall, it is the world's farmers that truly feed, clothe and fuel our growing world."[135] In 1999, Monsanto was in the news for its acquisition of Delta & Pine Land Company, a company that engineered and patented "gene protection" methods dubbed "Terminator" seed technology. "Terminator" seeds have been soaked in the antibiotic tetracycline, which sets in motion a genetic chain reaction that ultimately instructs the plant to kill its own seeds.[136] "Terminator" seeds yield plants with sterile seeds that will not flower or grow fruit after the initial planting. Concern

immediately arose among agronomists, agricultural scientists, farmers, environmental and development groups, churches, intellectuals and new democracy movements from India to Africa and Latin America. These seeds increase the dependency on seed suppliers, as farmers would have to buy new seeds from Monsanto each year. There was also widespread panic that the "terminator" effect would spread to native vegetation through pollination, rendering all plants unable to reproduce fruit. Monsanto pledged not to commercialize terminator technology, but no one was sure how secure that pledge would be.[137]

Several artists have been concerned with the genetic engineering of their food supply. They have used their artwork to call attention to the suspicious practices of agricultural companies like Monsanto. Artist Christy Rupp's interest in GMOs was sparked when she first heard about Monsanto's "terminator" seed. In her artwork, Rupp aims to produce objects which make people think about the environment.

> The idea that a seed could be manufactured to produce a one-time harvest, only to short-circuit its own biological need for reproduction, seems diabolical. Genetic engineering is a preoccupation with destruction, allowing life forms to be defined by death. By turning living crops into intellectual property, biotechnology increases corporate control over food resources and production. Rather than alleviate world hunger, genetic manipulation is likely to exacerbate it by increasing grower's dependence on the corporate sector for seeds and the materials needed to grow them."[138]

Rupp's work includes a project called *New Labels for Genetically Engineered Foods* (1999-2000) (Figure 15). In Europe, producers and retailers are required to indicate if a foodstuff has been genetically modified, but in the United States no such requirement exists. In this work, Rupp provides American consumers new packaging,

which cheekily signifies the modified status of their foodstuffs. These plastic containers display messages including, "Tell Us What We Are Eating," "Randomly Mutating Foods" and "This Product Lacks Diversity." Rupp offers these three nesting packages for sale on her website, and invites potential consumers to "celebrate the mystery while you speculate what that new breed of organisms in your digestive system is up to! [139]

In a project called *Animal-Vegetable*, artist Laura Stein uses modified foods as a way to explore nature and artifice, particularly the line between cultural imposition and natural development. In one such work, *Smile Tomato* (1996) (Figure 16), she secured an animal-shaped mold over a baby tomato to shape the vegetable's formal attributes. In Stein's words, "the imposition created a disparity between the object's natural growth cycle and a contrived one. The vegetables exerted their physical strength while in growth and frequently attempted to push through the limits of the molds. Some were too strong to be contained, but most conformed to the imposed shape."[140] Vegetables have an intense will to grow, regardless of whether they submit to or resist their formal fates; but unlike their genetically altered counterparts, individual will has an effect on their development. Stein views her molded vegetables as a culturally generated pressure, an applied norm, which then gets filtered into individually aestheticized interpretations including cartoon characters.[141]

Of Mice and Men's Clothes: Stem Cell Research and Semi-Living Tissue

Human embryonic stem cell research (hESC) has been a source of political and ethical controversy since the cells were first isolated in 1998. In addition to causing a

polarizing debate about the appropriate use and termination of human embryos, stem cells from animals have inspired the concept of semi-living tissue. In essence, semi-living tissue is cellular matter derived from immortalized cell lines which cultured a form a living, growing layer of tissue. It can stay “alive” when provided nutrients. The tissue is not an organism per se, as it has no organs and is incapable of movement on its own. Scientists and artists have explored the potential of stem cells in their respective disciplines.

