EDUARDO KAC

TELEPRESENCE, BIOTELEMATICS, TRANSGENIC ART

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FOREWORD
Peter Tomaž Dobrila

In 1998 Association for Culture and Education KIBLA, located in the Multimedia Center KiberSRCeLab KIBLA in Maribor, Slovenia, released the book Eduardo Kac: Teleporting an Unknown State, parallel to his exhibition of the same title. Teleporting an Unknown State seemed to push the web beyond it s known limits. This groundbreaking work received international recognition and praise. From this perspective, we could not know what to expect as Kac s next radical work.

Since the mid-eighties Kac has pioneered and developed new art forms, which he calls Telepresence, Biotelematic, and Transgenic Art. As part of his Transgenic Art, Kac succeeded in creating a rabbit with a fluorescent gene in early 2000. In a telephone conversation in May 2000 he expressed how happy he was to have Alba, the glowing rabbit, as a new family member.

Kac s Transgenic Art raises several questions. This book discusses some of them, while leaving many issues open for further debate. As we open the 21 st Century, we forge new paths and search for new art forms that reconcile aesthetic innovation and social awareness. This is precisely what Kac hasaccomplished. Therefore, the book entitled Telepresence, Biotelem atics, Transgenic Art is exceptional it will raise many issues and make us think about ourselves, our environment, and our future.

I would like to thank all who contributed to this book and especially Eduardo Kac for his work.

EDUARDO KAC, PIONEER AND VISIONARY
Annick Bureaud

No one medium can hold Eduardo Kac. His work ranges frombody-based performance art and graffiti to the use of fax machines, slow-scan, digital poetry, telerobotics, the Web and biotechnology. In Kac's art what matters is not the storage medium but the concepts which, in his case, can only be expressed through the use of new technologies.

Born in 1962 in Rio de Janeiro, Eduardo Kac spent the first part of his artistic career in Brazil before coming to Chicago in 1989. He now teaches at The School of the Art Institute. His work has been shown in many exhibitions around the world and is featured in the collections of such institutions as the Museum of Modern Art in New York, Chicago's Holography Museum andthe Modern Art Museum in Rio. Working with both verbal and visual media, he publishes copiously as well; Leonardo and Visible Language are among the journals to have carried his texts. Kac is a pioneer, a position clearly illustrated by three among many new concepts that characterize his work: holopoetry, [1] telepresence andbiotelematics. [2]

At the beginning of the '80s, when poetry was (once again) pronounced dead, Kac took the pronouncement as a challenge. His explorations of experimental verse (one ofhis favorite poets is e. e. cummings) led him to the conclusion that the two-dimensional page was, indeed, exhausted, and he decided to write hiswords in the three dimensions of real space. Holography made it possible to create an immaterial and mobile architecture of words, and a new visual syntax. He coined the word holopoetryfor this work in 1983. [3] Two years later, he put out animated poems on Brazil's minitel system. [4]

One of Kac's key concepts is hybridization; another is the creation of dialogical artworks. The body and its presence has also been a recurrent theme in his work since his first performances on the beaches of Rio in 1980. This approach would

eventually lead to "Ornitorrinco", a series of telepresenceworks created in the U.S. with the collaboration of Ed Bennet between 1989 and 1996. "Ornitorrinco" is arobot remote-controlled by telephone (and also the Internet), a substitute-body shared and "inhabited" by the participating public.

Kac's work is a search to express and manifest complexity. Kac's most recent pieces are based on the following parameters: integration of different spaces (physical and virtual) into a single piece so as to render the relationship between body and mind in all its richness of connections and interpenetrations; direct association of different life forms (humans, animals, but also emerging hybrids); and production of a new ecology where organic and technological systems cross-pollinate. He had to invent a term, biotelematics, to describe some of his recent works. For example: in "Teleporting An Unknown State" (1996), a seed sprouts thanks to light sent via the Internet by means of webcams. He uses the termbiorobotics when discussing "A-positive" (1997), an "exchange of lives" between a human and a robot. The robot receives human blood and from it extracts enough oxygen to support a small flame.

Kac is a man of his times in the literal sense, not because heuses the latest technologies or because all his work is marked by subtlepolitical and social critique, but because he is inventing new art formsand truly developing a new aesthetic.

NOTES:

[1] For more documentation on Kac's work see his site: http://www.ekac.org
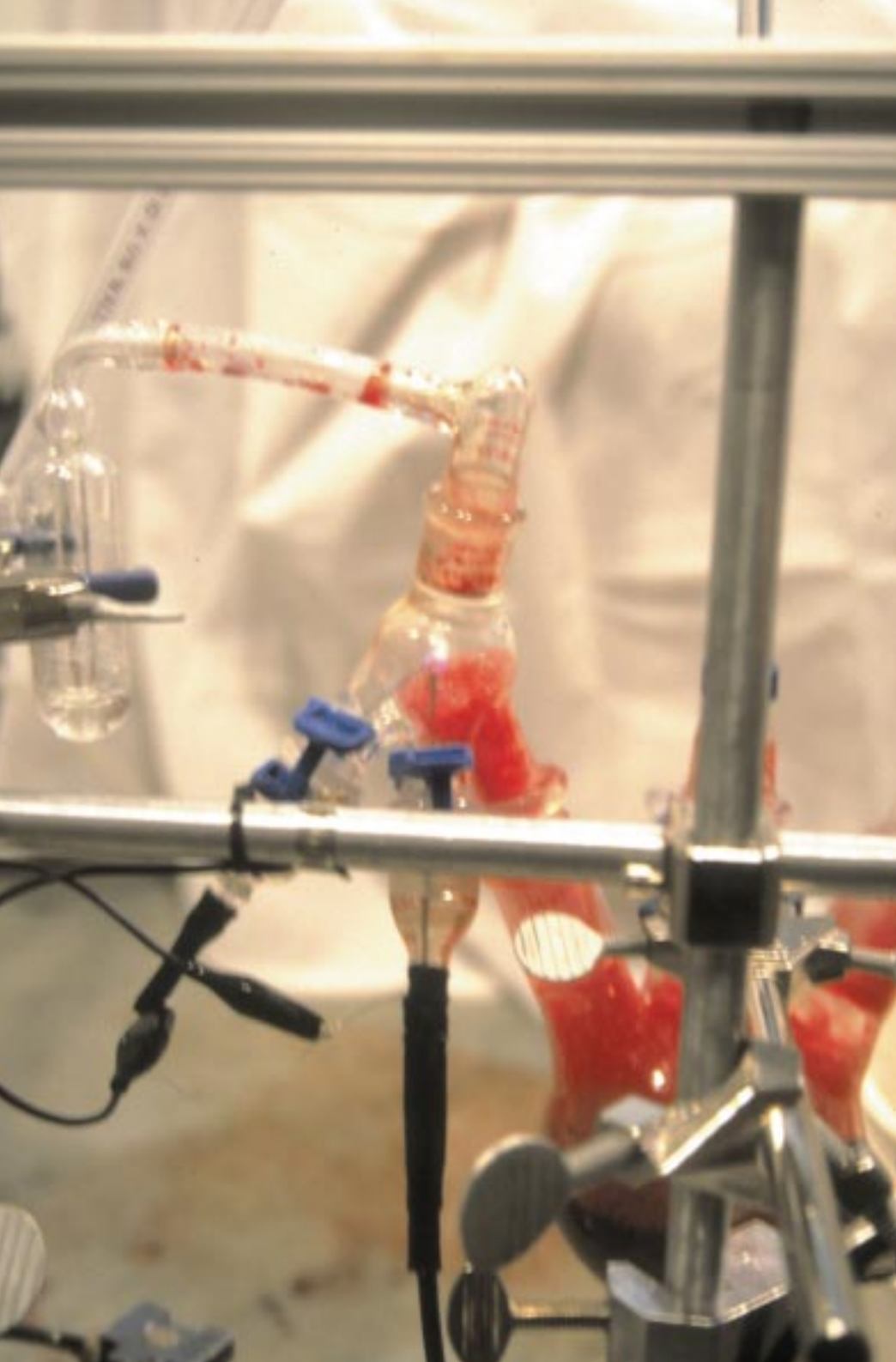[2] A term invented by the artist.
[3] Holopoetry does not consist of holograms of traditionalstatic versification; rather it is the creation of a dynamic poetry where beholders' readings (in both the literal and figurative sense) change asthey move.
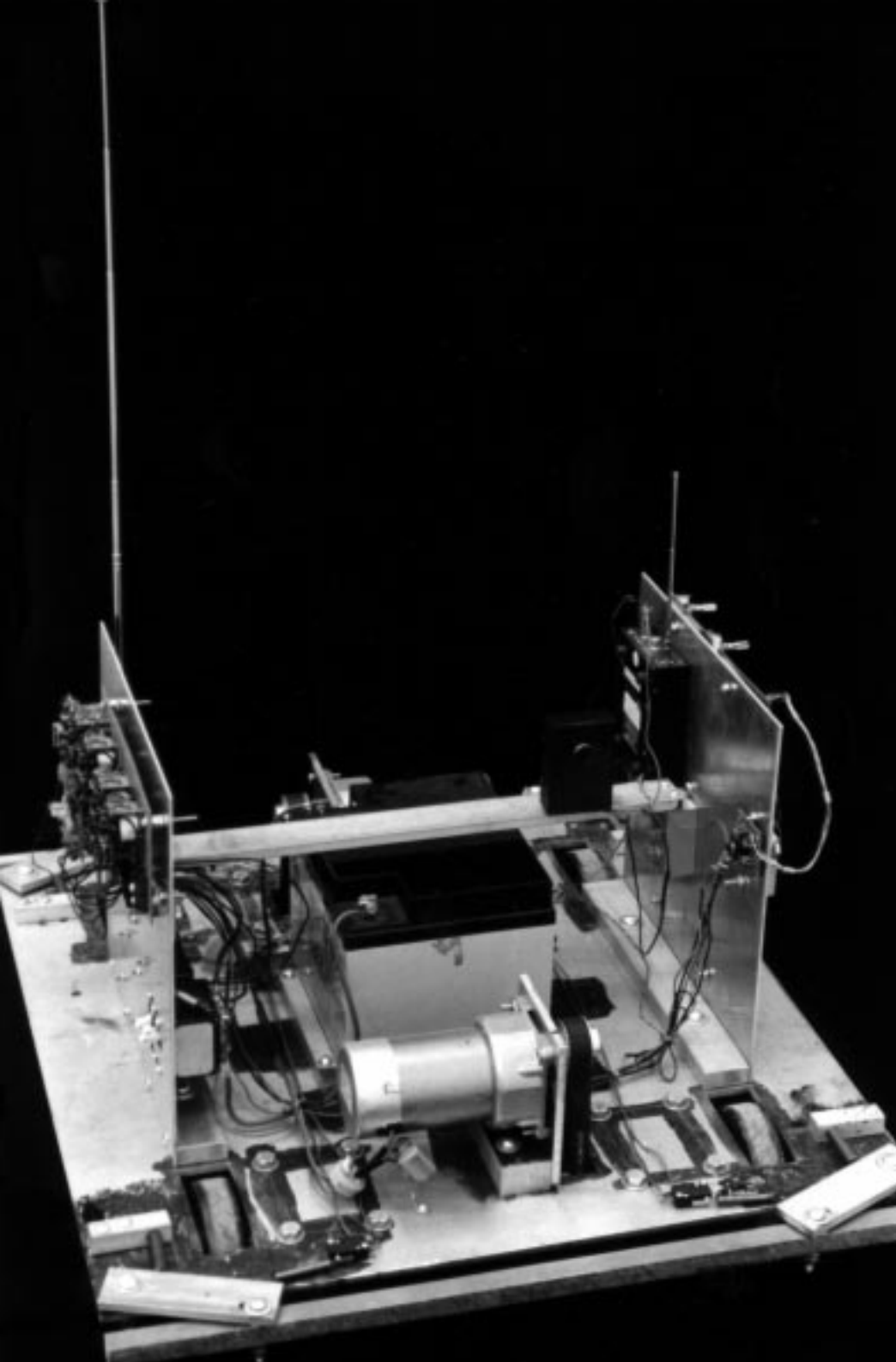[4] The minitel is a phone-computer appliance that enables userswith special terminals to read information on a central server by means of software resident

