

A History of Art Involving DNA

by George Gessert

Genetic art, or art that involves DNA, includes a bewildering diversity of works. These range from paintings of chromosomes, and sculptures of the AIDS virus to installations about genetically engineered foods, land restoration projects, transgenic organisms, and breeding projects to recreate extinct species. Such art has been associated with biotechnology and genetic engineering, but aesthetic endeavours that directly affected the genetic codes of plants and animals existed long before the biological revolution began, or for that matter before the science of genetics existed.

In Shakespeare's *The Winter's Tale*, Polixenes, the king of Bohemia, defends 'streakt gillyvors,' that is, highly domesticated carnations, as 'an art which does mend nature - change it rather - but the art itself is nature.' [1] Shakespeare expressed what was a radical idea for his time, that living, reproducing things could be art, and yet domesticated ornamental plants had already existed for thousands of years. We might begin then by asking: why has it taken so long for nonhuman life forms to be recognized as art mediums?

Beginnings

Plant and animal domestication, which began more than 10,000 years ago, initially may have involved aesthetics more than utility. Contrary to popular belief, humans almost certainly did not domesticate plants and animals to alleviate hunger. Hungry people would not have had the time or energy to undertake longterm, uncertain experiments in selection. Consequently crucial stages of domestication probably began among people who were well-fed. Among the first domesticated organisms may have been animals kept as pets or used in religious ceremonies, and plants that yielded dyes, magical substances, or accessories to ritual. [2] The geographer Carl Sauer drew special attention to tumeric, a tropical plant in the ginger family. Tumeric grows only in association with humans. Its origins are unknown, although Southeast Asia may have been its original home. Sauer suggests that tumeric was domesticated in the remote past to provide coloring for bodies, clothing, and food. Its use as a spice came later. In Southern Asia many people still believe that tumeric has the power to enhance fertility. This power arises from its intense yellow color, the color of the sun. [3] Color may have played a role in the domestication of animals as well. Sauer proposes that the first domesticated chickens were rare black variants used in magic.

Purely ornamental plants, that is, those cultivated only for their aesthetic qualities, go back at least to Assyria, where kings had hunting preserves and park-like tree plantations. The practice of growing pure ornamentals seems to have arisen independently in Mesopotamia, China, Mexico, and Western South America. From these centers, the practice spread to other areas. According to the social anthropologist Jack Goody, ornamentals were first cultivated as luxuries that denoted class. Entrenched class systems encouraged an elaborated consciousness of flowers, and this consciousness produced new ways of describing flowers. [4]

Class-generated consciousness of flowers also produced new opportunities for plants. Beginning about 2,500 years ago double flowers, which are quite rare in the wild and ill-suited for survival there, began to proliferate in cultivation. By the time of the Caesars double roses were common in parts of the Roman Empire. Pliny the Elder, in what may be the oldest surviving example of ornamental plant criticism, faulted one rose for having too few petals, another for being too small, and several others for lacking perfume. [5]

In many non-Western cultures art was considered part of nature, but this did not lead to recognition of highly bred plants or animals as art, even in China and Japan, where selection produced extraordinarily refined expressions. Just as in Europe, ignorance about heredity and about the human role in evolution made claims to art almost unthinkable. And just as in Europe, human impacts on evolution and aesthetics were attributed not to human choice or effort, but to divine forces or to nonhuman nature.

Plants and Animals as Components of Art

The first animals analogous to ornamental plants, that is creatures kept solely for their aesthetic qualities, were probably birds, such as peacocks, or menagerie animals. Such creatures existed in classical times in the West, and also in Mexico before the arrival of the Spaniards. However, to the best of my knowledge no one wrote of these creatures as art until the 20th century. As for the live animals used in theater and circuses: few of these creatures were permitted to rise above lamentable caricatures of themselves, and serve us today primarily as examples of what not to do when using living things as art.

The idea that landscape gardens are fine art was well-developed by the 18th century, and was approved by Kant in *Critique of Judgment*. Two obvious implications flow from Kant's endorsement of the idea that landscape gardens are art. First, live plants can be components of art, and second, works of art can consist largely or entirely of living things. However, Kant stopped short of recognizing individual plants as fine art, or plant selection as an art. To do so would have been dangerously radical, even heretical, in spite of Shakespeare's gillyvor. Kant defended the traditional view that nature was one thing, and art quite another.

This view was deeply rooted in Western culture. We find it in the book of Genesis, in which god creates humans separately from 'the beasts,' and in his own image, while all other creatures exist only in their own, earthbound images. The message is clear: an unbridgeable chasm separates human beings from the rest of life.

Humankind's unique and divinely privileged place in the scheme of things became a key Christian tenet, reinforced by borrowings from Greek philosophy. Until well into the 19th century most aesthetic theory echoed church doctrine by arguing that art arose from the human mind or spirit and was therefore outside of and superior to nature. [6]

Darwin's Contribution to Art

Challenge to this deeply entrenched dualism came not from philosophy or art, but from science. *The Origin of Species* begins with descriptions of fanciers' pigeons - Jacobins, tumblers bred to resemble finches, and pouters with inflatable crops which 'excite astonishment and even laughter.' [7]

From highly domesticated pigeons kept for aesthetic pleasure, Darwin confirmed evolutionary processes that affect all life.

Darwin does not divide creatures into those with souls and those without, nor does he claim special dispensation for human beings. Domesticated and wild creatures are parts of a single whole that is dynamic, orderly, and intricate. Darwin's reaction to wild nature was much the same as his reaction to fanciers' pigeons. He viewed both with a mixture of intense wonder and disciplined curiosity. He described nature as if it were an authorless and boundaryless work of art symbolizing nothing, and manifesting sublime order.

Darwin's main interests appear to have been science and aesthetic pleasure. The word 'art' occurs only two times in *The Origin of Species* [8], but the words 'beautiful,' 'wondrous,' and 'astonishing' occur repeatedly.