In science, hESC offers great promise for new ways to treat disease. Since human embryonic stem cells derive from embryos that are several days old, they can differentiate into virtually any type of human cell, from blood cells to skin cells. Stem cells are unique from other cells through their ability to develop into any cell type in the body. They function as a repair system, so they could theoretically divide without limit to replenish other cells. When a stem cell divides, each new cell has the potential to either remain a stem cell or become another type of cell with a more specialized function.[142] Once a stem cell is isolated from a human embryo or fetal tissue, it is used to create a pluripotent stem cell line, which is a culture that can grow indefinitely in the laboratory. Stem cell lines grown in the lab provide scientists with the opportunity to "engineer" them for use in transplantation or treatment of diseases. The issue of research in both human embryonic stem cells and later in adult stem cells has caused a massive ethical and political debate.

The crux of the issue of human embryonic stem cell research is the ethical question of whether it is justified to create and terminate a life in order to save another’s life. Adult stem cells have been studied in lieu of embryonic stem cells, but proponents

of hESC research maintain that embryonic stem cells have much greater developmental potential than adult stem cells. Research has continued and new discoveries have been made in adult and animal stem cell research, but the issue has remained a heated topic. Supporters of hESC have cited that in-vitro fertilization clinics routinely create more human embryos than are needed for fertility treatments, so they are left with excess embryos that are often discarded. Thus, they have maintained it would be morally permissible to use such embryos for potentially life-saving biomedical research. Opponents object to this argument, however, saying that such research would condone the destruction of embryos.

As the head of the executive branch of the federal government, the President of the United States has the authority to set federal government policy for funding hESC research. President Bush's official statement on the issue was, "Stem cell research is still at an early, uncertain stage, but the hope it offers is amazing: infinitely adaptable human cells to replace damaged or defective tissue and treat a wide variety of diseases. Yet the ethics of medicine are not infinitely adaptable. There is at least one bright line: We do not end some lives for the medical benefit of others. For me, this is a matter of conviction: a belief that life, including early life, is biologically human, genetically distinct and valuable."[143] President Bush moved to allow federal funding of hESC research on cells already present through 64 "cell lines" that existed in ten international laboratories. So while Bush permitted research on embryos that had already been destroyed, he strongly refused publicly-funded research on any cell line not yet created, so as to discourage further destruction of human embryos.

The Bush Administration's position drew mixed reactions from groups on both sides of the issue. Some opponents of hESC research praised the decision for limiting research to existing cell lines, while others held fast that no research should be permitted under any circumstances. Proponents of hESC research, praised the President for allowing some research to go forward, but wondered if the restriction to use only existing cell lines would inhibit innovations. Interest groups on both side of the issue waged intense lobbying campaigns. Patient groups, scientific organizations and the biotech industry lobbied the Bush Administration to go forward with federal funding for hESC research, while conservative anti-abortion groups and the Catholic Church urged against it.

Strides have been made under President Bush's stem cell research policy, but Bush's successor, president-elect Barack Obama, has stated that even more progress could be made. Obama has supported stem cell research in an effort to find cures for diseases such as Alzheimer's and has said he will use executive power to reverse Bush's policy on stem cell research. "Due to President Bush's veto…we are moving backwards in our efforts with these current restrictions. Stymieing embryonic stem cell research is a step in the wrong direction. It closes the door on many Americans awaiting new treatments that could potentially provide a better quality of life, or, perhaps, even save their life. My hope…is to provide our researchers with the means to explore the uses of embryonic stem cells so that we can begin to turn the tide on the devastating diseases affecting our nation and the world."[144]

The debate has raged on. Many groups have formed in support of human embryonic stem cell research including The International Society for Stem Cell

Research (ISSCR), and there are several opposition groups: Do No Harm: The Coalition of Americans for Research Ethics, the Center for Bioethics and Human Dignity, the National Conference of Catholic Bishops, the American Family Association, the Culture of Life Foundation, Focus on the Family and the National Right to Life Committee.