on that server. Brazil bought France's minitel technology in its full graphic capacity, while France itself only implemented a text-based version of thetechnology.

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Annick Bureaud is a Paris-based art critic and curator whocontributes a regular column to the magazine Artpress. She is a Lecturerat the art school of Aix-en-Provence and a member of the Editorial Board ofthe journal Leonardo. She is the director of OLATS (Leonardo Observatory forthe Arts and Techno-Sciences, http://www.olats.org), the French branch of Leonardo. Creator and Editor of IDEA (International Directory of Electronic Arts, http://nunc.com), Annick Bureaud lectures regularly at international venues.

TELEPHONE KEYPAD
MOTION AND VISION
CONTROL CODE

FORWARD

15° LEFT

15° RIGHT

90° LEFT

90° RIGHT

180° LEFT

180° RIGHT

1	2	3
4	STOP & 5 IMAGE	6
7	8	9

BACKWARD

CHICAGO

The Internet Onomotoco

MOTION CONTROL AND VISION

SEATTLE

MOTION CONTROL AND VISION

VISION

LEXINGTON

THE WORLD
VIA THE INTERNET
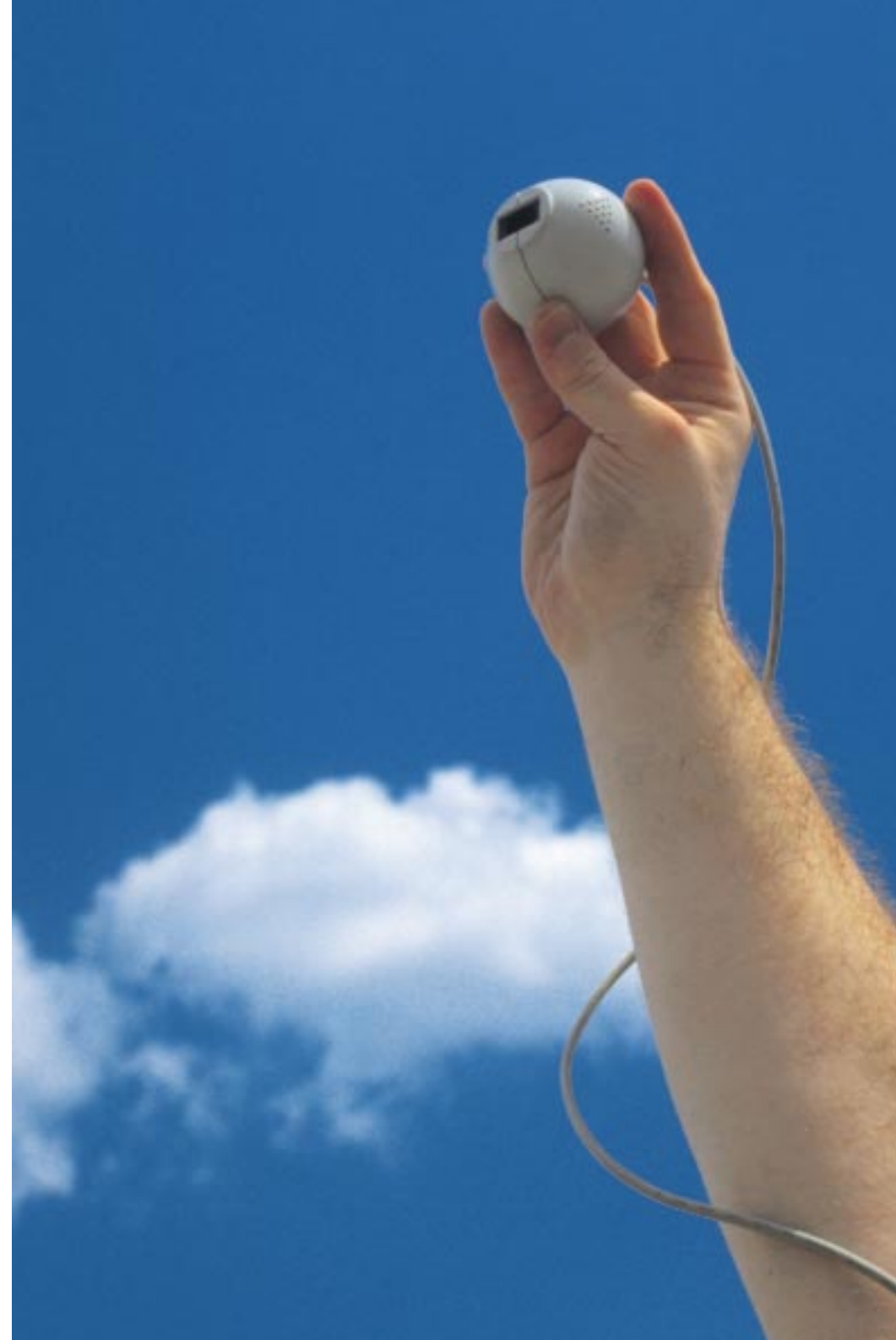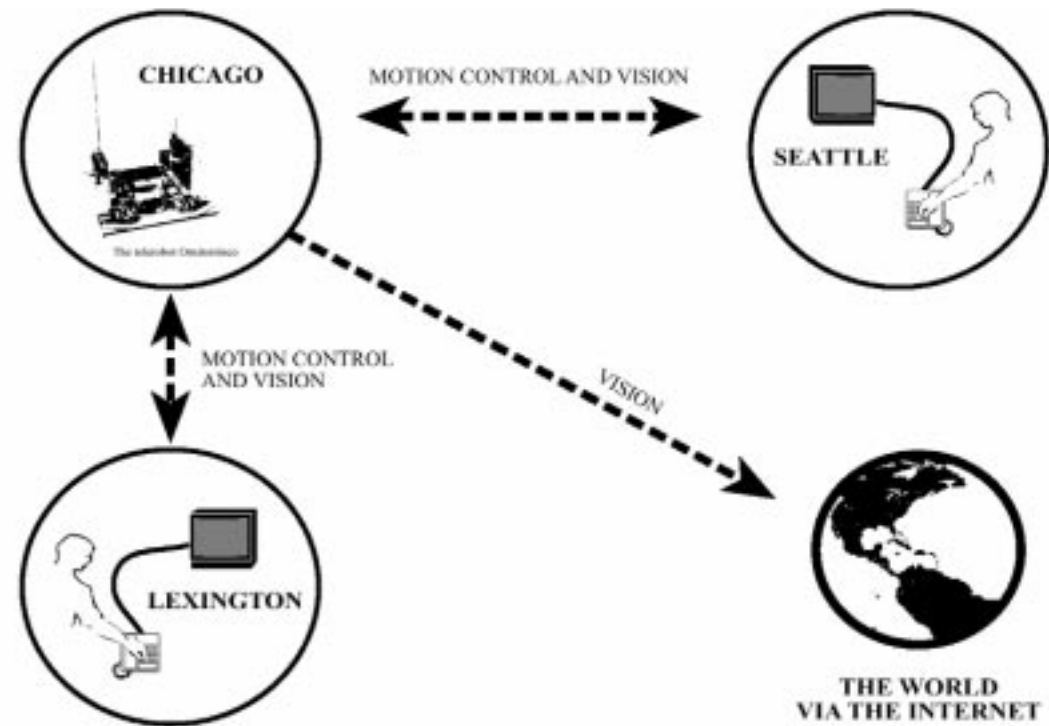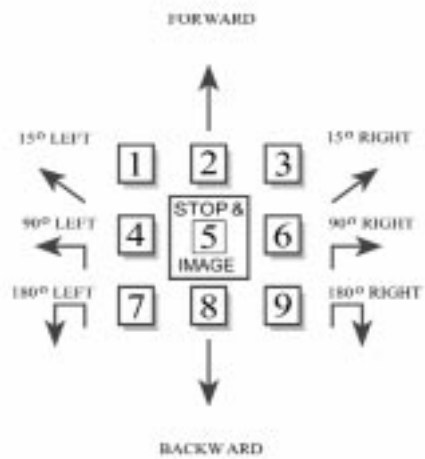
TELEPOR TING UN UNKNOWN STATE • EDUARDO KAC
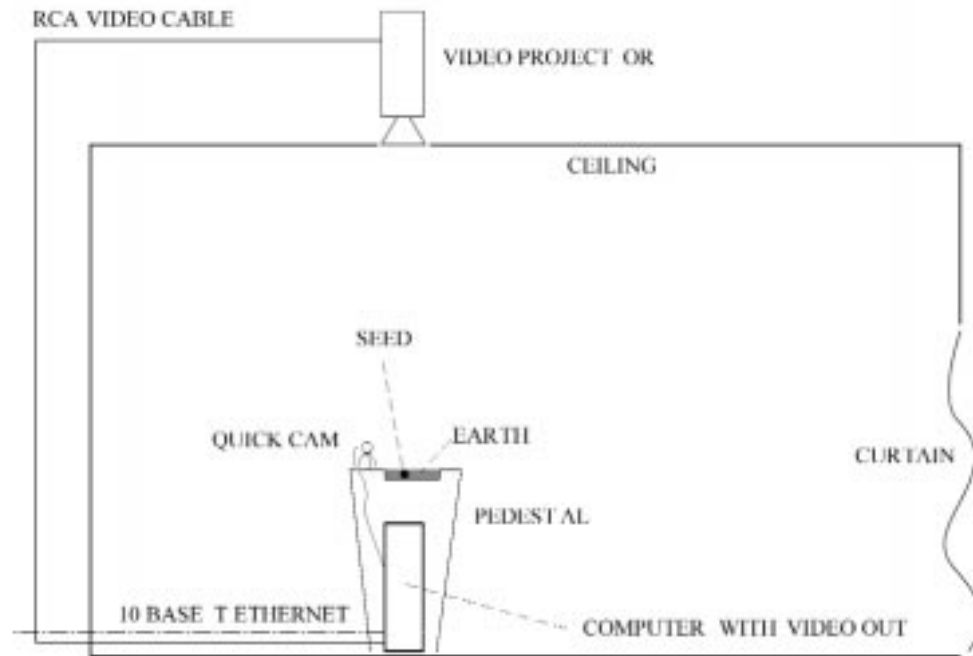
AGENTS OF UNDERSTANDING: ART AND TELEROBOTS
Edward A. Shanken

"If artists working with or interested in robotics cannot ignore mythological, literary, or industrial definitions of robots, it is also true that these definitions do not directly apply to any given robotic artwork. As artists continue to push the very limits of art they introduce robotics as a new medium at the same time that they challenge our understanding of robots - questioning therefore our premises in conceiving, building, and employing these electronic creatures."