In his most famous passage, he describes a tangled bank in the English countryside. 'From famine and death the most exalted objects which we are capable of conceiving ... directly follow ... From so simple a beginning endless forms most beautiful and wonderful have been, and are being evolved.' [9] Joy and suffering, beauty and terror flow in and out of one another in a vision of evolution that is classically sublime.

With publication of *The Origin of Species*, biblical accounts of life lost their stranglehold on Western culture. Darwin's revolution was far too great to take effect immediately and everywhere: even today we have only begun to explore its implications for

art. However, well before the end of the 19th century several influential writers claimed garden plants as art.

Thomas Huxley, Darwin's most famous defender, argued that ornamental plants were art, although not fine art. The French novelist Joris-Karl Huysmans, or rather his character Des Esseintes in the novel *Au Rebours*, so admired exotic and overbred plants such as caladiums with leaves colored like zinc, or like syphilitic sores, that he declared 'in these present times, the gardeners are the only and the true artists.' [10]

The American plant breeder, Luther Burbank, went farther. Speaking in San Francisco in 1901 he said that 'plants can be more readily molded into more beautiful forms and colors than any sculptor can ever hope to equal ... The fundamental principles of plant breeding are simple. The practical applications of those principles demand the highest and most refined efforts of which the mind of man is capable.' [11] With none of Huysman's irony, Burbank affirmed plant breeding as inherently superior to painting and sculpture. Plant breeding was the supreme art.

Scientific developments lent some credibility to his claim. In 1900 three investigators independently rediscovered Mendel's laws of inheritance, which elevated genetics to a science, and undermined the strongest post-Darwinian argument against recognizing ornamental plants and fanciers' animals as fine art: human choice did not sufficiently affect their aesthetic attributes. The new science showed how selection had already produced creatures selected for extraordinary aesthetic effects, and seemed to promise that in time selection would become faster and more exact.

Ornamental Plant Breeding as Fine Art

Evolution is slow and Darwin's revolution was profound, so not surprisingly artists and writers were slow to take up the new ideas. The first full-length book about plants as fine art did not appear until 1939. Sacheverell Sitwell's *Old Fashioned Flowers* has a forgettable title, but is brilliant and perverse, asserting that highly bred ornamental plants are fine art because they 'represent a direct and conscious attack upon Nature.' Some ages and individuals prefer ornamental plants that evoke wild nature. Sitwell preferred artifice, which he saw as fidelity to an indisputably conscious, human order. 'It is better to be ugly,' he wrote, 'than only to be wild.' [12] Like Huysmans and Thomas Huxley, Sitwell recognized ornamentals as art but left unchallenged the rest of the edifice of pre-Darwinian distinctions between art and nature.

Sitwell argued that some garden flowers reflect not only the tastes of their hybridizers but also specific times and places. For example, he saw in smooth-edged laced pinks the lives of the early 19th century British weavers who bred them. These weavers, who were famous for shawls, lived in the town of Paisley near Glasgow and were bound by a strict Prebysterianism that forbade almost all pleasures. Gardening, however, was allowed. According to Sitwell, the weavers lived "in an exotic trance, fortified by the desire for all those things from which their religious prejudices excluded them." The flowers that they hybridized expressed everything illicit. [13]

The first artist to claim plant breeding as a fine art was the photographer Edward Steichen, who, from the 1920s until the outbreak of World War II, hybridized delphiniums, cleomes, nicotianas, poppies, and sunflowers at his country home in Connecticut. In 1936 the Museum of Modern Art held an exhibition of his delphiniums, an event that he believed confirmed plant breeding as an art. [14] Steichen compared plant hybrids to poetry, and named delphiniums for poets, but the process of plant breeding reminded him more of photography, because both arts involve working with variations on a theme, and both are potentially democratic. He dreamed of selling the seeds of his finest delphiniums for twenty-five cents a packet, which, adjusted for inflation, is just a few dollars in today's money.

The End of the First Culture of Genetics

During the twentieth century, the Western art world embraced one new or previously unaccepted form of expression after another, so Steichen's belief that his show of delphiniums had confirmed plant breeding as a fine art was not unreasonable, especially considering the Museum of Modern Art's prestige. However, in the six decades since the show, the Museum of Modern Art has not held another exhibition of hybrid plants. Nor has any other major art museum. [15]

The primary reason was the Holocaust, which destroyed connections between genetics and art. Before World War II public opinion, especially in the United States, held that the new science of genetics was destined to play an extremely important role in human affairs, and consequently was everybody's business, including artists. After World War II, genetics was cordoned off from the larger culture, and became the de facto property of scientists and business people. To understand this change, it may help to look in some detail at the work of the most visionary spokesman for genetic art from the period before World War II, Olaf Stapledon. In his work plant and animal breeding mingle with eugenics.

Stapledon was a writer, well-known in his lifetime and admired by Virginia Woolf, among others, but neglected since, except by science fiction enthusiasts (among them Doris Lessing, whose *Canopus in Argos* novels are indebted to Stapledon.) He took the implications of Darwinism much farther than Steichen. When Steichen brought delphiniums into the Museum of Modern Art, he realized a fairly obvious implication of *The Origin of Species*: domesticated creatures that had been selected for their aesthetic appeal could be fine art. However, Steichen did not question whether an art museum was the best setting for his hybrids, and he did not attempt to explore the more radical cultural possibilities of Darwinism. Stapledon's 1930 novel, *Last and First Men*, considers some of these. *Last and First Men* is simultaneously an epic, a masterpiece of science fiction, and a meditation on human destiny. The book is a history of the next two billion years, during which time some 18 different human species rise and fall. Evolutionary dramas so pervade *Last and First Men* that it can be read as an investigation into how Darwinism affects perceptions of humankind and the future.