So far, although the issue of human embryonic stem cell research has remained a major dividing issue, the use of animal embryonic stem cells has not been as vehemently denounced or ethically debated. In addition to being a prevalent occurrence in scientific laboratories, the use of stem cells from animals like mice and pigs has cropped up in the art world, as well. Since 1996, a pair of Australian artist/scientists have used embryonic stem cells from mice in their artwork. Termed the *Tissue Culture and Art (TC&A)* project, collaborators Oron Catts and Ionat Zurr create "organisms" of semi-living tissue. In the artwork, *Victimless Leather* (Figure 17), they set up a conceptual experiment to produce a leather jacket by cultivating living tissue in the shape of a garment, without requiring the death of an animal. The *Victimless Leather* jacket was grown out of immortalized cell lines, which cultured and formed a living layer of tissue. The cells were supported and shaped by a biodegradable polymer matrix in a form of miniature, stitch-less coat. The project was intended to confront people with the moral implications of wearing parts of dead animals for protective and aesthetic reasons.

Catts and Zurr were not interested in providing a true consumer product, but rather in raising questions about mankind's exploitation of other living beings. For thousands of years, humans have covered their vulnerable bodies with animal skins to

protect against the external environment. This once humble act of survival has since developed into a complex social ritual, transforming the garment from something essential to an evocative, highly personalized object of status and individuality. Catts and Zurr's visionary artwork provides a tangible, conceptual example of a possible future production method. *Victimless Leather* was not intended to provide an actual garment for daily use, but to suggest an alternative practice to the creation of commercial goods.[145]

Victimless Leather was recently exhibited at the Museum of Modern Art's *Design and the Elastic Mind* exhibition, which presented a survey of the latest developments in the field of design. The show focused on designers' ability to grasp momentous changes in technology, science and social mores and convert them into objects and systems that people could understand and use. The exhibition also explored the current reciprocal relationship between science and design by bringing together design objects and concepts that joined the most advanced scientific research with attentive consideration of human limitations, habits and aspirations.[146]

Although it was on display for a time, Catts and Zurr's installation of *Victimless Leather* did not carry out its purpose. Although the artwork was equipped with its own life support system, and essential nutrients were fed through an incubation chamber, the miniature jacket expired while on display. It experienced an unexpected growth spurt and started to expand too rapidly for its self-contained eco-system. The exhibition curator, Paola Antonelli, was forced to terminate the artwork by pulling the plug. The jacket "started growing, growing, growing until it became too big. And [the artists] were back in Australia, so I had to make the decision to kill it. And you know what? I

felt I could not make that decision. I've always been pro-choice," Antonelli told The Art Newspaper, "and all of a sudden I'm not sleeping at night about killing a coat!"[147] It has been suggested that Antonelli's actions have inadvertently brought the message behind the work of Catts and Zurr into sharper focus. Conceived as a two-pronged attack on the morality of stem cell research and the fashion industry's exploitation of human and animal life, *Victimless Leather* has incited controversial debates. Journalist Mark Hooper begged the following ethical questions of the work: did the embryonic mouse stem cells die in vain? Do living stem cells have anything we can describe as a life anyway? And if you've created a life, are you entitled to end it?[148]

Unnatural Selection: Artists who Alter/Engineer Animals or Plants

In the process of creating art, many others have created new life by exploring the potential of genetics in art-making. In the 1930s, the photographer Edward Steichen bred flowers for more appealing aesthetic properties. He exhibited his hybrid delphinium plants at the Museum of Modern Art in 1936, signaling what he thought to be the official inception of genetically altered plants as art forms.[149] Steichen's dream was short-lived, and genetic art took a hiatus until much later in the century. The traumas of the Holocaust reduced genetic experimentation to the exclusive property of medicine, science and government. Subsequent artists kept their distance for decades so as not to condone the horrifying scientific practices of the Nazis. What distinguished Eduardo Kac's work from Steichen's was that *GFP Bunny* was a transgenic artwork, not a breeding project.[150] Kac's role was that of artist as genetic programmer. He did not create Alba for the sake of aesthetics alone; she was part of a larger social context

and a philosophical investigation into human-animal relationships. Insisting that "the artist is not a decorator," Kac explained that, "the artist is a philosopher. Art is philosophy in the wild."[151]