<div align="right">Eduardo Kac [1]</div>

Kac rightly notes that the concept of the robot or automaton was not the invention of engineering, but rather emerged thousands of years ago in the Greek myth of Galatea, and was recapitulated in the Jewish mystical legends of the Golem, beginning in the Middle Ages. The historical inextricability of automata, robots, and the arts is well documented in Jack Burnham's monumental book, Beyond Modern Sculpture. [2] Indeed, the word "robot" gained its contemporary meaning only in the 20th century after Czech dramatist Karel Čapek used the term to refer to mechanical automata in his 1921 play R.U.R. (Rossum's Universal Robots).

It is inevitable that mythology and the arts will continue to play an important role in creating the future of robotics and telerobotics, if through no other process than by simply imagining possible uses (or misuses) of them for aesthetic, rather than practical purposes. Along these lines, artist/curator Rafael Lozano-Hemmer has recently advocated the work of artists who "pervert technological correctness" by using technology to interrogate technocratic norms and values, thereby opening up new ways of thinking about the relationship between humans and machines.[3] Such artistic interventions have a distinguished history. In 1962, Renato Poggioli described "perversion" as an ironic strategy of the avant-garde, which points out the emptiness of the "miracles that science seems to promise." Such irony, he wrote, "can become pathetic and tragic focusing not only on the

way the machine fails man, but also on the way man fails the machine."

Essay Concerning Human Understanding (1994), a collaboration between Kac and Ikuo Nakamura, stands out as a rare artistic use of telerobotic devices to facilitate remote communication between non-humans, in this case, a canary in Kentucky and a philodendron plant in New York. Kac described the mechanics of the installation: "An electrode was placed on the plant's leaf to sense its response to the singing of the bird. The voltage fluctuation of the plant was monitored through a (computer) running software called Interactive Brain-Wave analyzer. This information was fed into another (computer)... which controlled a MIDI sequencer. The electronic sounds (sent from the plant to the bird) were pre-recorded, but the order and the duration were determined in real time by the plant's response to the singing of the bird." [4]

While the bird and the plant ostensibly communicated with each other, Kac noted that humans also interacted with the bird and the plant as well, causing the bird to sing more or less, and the plant to activate greater or fewer numbers of sounds. In this way, humans, plants, and animals became part of a tele-mediated assemblage of feedback loops, each affecting the behavior of the other and the system as a whole. Here agency was no longer the exclusive province of humans, but was endowed primarily to the canary and philodendron who actively and mutually shared information. [5] But agency in Essay is more properly rhizomatic, in the sense that multiple agents interacted with each other on myriad levels, all contributing to the overall behavior of a non-linear system of exchange. [6]

The title of this artwork ironically refers to John Locke's 1690 treatise of the same name, which begins by stating that "it is the Understanding that sets Man above the rest of sensible Beings, and gives him all the Advantage and Dominion which he has over them". [7] Kac and Nakamura's Essay subverted the conventional master-slave relationship described by Locke, which remains fundamental to most implementations of telerobots. In the artwork, there was a multi-directional flow of information in which avian and botanical agents were primary, and human

agents secondary, as opposed to a one-sided exchange in which agency is defined by human command causing non-human response. While the degree to which the bird and plant in the work actually understood each other remains unclear, Kac and Nakamura attempted to enable interspecies communication by translating between the participants. At the same time, Essay can be seen as a allegory of the very possibility of communication and the human desire to overcome isolation by bridging the gap between self and other, subject and object.

As an unanticipated result, this work of art also brought to light the difficulty of overcoming the boundaries between science and art, forcing the artists to question the possibility of communication between them. Kac noted that, "scientists were quick to ask if and how we were measuring the bird's and the plant's responses reveal(ing) a basic misunderstanding of our work on their part." [8] For the artists were concerned with producing symbolic, qualitative meaning, not with gathering and quantifying experimental data. This disjuncture between science and art parallels how the goals of artists and engineers using telerobots may also diverge, but at the same time offer each other important insights into different ways of creating meaning and value. In these ways, Essay brings into relief the myriad taxonomic, geographical, cultural, and linguistic boundaries to agency, if it is to extend beyond the problematic master-slave model, and if understanding is to be produced between disciplines, much less globally.

The master-slave model of robotics is a metaphor for human-machine relations. Because metaphor functions not only as the content but also as the concrete material form of artistic practice, it is of the utmost art theoretical importance that artists like Kac have sought alternatives to the hierarchical relationship of subject and object and the active-passive conditions of agency employed in most commercial and scientific implementations of telerobots. Indeed, for over decade, art historian Kristine Stiles has theorized that the conventional metaphorical function of art was appended by an interactive metonymical function that emerged when the human body became the primary medium and content of visual art. By introducing the possibility for a subject-subject relationship

between artist and spectator (that simultaneously entailed a subject-object experience of the artist as object before the spectator), Performance Art, she has argued, held the possibility for a more connected relationship. The inherently interactive situation of exchange between two subjects had the effect of altering the binary condition of alienation in the subject-object viewing conditions of traditional art, thereby enhancing interpersonal agency and reducing, although never completely eradicating, alienation.