Sometimes art plays a role in these evolutionary dramas, sometimes not, but nowhere does it play a greater role than with the third human species, which appears 40 million years from now. The third men are smaller than ourselves, lithe and covered with red-gold hair. They have golden eyes, "more enigmatic than profound," [16] cat-like faces, and a mental life characterized by sensuality, religiousness, love of music, and sympathy with all kinds of plants and animals, but darkened with latent cruelty. Over eons their civilizations come and go, but all revolve around plant and animal breeding. The culminating and most brilliant culture develops 'plastic vital art', which rejects every kind of utilitarian breeding, and aims to 'evoke the full potentiality of each natural type.'

The ultimate aim of vital art is to heighten (or, in its negative manifestations, to undermine) all life. In this culture almost everyone is an artist. Most seek beauty and natural order, and produce expressions such as ants with novel instincts, supremely intelligent dogs, and new species to occupy empty ecological niches. But some breeders deliberately produce monsters. A few artists combine the two modes to create beautiful creatures with flaws. These might express tragic visions, or merely reflect the vanity or cruelty of individual artists. Vital art eventually encompasses entire ecosystems, until earth is organized as an intricate system of zoos, botanical gardens, and wild parks.

Stapledon's account reads like unusually imaginative contemporary speculation about the possibilities of the biological revolution. However, his treatment of eugenics clearly identifies his vision with the period before World War II. Throughout their existence, the third men practice eugenics, usually emphasizing "improvements about which there could be no two opinions" such as eliminating hereditary diseases. However, some societies breed for physical beauty, others seek cat-like agility, or exceptional perception in vital art. Occasionally manias burst forth. One society breeds for human mediums to enter

into contact with divine forces. Another carries breeding for musical ability to such an extreme that persons hearing music not to their taste might run amok and kill the performers.

Each of these manias runs its course and leaves no permanent effects on the species. But one genetic experiment proves disastrous. In secret, a group sets out to craft a super-intelligent being. The final result is a limbless, sexless superbrain. It is the first of the fourth men, a new human species. Initially this living computer brings great benefits to the cat-like people, but soon it enslaves, and then exterminates them.

The story of the third men is cautionary. Stapledon was well aware that eugenics was being used to further racist and class-biased programs, which he abhorred. However, he did not believe that eugenics had no merits. In this he was not alone. People as diverse as Winston Churchill, Julian Huxley, George Bernard Shaw, Luther Burbank, and Emma Goldman supported eugenics. Their reasons were diverse. Burbank, for example, defended immigration on eugenic grounds, arguing that race mixing would produce hybrid vigor. David Starr Jordan opposed war as a biological evil that killed the fit and preserved the unsound. Opposition to indiscriminate use of x-rays in medicine and elsewhere began as a eugenic struggle, led by H. J. Muller.

Stapledon, like many people of his time, associated eugenics with a range of possibilities, many bad, but some beneficial. He hoped that the new science of genetics would be used to lessen suffering, and perhaps to improve humankind physically and intellectually. Many people today hope that genetics will eliminate hereditary diseases, but few identify this with eugenics. More important however, today no informed person can assume that there might be no two opinions about even a single genetic 'improvement in the human species.

With the death camps, the first culture of genetics came to an end. The last nail in its coffin was delivered by Lysenko in the Soviet Union. He rejected Mendelian genetics as bourgeois, and revived Lamarckianism, which held that inheritance is always subject to modification by environment. This view had no scientific merit, but was in tune with utopian programs of the time. Stalin lent his support to Lysenko, and many Mendelian geneticists, including Vavilov, died in the gulag. Soviet genetics was set back a generation. [17]

In the postwar West, atomic testing drew public attention away from the benefits of genetics, to the dangers of mutation. From 1945 to 1960 genetic monsters overran science fiction, and the idea of genetic art was forgotten, except as an absurd joke. In Kurt Vonnegut's *The Sirens of Titan*, for example, an extraterrestrial robot named Salo is marooned on a moon of Saturn, where he takes up plant breeding to while away the time. 'When Salo arrived on Titan in 203,117 B.C., the blooms of Titanic daisies were tiny, star-like, yellow flowers barely a quarter of an inch across. [Now...] the typical Titanic daisy had a stalk four feet in diameter, and a lavender bloom shot with pink, and having a mass in excess of a ton.' [18] Salo is an ingenious artist, but his intervention in evolution only highlights evolution's utter pointlessness - and the futility of art as well.

Earth Art and Ecological Art

Plants and animals returned to art in round-about ways in the late 1960s with earth art. Many earthworks were so large that they provided habitats for small organisms. No one explored the implications of this, but a few artists used living things as the central components of their works. For example, Alan Sonfist's *Time Landscape*, first articulated in 1969 but not planted until 1978, recreates natural landscapes from New York City's past. In a series of sites dotting the city, he reintroduced plants that had grown in Manhattan prior to European settlement. As long as these reconstructed fragments of the ecological past survive, the plants and animals that comprise them will undergo selective pressures from the city and from larger environmental forces such as weather, as well as from interactions among organisms that make up the work itself.

Helen and Newton Harrison's life chain proposals, most not realized except on paper, encompass biological systems that would be preserved, or in some cases created through art. *Trümmerflora on the Topography of Terrors* is representative. This work was to consist of rubble from two large piles that already existed on a site in Berlin near the Gropius-Bau, at the bureaucratic centre for the death camps of the Third Reich. Along with the rubble were trümmerflora, or plants that spring up in disturbed places. The rubble was to be dispersed over sites used by the Gestapo to plan the concentration camps. Trümmerflora would from then on inhabit those sites, and compose a living memorial to those who had suffered in the camps. The Harrisons designed this work to maintain an already existing biological process with genetic elements that would be destroyed unless sanctioned by art.