Laura Cinti is a British artist whose work also intersects the art and biology debate. She is co-founder of c-lab, an artistic platform that engages in critical and contemporary amalgamations of bio- and electronic art.[152] Her work explores meaning and idiosyncrasies in terms of the organic, the artificial and the concept of otherness. Started in 2002, Cinti's *Cactus Project* (Figure 18) is a collaborative bio-art project that has produced a cactus which grows human hair. As a transgenic work, it entails the transfer of genetic material from one species to another. In this case keratin genes were inserted into the cactus genome, so the cactus produces hair externally.[153]

Cinti's work juxtaposes sexuality with sterility, nature with artificiality. She sees the *Cactus Project* as a "fascinating semantic orgy, turning genetic engineering inside-out."[154] Cinti selected to work with a cactus because its fleshy construct is monolithic yet innocent, since it is protected by growing spines. She chose it to grow human hair because hair is a signifier of reproductive maturity, a sign that a body is becoming sexual. And while the cactus represents a sexual figure in the form of an erect phallis, the plant is actually sterile. Because the cactus was engineered through an artificial scientific process, it is incapable of natural reproduction.

When asked if she thinks the creation of new life by humans is a sin of our hubris or a natural result of creative impulse, Cinti answered, "One of the cybernetic paradigms tells us that we have evolved the ability to evolve… [and] what is interesting about art in the realm of genetics and biotechnology is that it offers alternative

investigations into what can be created and communicated. I think we are beyond the point of what is natural and what is not."[155] She does, however, believe there is a limit to artistic creation with living materials when it comes to suffering and pain. The goal of bio art is not to prove that artists have the power to take life, but to showcase an appreciation of a greater diversity for what can be considered life.

Kac and Cinti's work has aspects in common with David Kremers, Caltech's Distinguished Conceptual Artist in Biology. Kremers is a contemporary artist who deals with genetic material in living artworks, and his practice involves genetically altering E. coli bacteria so they produce transparent colored surfaces. He paints these bacteria on acrylic plates and seals them so the bacteria stop growing.[156] Fundamentally, Kremers engineers bacteria to produce colored enzymes that simulate a self-directed painting machine. Kremers believes that live art implies new relationships between art objects and their owners. "The sale of any living artifact requires an approach to benefit that artifact. We must ask, 'What does this artifact want? Where does it want to live?'"[157] For Kremers, ownership became custodianship. The idea that the artist should not only care for the living things he works with, but consider their wishes and well-being is a fundamental concept for artists who work with living artwork. For Kac, as well, his custody and continued care of Alba has been a fundamental component of his transgenic project.

Like Cinti and Kremers, Eduardo Kac saw his artistic process as constructive and creative. For the *GFP Bunny Project*, Kac invented Alba with the intention to nurture and care for her. "Responsibility is key," he insisted, and objected to "treating an animal as an object, be it an art object or an object of any kind."[158] In contrast to the

one-way relationship of power that manifests in "corporate genetic engineering," Kac argued that the transgenic artist's responsibility is "to conceptualize and experience other, more dignified relationships with our transgenic other."[159]

Art and science are held to a different moral standard. Although scientific practice may involve highly controversial methods, the discipline is often cloaked from criticism by virtue of its perceived service toward a perceived greater good. Contemporary artists are seldom recognized for providing a similar service for humanity. The artistic investigation by Kac and others into the ethical fiber of society begs the question: what is moral in the 21st century? The aim of transgenic art has not been to provoke or shock, but rather to obscure through subtleties the cultural impact of genetics.[160] For artists working with transgenic art, morality is not an obstacle, but a component in the creation of valid contemporary art.