In this regard, certain works of Telerobotic Art can also be said to employ the A principle of metonymy, contesting the hierarchical master-slave relationship of subject and object by cultivating active agency between equivalent subjects. As Kac has suggested, "the fascination robots exert on the population at large has unexplored social, political, and emotional implications. These implications must be coupled with the new aesthetic dimension of modeling behavior and developing unprecedented interactive communicative scenarios in physical or telematic spaces." The epistemological implications of these alternative models of behavior and agency are unclear. Nonetheless, it stands to reason that there are significant differences between the ways of knowing and being that emerge from a collaborative or rhizomatic exchange between active agents and those derived by an active agent controlling a passive machine. Kac's work is based on a model of co-mutual agency and therefore it conveys a message about the fundamental importance of transcending hierarchical relations and permitting all components of a communication network to participate actively in it.

NOTES:

[1] Eduardo Kac, "Foundation and Development of Robotic Art," Art Journal, 56:3 (Fall 1997): 60.
[2] Jack Burnham, Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century. New York: George Braziller, 1968. See especially chapter five, "Sculpture and Automata" and chapter eight, "Robot and Cyborg Art."

[3] Rafael Lozano-Hemmer, "Perverting Technological Correctness," Leonardo 29:1 (1996): 5. Lorne Falk is cited as the source of the term "technological correctness."
[4] Eduardo Kac, "Telematic and Telepresence Installations," in Visual Proceedings, The Art and Interdisciplinary Programs of SIGGRAPH 96, (New York: ACM, 1996): 137.
[5] In sociological terms, agency indicates the freedom to create, change, and influence institutions and events.
[6] On the concept of the rhizome, see, Gilles Deleuze and Felix Guattari, A Thousand Plateaus: Capitalism and Schizophrenia. Trans., Brian Massumi. Minneapolis: University of Minnesota Press, 1987.
[7] John Locke, An Essay Concerning Human Understanding. (Oxford: Oxford University Press, 1975): 43. Original emphasis and capitalization.
[8] Eduardo Kac, "Essay Concerning Human Understanding," project description published on the artist's website, (cited April 28, 1999).

This essay published by permission of the College Art Association, New York. It is excerpted from Shanken's "Tele-Agency: Telematics, Telerobotics, and the Art of Meaning", published in Art Journal 59:2 (Summer, 2000).

Edward A. Shanken is an art historian and media theorist whose research focuses on 20th century experimental art. He is editor of Telematic Embrace: Visionary Theories of Art, Technology, and Consciousness by Roy Ascott (University of California Press, 2001). Recent and forthcoming publications include articles on the history of art and technology, art and cybernetics, telematic art, artificial life and art, and interactive multimedia. He is a member of the editorial board of Leonardo Digital Reviews, and a participant in the Leonardo Pioneers and Pathbreakers of Electronic Art online project.
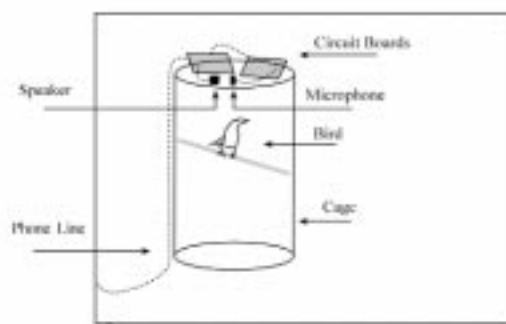
Essay Concerning
Human Understanding

Eduardo Kac &
Ikuo Nakamura, 1994

Inter-species telematic
interactive installation
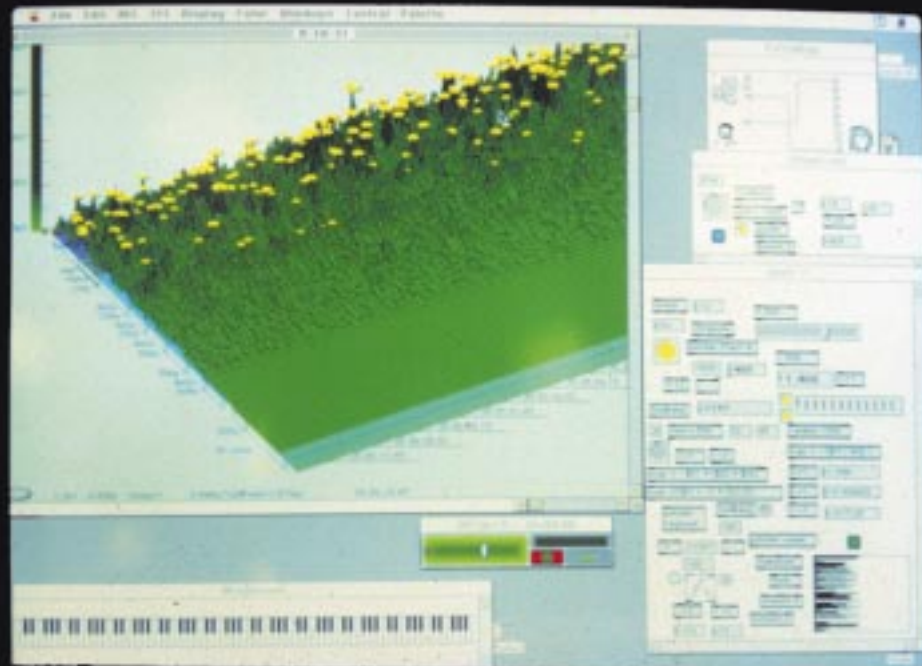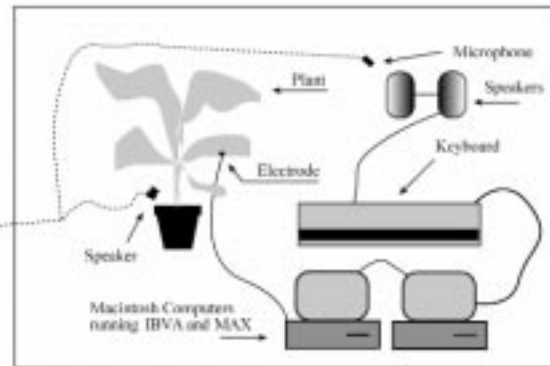
TIME CAPSULE: A SITE-SPECIFIC WORK BY EDUARDO KAC