Some of the Harrisons' proposals encompass watersheds and bioregions. *Sacramento Meditations* (1976-77) evaluated and proposed changes for the watersheds of California's two largest rivers, the Sacramento, and the San Joaquin. *Meditations of the Great Lakes of North America* (1978) proposed a new nation to coincide with the watershed of the Great Lakes. *Mediation on the Gabriolinos* (1976) considered the extinction of the Gabriolino Indians in terms of information loss, specifically of cultural, linguistic, and genetic information. *The High Ground* (1990 to present) presents a plan for the reforestation of Tibet. And *Serpentine Lattice*, a work in progress, envisions a series of nature preserves located at approximately 40 mile intervals along the Pacific Coast from San Francisco to the panhandle of Alaska. All of these projects favor genetic diversity by deliberately limiting human activities, or redirecting them toward respectful interactions with existing biological systems.

The Harrisons told me that they consider genetics central to their work. However, the genetic component is implicit, not explicit, even in *The Lagoon Cycle*, (begun 1972), which involved breeding crabs. *The Lagoon Cycle* emerged from a search for edible organisms that could survive exhibition in art galleries. From a biological perspective, galleries are extremely inhospitable environments where few nonhuman organisms can survive for long. The search led the Harrisons to Sri Lanka, where they studied the crab *Scylla serrata*, which is an important food source in some parts of Southern Asia. After returning to the United States, the Harrisons raised these crabs in a studio and discovered how to breed them, something that had never been done before in captivity. The Harrisons then considered various ways to grow the crabs outdoors in California.

One possibility that they explored was to transform the Salton Sea, a forty-mile-long body of water in Southern California, into an estuarial lagoon. This transformation would require cutting a channel from the Salton Sea to the Colorado River Delta. The Harrisons calculated that the cost would be 'roughly equivalent to that of building a four-lane highway over the same terrain.' [19] But eventually the Harrisons, through their personae Lagoon-Maker and Witness, rejected these plans because environmental damage to the Gulf of California would be too great. *The Lagoon Cycle*, which began as a search for an edible organism that could survive the rigors of art galleries, and led to proposals for one of the largest art works ever conceived, evolved into a performance piece tracing the unfolding of environmental awareness.

The final version of *The Lagoon Cycle* includes panels with maps, written texts, and photo-based images, all informed by an ethic favoring sustainable agricultural, economic, and social systems, and long-term biological diversity. This work also explores differences between masculine and feminine consciousness of the environment, and offers a tentative synthesis of personal, aesthetic, and environmental concerns. Finally, *The Lagoon Cycle* is one of the first artworks to engage global warming. The concluding map in the cycle is unforgettable. It shows what future continents will look like if all the world's ice melts, and sea levels rise 300 feet.

Following in the footsteps of the earth artists and the Harrisons, many artists produced projects to purify water, restore degraded sites, build community gardens, establish urban

forests, and create habitat for wildlife. Works such as *Seven Thousand Oaks* by Joseph Beuys, *Leonhardt Lagoon* by Patricia Johanson, Herbert Bayer's *Mill Creek Canyon Earthwork*, *Ocean Landmark Project* by Betty Beaumont, *Isla de Umunnum* by Heather McGill and John Roloff, and *Revival Field* by Mel Chin have genetic dimensions. However, genetics in these works is implicit, not the focus.

The 1980s

By 1980 the trauma of World War II had diminished, partly for no better reason than that so many who had suffered had died. Meanwhile, genetic engineering had begun to affect economies and cultures. Art that explicitly engaged genetics appeared once again. To the best of my knowledge, the first artists to directly engage genetics in the 1980s did so independently of one another. They worked in unrelated styles informed by different currents within the art world. All that these artists shared was the same postmodern moment, and the common experience of discovering a new continent that turned out to be not so new after all. But they soon pushed into regions that no one before World War II had reached.

In the early 1980s Alexis Rockman developed a style of painting that drew on such diverse sources as Dutch flower painting, nineteenth century landscape painting, science fiction movies, and natural history dioramas. In Rockman's work nature is a Hobbesian spectacle in which ants devour butterflies, flowers drip sinister nectars, and human creations proliferate amid feces, traps, and evolutionary cul-de-sacs. Garish decay pervades not only Rockman's subject matter, but his color and use of materials. He favors sickly greens, lurid reds and golds, and deep shadows. His glazes are so heavy that some canvases glisten like hams. Rockman's most blackly humorous works blend genetic engineering and pornography. In *The Trough* a pig mounts a duck; *Barnyard Scene* shows a racoon sodomizing a rooster; and in *Jungle Fever* a preying mantis mates with a chipmunk. [20]

In the *Biosphere* paintings horror overwhelms humor. *Biosphere: Laboratory* (1993) shows a laboratory orbiting Saturn. The laboratory contains two-headed cows, a goat-cow-pig hybrid, and a dog with a puppy's head grafted onto its neck. The scene recalls *The Island of Dr Moreau*. Both Wells and Rockman explore secret worlds, where under the rule of science, pathologies play themselves out. The most striking difference between Rockman's vision and Wells' is that while Dr. Moreau had to leave civilization to pursue his experiments, Rockman mirrors the heart of civilization. True, the space station is modelled after the rebel station in the movie *Silent Running*, but the only thing approaching rebellion in *Biosphere: Laboratory* is the arrogance of power. Space stations embody dominant forces in contemporary civilization, and some of Rockman's most shocking imagery comes directly from government-sponsored research. The two-headed dog, for example, was actually created in a Moscow laboratory in 1959. The animals survived for a brief time. While much of Rockman's imagery comes directly from contemporary culture, his style, reminiscent of the 19th century realism, suggests that popular imagination about biology may have changed much less in the last century than we might assume.

In 1987 Dennis Ashbaugh began making paintings of banded segments of DNA. These 'DNA paintings' as Ashbaugh calls them read simultaneously as representations of DNA, and as painterly works concerned with color, composition, paint application, and the picture plane. Painterliness encourages meditation on how biotechnology affects our view of life.