V. What Happens Next?

Along with the potential good of biotechnological advancement has come debate and protest. The onset of new technologies has brought cause to ask a plethora of questions. Will improved technologies allow us to live longer, healthier, more perfect lives. Will new discoveries, products and technological practices have unsuspected consequences on the earth and our health? How will we collectively and individually face the challenges, choices and opportunities that the genetic revolution promises?[161] These and many other open-ended questions remain regardin the impact that today's biotechnology will have on our future.

A symposium at Chicago-Kent College of Law addressed some of the controversial issues of transgenic art, particularly with regards to the work of Eduardo Kac. "Art, Science and Free Speech: the Work of Eduardo Kac" was presented in September of 2000.[162] One of the panel members was Christiane Paul, curator of new media arts at the Whitney Museum of American Art in NY. She maintained that Kac's work was positive, for it provoked questions about how transgenic techniques alter ideas about what constitutes a living thing's identity. "The most important effect is to take genetic engineering out into the public."[163] Another participant, Stuart Newman, professor of cell biology at New York Medical Center, opposed such uses of genetic engineering technology citing the dangerous precedent this could entail. At what point does research cross the line? Newman insisted, "I think it's absolutely imperative that we draw a line and not do this on people."[164]

The obvious issue that many critics of Kac's *GFP Bunny Project* have, including Stuart Newman, is the unethical modification of animals because it implies

that humans are not far off. Across the board, the proposition of transgenic humans has met with strong opposition (even by Kac himself).[165] In fact, Kac's choice of rabbit over other animals contributes to the public's discomfort with the project. Rabbits are cuddly mammals. Humans are mammals, Kac explained, and this new being is close to us by association. The existence of Alba prompts within us a visual, intellectual and emotional response.[166] Rabbits are also notorious for their fecundity, often producing offspring at an alarming rate. While Kac intended to keep Alba in a controlled environment, rabbits are, by nature, social creatures that live in groups. The potential would exist for her to mate with another rabbit. If Alba's existence alone caused a scandal, imagine the broad-reaching and dangerous implications that would result from a herd of bioluminescent rabbits.

Kac suggested that humans make up for the extinction of endangered species by increasing the earth's biodiversity by inventing new life forms.[167] Although the artist's statements may be construed as ironic, Kac has always maintained a deep appreciation of the world around him. Yet, despite Kac's sincere respect for the natural world, the question arises as to who among us has the authority to create new life. Genetic engineering, which was once the restricted domain of science, could become an unregulated free-for-all. One scientist, having pondered the liberties extended to scientists ventured to parallel the role of the artist with that of the scientist. "How did I and my fellow scientists become anointed to do things that should be prohibited to artists? Because we are contributing to the understanding of things? So are artists."[168]

With the *GFP Bunny Project*, Kac was less concerned with *how* an organism was brought into the world, than he was with what happened afterwards. That question

seems to be the most fundamental of all, not just in Kac's art, but in life. Although time will tell, it remains to be seen with regards to the future of transgenic art what will happen next.

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[1] Bureaud, Annick, Peter T. Dobrila, Eduardo Kac, Aleksandra Kostić (eds.) Eduardo Kac: Telepresence, Biotelematics, Transgenic Art. Publication of the Association for Culture and Education, Kibla Multimedia Center, Maribor, Slovania, 2000, p. 106

[2] Kac, Eduardo. Telepresence & Bio Art: Networking Humans, Rabbits & Robots. The University of Michigan Press, Ann Arbor, 2005, p. 236.

[3] Eskin, Blake. "Building the Bioluminescent Bunny." ARTnews, December 2001, Vol. 100, No 11. pp. 118-119.

[4] *Culture and DNA: Science Meets Art* panel discussion. Digital footage recorded by Miggs Burroughs.

[5] Quote by artist/curator Rafael Lozano-Hemmer reproduced in Eduardo Kac: Telepresence, Biotelematics, Transgenic Art. p. 9.