Christiane Paul

The question of memory is experiencing a revival but the discussionsevolving around the topic aren't necessarily focusing on collective orpersonal recollections. Today's much-discussed memory is artificial, the storage unit of a machine, the information contained on a microchip–it is learned, not lived memory.

The relationship between memory, the body, and technology has undergone-profound changes. Technology has contributed to the continuous extrapolation of memory and at the same time has been invading our bodies. Early imaging technologies such as photography and film promised to be tools for preserving the moment–a time capsulecontaining memories that were once human-only. Yet, every choice ofperspective implies a form of manipulation and mediation of "reality"–by nature, images were never the most trustworthy agent in thepreservation of memory. Today, the representational era of the image isdefinitely gone. Not only have contemporary media created a globalinflation of the image, digital technologies have multiplied the possibilities of altering it.

Technological development also has a profound impact on our bodies andnotions of identity. Memory and identity were once understood as inextricably interconnected, and skin, face, and body were imprinted withexperiences and memories. Now plastic surgery and bioengineering haveturned the body into a modifiable sculpture. Memories can be chemically peeled off. Identity has become a matter of identification. In terms of memory, the body has been one of the lastfrontiers of technology invasion–a "site" hosting human-only instead ofartificial memory.

Eduardo Kac's "Time Capsule" crosses this frontier. Kac's radical approach to the creation and presentation of the body as a wet host for artificial memory and "site-specific" work raises a variety of important questions that rangefrom the status of memory in digital culture to the ethical dilemmas we are facing in the

age of bioengineering and tracking technology. By now we are used to thinking of objects as containers of memory–what are the ethical implications of turning the human body into a host for artificial memory?

"Time Capsule" is an "intracorporeal" art work that combines a local event-installation with a site-specific work–in which the site itself is both the artist's body and a remote database–and a simultaneous broadcast on TV and the Web. The event took place on November 11 at Casa das Rosas Cultural Center in Sâo Paulo, Brazil: using a special needle, Kac subcutaneously inserted a microchip with a programmed identification number (026109532) into his left leg. The microchip–a transponder with no power supply to replace or moving parts to wear out–is integrated with a coil and a capacitor, all hermetically sealed in biocompatible glass. After implantation, a thin layer of connective tissue forms around the microchip preventing migration. The scanning of the implant generates a low-energy radio signal (125 KHz) that energizes the microchip and causes it to transmit its unique and inalterable numerical code, which is shown on the scanner's 16-character Liquid Crystal Display (LCD).

At the event, Kac placed his leg into a scanning apparatus, and his ankle was then webscanned from Chicago (the scanner's button was pushed via a telerobotic finger). Kac subsequently registered himself in a Web-based animal identification database, originally designed for the recovery of lost animals. It was the first time a human being was added to the database–Kac registered himself both as animal and owner. The event was shown live on television in Brazil and on the Web.

The exhibition at the gallery where the event took place comprised seven sepia-toned photographs–shot in Eastern Europe in the 1930s–resonating personal recollections; a hospital bed; a computer wired to the Net and hooked up to the telerobotic finger, which was left pressing the scanner button (the scanner's LCD display showed the number retrieved from the artist's ankle until the end of the show). Also exhibited was a diptych combining an X-ray of Kac's ankle with an enlargement of the identification and recovery database interface.

Walking on the edge of dystopian surveillance and liberation from the machine, Eduardo Kac's work perfectly captures the ethical dilemma of fusing body and technology. "Time Capsule" might be considered an Orwellian dystopia come true. By now, videosurveillance, tagging, tracking, and identification technologies are forming a body of data–a "body double"–that threatens to slowly take over our identities. "Security" has become the major justification for surveillance systems but the constant need for identification isn't compatible with the idea of individual autonomy: we witness an invasion of technology into the most private spheres of the individual; autonomy surrenders to personal security. The conversion of personal traits–such as iris patterns and fingerprint contours–into digital data for the sake of identification doesn't exclusively belong to the realm of science fiction anymore. Implanted microchips might as well become the passports of the future, allowing the identification and tracking of the individual and offering the ultimate protection from crimes such as abduction.

Yet there are medical uses of intrabody microchips that seem to be perfectly acceptable. As Kac points out, the current successful use of microchips in spinal injury surgery has opened up an as yet uncharted areas of inquiry; bodily functions are stimulated externally and controlled via microchips. Experimental medical research using microchips that enable the blind to see by creating artificial retinas would be yet another example of the liberating effects of technology. Computers are now commonly seen as extensions of the human mind–"tools to think with." However, this approach distracts from the question in how far the human body has already become an extension of the machine.

As Kac explains, "the passage into a digital culture–with its standard interfaces that require us to pound a keyboard and sit behind a desk while staring at a screen–creates a physical trauma that amplifies the psychological shock generated by ever-faster cycles of technological invention, development, and obsolescence."