Ronald Jones employed a somewhat similar postmodern mix of non-representational and representational modes in sculptures of chromosome fragments and viruses. His works recall Brancusi and Arp, but where those artists are comic or transcendent, Jones reminds us of crushing realities. A 1989 sculpture that on first glance suggests one of Arp's floating blobs, bears the title *Untitled (DNA Fragment from Human Chromosome 13 carrying Mutant Rb Genes also known as Malignant Oncogenes that trigger rapid Cancer Tumorigenesis)*. Amid the bone-chilling elegance, only the ghost of Arp's lightness remains.

Kevin Clarke also explored imagery of DNA and chromosomes to produce commentaries on the biological revolution, and how it encourages us to see one another in terms of genetic information. He painted portraits in which base sequences serve as key aspects of individual identity.

In the U.S. sustained public discussion of biotechnology has never taken place. Instead, the biological revolution has insinuated itself into daily life through consumer choices. For instance, anyone who purchases a named rosebush today is probably purchasing a plant that is patented. Larry Miller, a veteran of Fluxus, responded to such developments with a public action in 1989 to copyright his DNA. During the next decade he widely distributed copyright forms to anyone interested in legally owning their own genes.

Also during the 1980s, several artists began working with living things on the genetic level. In 1984-5 Joe Davis created *Microvenus*, a strand of DNA configured like the Germanic rune for life, and inserted into an E. coli bacterium. This was the first transgenic artwork. [21] Since bacteria and DNA are invisible under ordinary circumstances, *Microvenus* functions largely as a conceptual work. However, DNA and E. coli are much more than ideas, so *Microvenus* also highlights the power of invisible realms, and the faith that we invest in genetics.

In 1987 Peter Gerwin Hoffmann exhibited *Mikroben bei Kandinsky* in *Animal Art*, a show involving live animals and microorganisms held in Graz. *Mikroben bei Kandinsky* consisted of cultures of bacteria scraped from the surface of a Kandinsky painting. In the catalog to the exhibition, Hoffmann wrote that 'gene technology has put ... an end [to] [...] the polarity nature-art. It is of great social import for our future to analyze and criticize works of art (a cow or a gene-manipulated bacterium) by the views and criteria of art. The living organisms [...] that surround us [...] can only be understood and interpreted as works of art.' [22]

I began breeding irises in 1979, and first exhibited them as art in 1985. The same year I published *Sky*, an artist's book that consisted of a series of conceptual works about nuclear devices. One proposal was for a site-specific strain of irises to mark the Bangor Naval Submarine Base, where U.S. submarines are outfitted with nuclear warheads. In 1988 I exhibited *Iris Project*, an installation of iris hybrids, at New Langton Arts in San Francisco. The next year I began breeding oriental and opium poppies, and later I also worked with steptocarpuses, bearded irises, California poppies, corn poppies, and other plants.

Vilém Flusser, writing in *Art Forum* in 1988, predicted that artists might someday create wheat with the power of sight, photosynthetic horses, and 'an enormous color symphony [...] in which the color of every living organism will complement the colors of every other organism.' In what seems like a distant echo of Stapledon, Flusser wrote that the new artists would lay the 'foundations of mental processes that have never before existed.' [23] Flusser had seen Hoffman's petri dishes of bacteria in Graz, but seems not to have known about other genetic artists, including Steichen.

By 1989 genetic art as we know it had taken rough shape. Most artists used traditional media such as painting or sculpture to explore the imagery of DNA and chromosomes, and to comment on the biological revolution. DNA portraits, cancer genes, and AIDS imagery updated the traditional Western focus on the human body. However, a few artists took nonhuman life as their medium, or explored effects of human consciousness on evolution.

1990 to the present

Genetic art proliferated after 1990. An important development in representational work was what Suzanne Anker calls 'the new grotesque,' freakish or malformed human figures. This tendency in art began well before 1990, but only afterwards

did it begin to register hopes and fears unleashed by biotechnology. Examples include Jake and Dinos Chapman's sculptures of conjoined children, and Aziz + Cucher's chimeras.

Another important development in genetic art was expanded use of photography. Prior to the 1990s, the only role that photography played was documentation of breeding projects and exhibits. Gary Schneider's *Genetic Self-Portrait* explores a very different possibility. *Genetic Self-Portrait* is a series of photographs of the artist's body. [24] They range from an x-ray of his skull to microscopic views of his cells and DNA. Visually the interior of the human body is largely unfamiliar territory to most of us, so the microscopic details of Schneider's body may not immediately bring the human figure to mind, much less self-portraiture, yet titles and associations with medical photography encourage the connection.

The single most important development since 1990 is new kinds of live art. David Kremers's *Somite* series, begun in 1992, consisted of genetically-altered bacteria painted on agar-covered acrylic plates. There the bacteria interacted with dyes to produce complex stains. Kremers then sealed out moisture to arrest growth, and the works became stable, but remained alive. Kremers wrote that "the sale of any living artifact requires an approach to benefit that artifact. We must ask, What does this artefact want? Where does it want to live?" [25]

Eduardo Kac's premiere transgenic installation was *Genesis*, first exhibited during *Ars Electronica* in Linz in 1999. Kac translated into the four-letter alphabet of DNA the Biblical passage, 'Let man have dominion over the fish of the sea, and the birds of the air, and all creatures that crawl upon the land.' He then ordered a strand of DNA containing the sequence from a scientific supply house, and with the help of other technicians had the DNA inserted into a bacterium.

During *Ars Electronica*, *Genesis* occupied a dimly lit space in which the Biblical passage in white letters occupied one wall, the DNA sequence a facing wall, and a projection of a petri dish of genetically altered bacteria on a third. The projected bacteria looked like a glowing rain. By joining the Bible and genetic engineering, the work draws attention to a frozen strata of culture from which contemporary high technology perpetuates ancient patterns of faith in human exceptionalism.