[6] Kac, Eduardo. "Toward a Telepresence Art." Originally published in English and German in Teleskulptur. Richard Kriesche (ed.) Kulturdata, Austria, 1993. pp. 48-72.

[7] Kac's use of the term, telepresence, was different from the term used in science. Modern science saw telepresence as a pragmatic and operational medium that linked robotic and human experience. The scientific goal was to reach a point in which the anthropomorphic features of the robot matched the nuances of human gestures.

[8] Under normal lighting conditions Alba appeared completely white like a regular albino bunny.

[9] Allmendinger, Ulli. "One small hop for Alba, one large hop for mankind." NY Arts Magazine, Vol. 6, N. 6, June 2001.

[10] *Ibid.*

[11] Baker, Steve. "Philosophy in the Wild?" published in The Eighth Day: The Transgenic Art of Eduardo Kac. Sheilah Britton and Dan Collins (eds.) The Institute for Studies in the Arts, Arizona State University, Tempe, 2003. p. 35.

[12] *Ibid,* p. 101.

[13] *Ibid,* pp. 101-102.

[14] Organisms can be genetically engineered to contain the gene luciferase (the light source in fireflies) but luciferase harms some animals. Kac chose GFP for Alba because, in scientific experiments over the past decade, GFP had been transferred many times into mice and rabbits without evidence of harm. Gessert, George. "Art is Nature." Art Papers, March/April 2001, pp. 16-19.

[15] Bureaud, et al. p. 101.

[16] According to Kac's website, www.ekac.org, the Parisian neighborhoods included Le Marais, Quartier Latin, Saint Germain, Champs de Mars, Bastille, Montparnasse, and Montmartre.

[17] Radio: Radio France and Radio France Internationale. Print: Le Monde, Libération, Transfert, Nova, Ça M'intéresse. Television: Canal+, Paris Première www.ekac.org

[18] Revue D'Esthétique. No. 39. 2001. www.ekac.org

[19] Venues for Kac's lectures included: Sorbonne, École Normale Superior, École Superior des Beaux Arts, Forum des Images. www.ekac.org

[20] See attached bibliography for a list of scholarly books and articles written by Eduardo Kac.

[21] The description of It's Not Easy Being Green! is adapted directly from the description on Kac's website www.ekac.org

[22] All the following quotes from the Alba Guestbook can be seen on Eduardo Kac's website in the The Alba Guestbook 2000-2004: www.ekac.org/bunnybook.2000_2004.html

[23] Jyni of St. Paul, MN posted this in The Alba Guestbook in 2004.

[24] Mission statement as found on the Justice for Animal Art Guild (JAAG) website www.brittonclouse.com/jaag.htm

[25] Baker, Steve. "Animal rights and wrongs." Tate Magazine. No. 26, Autumn, 2001. pp. 42-47.