Prior to the early 1990s live works of genetic art involved plants or bacteria. Animals played no role, except in the Harrisons' *Lagoon Cycle*. In 1994 Andrea Zittel used chickens in an installation titled *Breeding Unit for Reassigning Flight*. Only chickens who could fly to certain heights could hatch their eggs. However, Zittel's installation was more a commentary on social Darwinism than a sustained experiment in animal breeding.

The first artist to seriously explore animal breeding was Brandon Ballengee, who in the late 1998 began a long-term project to recreate a possibly extinct species of African frog from allied frogs in captivity. To reconstitute the species, he breeds its near-relatives and selects hybrids that most resemble it.

Since 2000 other artists have done multigenerational breeding projects with animals. Dave Powell breeds cats, selecting for polydactyly and other characteristics with the long-range goal of creating what he calls a 'bullcat', one that physically resembles bulldogs. Tera Galanti works with silkmoths (*Bombyx mori*). The Chinese began rearing these insects at least 5,000 years ago. Today all wild populations of silkmoths appear to be extinct, and domesticated moths can no longer fly, so the species has become flightless. Galanti is breeding to restore flight.

Transgenic works involving animals appeared after 2000. Dmitry Bulatov, a Russian artist, has genetically engineered tadpoles to glow in a range of spectral colors. Eduardo Kac used genetically engineered mice and zebrafish in his installation, *The Eighth Day* (2003). Kac's best-known transgenic animal is the rabbit Alba. She is the centerpiece of *GFP Bunny*, and fluoresces green under blue light because she contains a jellyfish gene for green fluorescent protein (GFP). In spite of her fame, only a few people have actually seen her. Paul Vial, the

director of Institut National de la Recherche Agronomique (INRA), the French laboratory where gene transfer was performed and Alba was born, decided at the last minute not to release her, so she has remained there, inaccessible to the artist and the public. (Rabbits often live for seven to twelve years, so as I write, Alba may still be alive.)

INRA's refusal to release Alba helped make Alba a cause celebre, and drew international attention to genetically engineered animals. GFP mice, rabbits, and other animals have existed since 1997, but they have remained sequestered in laboratories, out of public sight and mind. Kac's attempt to bring Alba into the public realm unleashed, for a spell, long-muffled concerns about genetic engineering. A complicating feature of the situation has been rumors that Alba never existed. Even in the art world doubts were widespread. In *The Molecular Gaze*, (2004) Suzanne Anker and Dorothy Nelkin describe Alba as 'allegedly luminous,' and speculate that Kac is engaged in 'commercial spectacle.' They suggest further that Alba's green color in photographs is a result of photoshop manipulation. [26] The authors do not explain why they single out Kac for criticism, when many of the works mentioned in *The Molecular Gaze* make claims that either cannot be verified, or else would require laborious research to confirm. Anker's own installation, *Zoosemiotics: Primates, Frog, Gazelle, Fish*, featured on the book's cover, contains representations of chromosomes which few people can correlate with those animals. We are of course free to ignore any work of art that requires too much faith or knowledge. However, Kac never intended Alba to be inaccessible or obscure.

Another challenge to GFP Bunny came from Joe Davis, Dana Boyd, Hunter O'Reilly, and Marek Wieczorek, who looked into the question of Alba's existence and published their findings in an entry on art and genetics in *Encyclopedia of the Human Genome*. O'Reilly communicated with Louis-Marie Houdebine of INRA, who according to Kac had helped perform the gene transfer. Houdebine maintained that 'no rabbits at his laboratory were ever created for Kac.' [27] However, this did not answer the question of whether Alba existed. One obvious possibility is that Alba was created in the INRA laboratory but not specifically for Kac. Davis and his co-authors considered this, but the encyclopedia's editors were unwilling to include a discussion of biological found art in the article. [28] This is a serious omission.

Houdebine disassociated himself and INRA from Kac only after the director's decision not to release Alba. In 2008, nearing retirement, Houdebine publically said that the problems surrounding Alba 'were due to the administration [at INRA], which was worried about adverse publicity if the rabbit was exhibited. [29] This discussion takes us far from more important issues that *GFP Bunny* raises. Kac never intended the work to consist simply of a genetically engineered rabbit. Rather, the work was conceived as 'a complex social event'. [30] Kac intended to present Alba to the world outside the laboratory in two steps. The first was to put her on display in France in an installation that would resemble a living room, and that Kac would share with her for the duration of the exhibit. Afterwards, in the second step, he would transport Alba to his home in Chicago and make her a member of his household. All this was intended to draw attention to human-animal social matrixes that genetically engineered animals belong to and influence.

For Kac it was crucial that Alba not unnecessarily suffer. He chose to work with the jellyfish gene because there is no evidence that GFP causes animals to suffer. Normal social interactions with other rabbits would be possible in spite of Alba's unusual genetic constitution because GFP does not manifest itself except in the presence of pure blue light.

Kac did not develop *GFP Bunny* as a conceptual project. However, in the absence of Alba, that is how the work functions. Alba is a real animal who because of circumstance beyond the artist's control has become an idea that has been a catalyst for cultural change. Filtered through media and internet reports, Alba is memorable and strange almost to the point of freakishness, and yet she is so unthreatening as to be a potential member of the family. She has sparked countless conversations and debates. She implies the need for a new social

contract that takes into account all sentient life, including genetically-engineered organisms.

The Steve Kurtz Case

Within and outside the artworld genetic art has been received with a mixture of enthusiasm, indifference, and hostility. The most concerted hostility has been directed toward Steve Kurtz. He is a member of Critical Art ensemble (CAE), an art collective that since the late 1990s has done performances and installations engaging biotechnology. Microorganisms sometimes feature in these works. *Cult of the New Eve* (1999), for example, is a pseudo-religious performance piece and installation that features wafers and beer made from yeast genetically engineered to contain a sequence of human DNA.

On May 11, 2004 Hope Kurtz, Steve's wife, suffered cardiac arrest and died at their home in Allentown, New York. Steve Kurtz called 911. After emergency workers arrived, one of them noticed laboratory equipment and petri dishes containing what appeared to be live cultures. The FBI was notified, and Steve Kurtz was detained and interrogated. His house was searched, and tested for ricin, anthrax, and plague. Authorities quickly determined that the petri dishes contained effectively harmless bacteria,[31] and that Hope Kurtz had died of natural causes. Nothing in the house posed any public danger, and yet Kurtz's computers, lecture notes, equipment, and a manuscript for a book were confiscated. A grand jury was convened to investigate the possibility that Kurtz was involved in bioterrorism.

When the grand jury failed to substantiate allegations of bioterrorism, Kurtz was charged with 'mail fraud' and 'wire fraud' because of an improperly filled-out laboratory form. Mail fraud and wire fraud carry maximum sentences of 20 years. Kurtz's interrogation, and the grand jury hearings have received national and international attention. However, in the U.S. the case is not well-known outside the art world, in part because Kurtz's persecution does not fit familiar patterns of attacks on art. No allegations of obscenity or blasphemy were involved. From the beginning the case was politically charged, but exactly what calculations pushed it forward have always been unclear.

Initially the government's responses to the petri dishes in the Kurtz's home may have been blunders attuned to the national hysteria of the time. That hysteria, encouraged by the Bush Administration, gave political bias to misunderstandings and errors of judgement. For example, just days before Kurtz's arrest, an art teacher in Posser, Washington reported a 15 year-old boy to the Secret Service after the boy did sketches of President Bush. One showed the President's head on a stake. Another showed him dressed as the devil. The Secret Service confiscated the sketches and questioned the boy. Posser Police chief Win Taylor said that the boy and his sketches were seen as 'a threat against the president of the United States'. [32]

Perhaps the Kurtz case was driven by officials trying to save face, and/or by pressure from federal agents looking for ways to pad statistics on domestic terrorism in order to please superiors and justify budgets, or simply to bolster preconceptions. After the anthrax scares of 2001 any Petri dish could easily arouse public fears. Another factor may have been CAE's political stances and activities. CAE has been a long-time critic of corporate biotechnology. The case may have been driven by prosecutors and others eager to prove their loyalty to powerful interests. At this point we do not know for sure, but if silencing Kurtz and CAE was the intent, it failed. The case received international attention, and Kurtz used his new reknown to bring attention to social and political issues raised by corporate biotechnology.

On April 21, 2008, nearly four years after Hope Kurtz's death, Federal Judge Richard Arcara ruled to dismiss the indictment as 'insufficient on its face'. This means that even if the allegations against Kurtz were true, they did not constitute a crime. [33] As I write, none of the materials seized from Kurtz had been returned to him. He has had to reconstruct the book, which is on biological warfare, from memory.

Allies

Prior to 1990 live genetic art had important allies in horticulture and literature. In the last decade new allies have emerged in performance, body art, and art forms employing developmental biology and tissue culture. Marta de Menezes manipulates the chemical environments of butterfly chrysalises to produce adults with novel wing patterns. Oron Catts, Ionat Zurr, and Guy Ben-Ary grow stem cells over non-living artifacts to create what they call 'semi-living sculptures.' And Orlan and Stellarc, in the course of manipulating their own bodies, have engaged some of the issues that genetic art engages.

Recent Writings About Art and Genetics

Since 1995 more has been written about art and genetics than ever before. Two important novels that deal with biotechnology are Michel Houellebecq's *The Elementary Particles* (2000), and Margaret Atwood's *Oryx and Crake* (2003). Overviews include *The Molecular Gaze* (2004) by Suzanne Anker and Dorothy Nelkin, and *Kunst aus dem Labor* by Ingeborg Reichle (2005, in German). Critical Art Ensemble's *The Molecular Invasion* provides political perspective, and *Biomedial*, by Eugene Thacker (2004) is a survey of contemporary issues in biotechnology relevant to artists and others. Among anthologies are *The Aesthetics of Care?* (2002), edited by Oron Catts, *Biomedial* (2004) edited by Dmitry Bulatov (Russian and English), *Art et Biotechnologies* (2005) edited by Louise Poissant and Ernestine Daubner (French), *Tactical Biopolitics* (2008) edited by Beatrice da Costa, and *Signs of Life* (2007) edited by Eduardo Kac.

Catalogs include *Paradise Now*, for a show of that name held at Exit Art in New York in 2000, *L'Art Biotech*, for an exhibition of live work held at Le Lieu Unique in Nantes in 2003, and *The Eighth Day: The Transgenic Art of Eduardo Kac*, for Kac's installation of transgenic organisms at Arizona State University in 2003.

Not all commentary has been friendly. In *Art and Fear*, Paul Virilio, a French cultural theorist, argues that the Nazis lost World War II but won the peace, with live biotech art the supreme expression of their cultural triumph. It is worth looking at Virilio's charge in detail because he expresses widespread fears and misconceptions about biotech art. He begins by quoting a visitor to Auschwitz who had the horrifying intuition that the death camp was a museum of contemporary art. Virilio then asks: did the Nazis produce 'forms of perception that are all of a piece with the mode of destruction they made their own?' [34] He proceeds as if it is self-evident that the Nazis, and other aspects of modern life such as biotechnology, have so damaged the foundations of our culture that contemporary art either registers a deadly absence of direction, or participates actively in war against humankind. The supreme expression of malaise is genetic art.

Virilio hints that secularism is ultimately responsible for the war against humankind, but assigns more immediate blame to Dada, Futurism, and German Expressionism. As evidence that they paved the way, he quotes Richard Hulsénbeck, a founder of Dada: 'We were for the war. Dada today [1918] is still for war. Life should hurt. There is not enough cruelty.' [35] Hulsénbeck is still shocking after all these years, but his words raise obvious questions. Should we take him literally? Was he intending to shock? Insult? Hold up a mirror? Virilio, however, has no patience for questions, and immediately concludes, 'The rest is history.' [36] This encapsulates Virilio's method.