[26] Baker, "Philosophy in the Wild." p. 37

[27] "World News Tonight," ABC Television, September 18, 2000.
[28] Nora, Pierre. "Between Memory and History: *Les Lieux de Mémoire.*" Representations 26, Spring 1989. pp. 7-25.
[29] *Ibid,* p. 8.
[30] Anker, Suzanne. The Molecular Gaze: Art in the Genetic Age. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY. 2004. p. 85.
[31] *Ibid,* p. 82.
[32] Suzanne Anker has pointed out an important distinction between chimerical and transgenic organisms. Technically, a chimera is composed of cells from two genetically distinct embryos. Chimeras can be created by introducing embryonic cells (or stem cells) into a host embryo. They then become "progenitor cells" that mature to replace equivalent host cells. However, each individual cell contains the genetic material from only one of the contributing organisms, so the characteristics of the chimera are not passed on to the progeny. In contrast, transgenic animals and plants are created by introducing a foreign gene into a fertilized zygote. Since the foreign gene is incorporated into the host's genome at the one-cell stage, the transgenic organism has foreign DNA in every cell. Thus, the characteristics of a transgenic organism can be passed to the next generation. p. 110.
[33] *Ibid.* p. 90.
[34] *Ibid.* p. 85.
[35] *Ibid.* p. 86.
[36] *Ibid.*
[37] Rubin, William. Dada, Surrealism, and their Heritage. The Museum of Modern Art, New York, NY. 1968. p 50
[38] Spies, Werner. Max Ernst Collages: The Invention of the Surrealist Universe. Abrams, New York, NY cited by Anker, p. 90.
[39] Kac, Eduardo. "Toward a Telepresence Art."
[40] Kac, Eduardo (ed.) Signs of Life: Bio Art and Beyond. The MIT Press, Cambridge, MA. 2007. p. 387.
[41] Baker, Steve. "Philosophy in the Wild?" p. 34.
[42] *Ibid.*
[43] Buchloh, Benjamin. "Conceptual Art 1962–1969: From the Aesthetics of Administration to the Critique of Institutions." October vol.55, Winter 1990. pp. 136-137.
[44] Fraser, Andrea. "From the Critique of Institutions to an Institution of Critique." ArtForum, September, 2005.
[45] *Ibid.*
[46] Daniel Buren website: www.danielburen.com
[47] Buchloh, p. 130.
[48] Duchamp, Marcel. "The Creative Act" lecture at Rice University in spring, 1957.
[49] Klüver, Billy. "The Engineer as a Work of Art." Art in America. January-February, 1968. pp. 40-42.
[50] *Ibid.*
[51] Biographical information about the human figure in an equestrian statue could be extracted from the position of the horse's legs. The horse rearing one leg up meant the rider had been wounded in battle; a horse with two legs up meant the rider had died in combat.
[52] Baker, Steve. "What Does Becoming-Animal Look Like?" Printed in Representing Animals. Nigel Rothfels (ed.) Indiana University Press, Bloomington, IN. 2002. p. 68.
[53] This description of Beuys' action is adapted from Levi Strauss, David. "American Beuys: 'I Like America & America Likes Me'" published in Between Dog & Wolf: Essays on Art and Politics. Autonomedia, Brooklyn, NY, 1999.
[54] *Ibid.*
[55] *Ibid.*
[56] Levi Strauss, David. "Coming to the Point at Three Rivers." published in Between Dog & Wolf: Essays on Art and Politics. Autonomedia, Brooklyn, NY, 1999. p.134.
[57] *Ibid*. p.137-138.
[58] Heidegger, Martin. The Fundamental Concepts of Metaphysics: World, Finitude, Solitude. Indiana University Press, Bloomington, IN, 1995. p. 202-203.

[59] Derrida, Jacques. "The Animal That Therefore I Am (More to Follow)." Trans. John Cottingham, Robert Stoothoff and Duglad Murdoch. Cambridge University Press, Cambridge. 1988. p. 279.
[60] Lippit, Akira Mizuta. "Vidoe Ergo Sum (The Animal That I See)." Diana Thater: Knots + Surfaces. Dia Center for the Arts, New York, NY. 2002. p. 13.
[61] Baker, Steve. "Philosophy in the Wild?" p. 30.
[62] *Ibid.* p. 31.
[63] *Ibid.* p. 27.
[64] Bullock, Marcus. "Watching Eyes, Seeing Dreams, Knowing Lives." Printed in Representing Animals. Nigel Rothfels (ed.) Indiana University Press, Bloomington, IN. 2002. p. 101.
[65] *Ibid.*
[66] *Ibid.* p. 118.
[67] Lippit, Akira Mizuta. "…From Wild Technology to Electric Animal." Representing Animals, edited by Nigel Rothfels. Indiana University Press, Bloomington, IN. 2002. p. 125.
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[152] Laura Cinti's bio on the website of c-lab, an organization she co-founded: http://c-lab.co.uk
[153] Laura Cinti's interview by Esther Quintero on Les Mutants website: www.lesmutants.com
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