Just how little Virilio knows about genetic art soon becomes evident. The following is typical: 'Genetics is on the way to becoming an art, a transgenic art, a culture of the embryo to purely performative ends, just as the eugenicists of the beginning of the twentieth century hoped.' [37] However, when Virilio wrote this, genetics was not on the way to becoming an art, it had already been an art for some time, and a substantial body of work was available for him to consider, had he wished to consult it. It is fair to ask if such art prepares the way for eugenics, but that is not the only question that needs to be asked. Are embryos the focus of genetic art?

Are genetic artists actively encouraging movement toward eugenics, as Virilio charges, or are they warning us against it? Are all artists doing the same thing? Virilio ignores these questions. Had he looked at genetic art, he would have found that the organisms most commonly used in transgenic art at the turn of the millenium, when he wrote 'A Pitiless Art', were bacteria, which have no embryos. Plants and animals played roles in some genetic art, but plant embryos did not concern him, and animal embryos held no interest except as precursors to experimentation with human embryos.

It is no secret that live human embryos are completely off limits for genetic artists. No artist that I know of has expressed a desire to violate this taboo, but if such an artist exists, I doubt that any funding agency, curator, or scientist would cooperate. However, let us suppose that a clandestine team of artists, scientists, and technicians comes together and produces a work involving a live human embryo. What would happen if it was exhibited, or made public in some other way? In the United States today, I expect that the artist, and everyone else involved, would become embroiled in problems, legal and otherwise, that would make pursuit of this kind of art, and perhaps any art, impossible.

Of course, public moods change, and may come to tolerate something that resembles Virilio's 'culture of the embryo'. Lee Silver argued that biotechnology under libertarian conditions is likely to lead to extensive germline genetic engineering of humans. [38] Art could play a role in this. However, what that role might be remains entirely a matter of speculation. The mere possibility that in the future some artist might manipulate a human embryo, or be complicit in its manipulation, or that some genetic engineer someday might claim to be an artist, in no way justifies Virilio's blanket condemnation of all genetic art as eugenic.

Virilio might have made a more compelling case if he had bothered to study actual works of art. Among those that he might have considered is *Human Earrings*, a 1989 sculpture by the Canadian artist Rick Gibson. It consisted of a traditional representation of a woman's head with two dead human fetuses hanging from her ears. This work does not quite prove Virilio's prediction that we are creating 'a culture of the embryo for purely performative ends' because Gibson was not working with live fetuses, and intended his work to show 'how we treat human beings.' [39] Furthermore, he had obtained the fetuses from a professor of anatomy with the understanding that they had been dead for twenty-five years. However, the work is deeply troubling, and seems to confirm Virilio's dismay over where culture has brought us - although not his analysis of what has brought us here, or the role that genetic art plays.

Others felt dismay when Gibson's piece was exhibited in Britain. Gibson and the owner of the gallery where the work was displayed were prosecuted and fined for the vague crime of 'outraging public decency.' However, the professor who supplied the fetuses was not punished. [40] I have not seen *Human Earrings*, but as an idea, and from the evidence of Gibson's statement, the work has nothing to do with the spirit or practice of Nazi eugenics: on the contrary, *Human Earrings* seems to be a protest or warning against the casual misuse of human life - whether for jewelry, or anything else.

Virilio could have looked beyond visual art to consider literature. In Joanna Russ's *The Female Male* (1975), a genius genetically engineers a disease that kills only males. The world, cleansed of human males, is left to their natural superiors, who live in bucolic harmony and reproduce technologically. The genocidal reach of this vision goes beyond the Final Solution.

Virilio, having experienced little genetic art, has little of substance to say, but he compensates by repeating himself and turning up the volume. He raises the spectre of Nietzsche, who 'flung the door to the laboratories of terror wide open.' 'The expressionism of a MONSTER' created by 'a GENETIC GENIUS' leads to 'extreme arts such as transgenic practices' which amount to 'the catastrophic continuation of Nazi experimentation.' [capitals and italics Virilio's] [41] This is a rant, right down to the italics and thrilling invective. Virilio apparently believes that artists, by engaging the demons of our time, become their agents. He has little tolerance for the messy, biological, all-too-human risks of

art. In this he is hardly alone. He expresses common ignorance and passions, and demonstrates by example the blinding power of the horrors of our time.

Conclusion

Virilio to the contrary, there is no serious philosophical opposition to genetic art today. However, a mature art of evolution remains only slightly less distant as it was before World War II. Full exploration of genetic art will require, as a bare minimum, not only a great deal more bioart, but new kinds of museums, spaces that welcome rather than exclude diverse forms of life. We can imagine traditional gallery spaces combined with courtyards, gardens, zoos, and wilderness areas.

Bioart is nothing if not ambitious, and new museums are only the beginning. The Harrison demonstrated that contemporary art can tap the collective energies - epic, megalomaniacal, world-creating and world-destroying - that post-industrial civilization gives to science, government, the military, and business, but withholds from art. *Serpentine Lattice*, which would extend more than 1,500 miles along the West Coast, and cost 5.7 billion dollars yearly for 25 years, [42] dwarfs not only the most ambitious constructivist projects, but most corporate projects as well. Yet *Serpentine Lattice* is modest in scale compared to Stapledon's vision of genetic art encompassing all life forms, including the human species.

Individual works of genetic art, for all their diversity, tend to bring up many of the same questions: what kind of consciousness does the work serve? To what extent does it aestheticize the biological revolution, help commodify life, and further the holocaust of nature? On the other hand, does the work contribute to awareness that plants and animals did not arise for our sake, that they have their own ways of becoming, and their own paths to fulfillment? How does a particular work of art affect the community of life?

These are social questions, but ones that in genetic art are inseparable from aesthetic experience.

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