According to Kac, current interface standardization has led to an overall restraining mechanism for the human body, which is forced to conform to the boxy

shape of the computersetup (monitor and CPU). In this context, "Time Capsule" might as well be seen as a radical liberation of the body from the machine–a reconciliation of aspects still generally regarded as antagonistic, such as freedom of movement, data storage and processing. As Kac puts it: "The living body wants to get out of the uncomfortable box and have unrestricted motion."

The Web component of "Time Capsule" offers yet another perspective by making the body accessible to the machine. One of the major attractions of the Internet is that it has taken the detachment or flight from the body to new levels--it allows us to create virtual identities, to impersonate characters and construct multiple selves beyond physical limitations. This disembodiment has caused a shift in theawareness of the "other," which no longer can be sensed as a corporealentity. The webscanning and identification of a body over the Net reinstates a temporary coincidence between body and cyberbody; the temporal scale of the workcomprises the ephemeral (identification through webscanning) and the permanent (the implant itself). In a clash of the tangible and the virtual, "Time Capsule" frees the body from the machine and at the same time makes it permeable and readable to theInternet.

Originally published in Intelligent Agent, Vol. 2, N. 2, (1998) pp. 4-13.

Christiane Paul is a curator at the Whitney Museum of American Art, NewYork. She has written numerous articles on New Media Arts, Hypermedia and internet technologies, has presented at conferences worldwide, and has edited several publications. She is the author of Unreal City: A Hypertextual Guide To T. S. Eliot's The Waste Land (Eastgate, 1997). She has taught at New York University and Fordham University, New York.
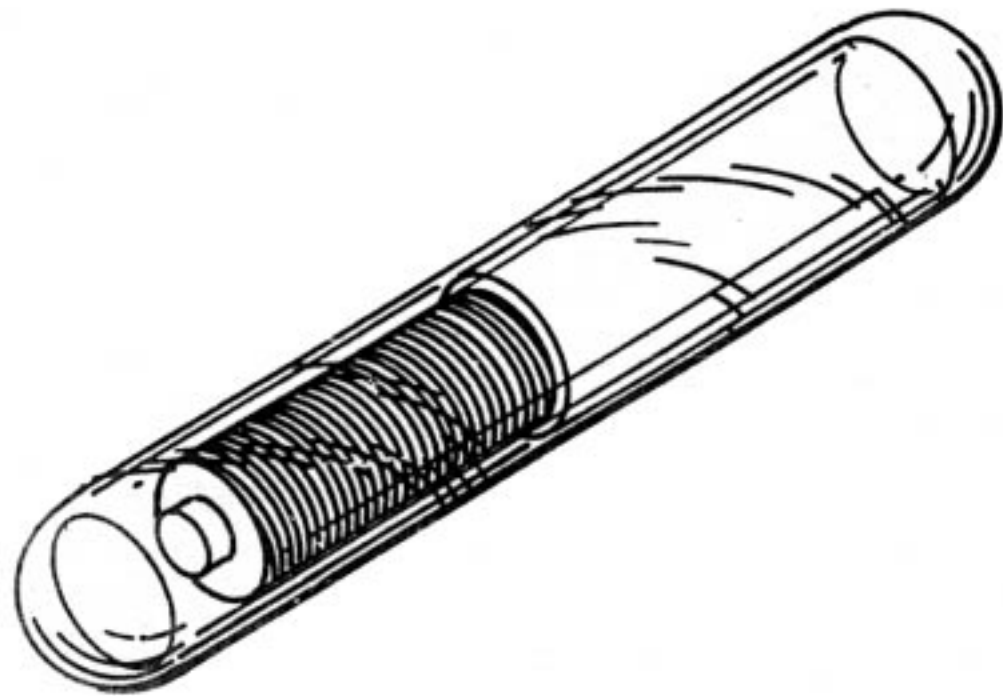
TELEPORTING AN UNKNOWN STATE ON THE WEB
Aleksandra Kostić

Is it possible for a plant to survive in the dark? Photosynthesis isimpossible without light. To survive plants need photons, the smallest parts of energy in electromagnetic waves, discrete particles which move at the speed of light. In the darkness of the Kibla Art Gallery viewers saw a plant sproutingfrom the earth, in the center of a rectangular field positioned on the floor. As participants on the Web engaged with Eduardo Kac's "Teleporting An Unknown State," they supplied the light necessary for the plant's survival.

Kac first realized "Teleporting An Unknown State" in 1996, linking the New Orleans Museum of Contemporary Art to the Internet through publicvideoconferencing (using free software available online). Participants were invited to point their cameras to the sky and teleportlight directly to the plant. The second version of the work presented at the Kibla Art Gallery, in Maribor, in 1998, was realized on the Web. In this version participants activateda global network of webcams directed at the sky of eight regions of the Earth, which caused light to be projected over the plant in the gallery. At first it appeared to be impossible, as gallery visitors waited for photons in the dark. One frequent gallery visitor, a chemist, was speculating that the photons would not be enough for the survival of the plant. He doubted that the teleportation of photons would work through the videoprojector.

As remote participants started to interact with the work we saw the Website projected on the soil floor of the gallery. As participants clicked ona portion of the grid representing the eight locations on the site, the dark areas gradually lit up. Live still images – in a grid of nine fields– displayed the sky of different cities, locations where webcams captured the sun light. The live stills projected by participants turned black again after sixty seconds, enabling other online participants to interact withthe work. Light was teleported from Chicago, Vancouver, Mexico City, Paris, Antarctica, Moscow, Tokyo, and Sydney. The webcam grid

on the site was organized as a standard map, fluctuating with the rotation of the Earth – it wasalways dark on the left or the right of the site projection. When we lookedcarefully at the map it became obvious that there was a geographical mistake, a gap. The plant in Maribor was in the center of the world map(in real time). Where is Maribor? In Slovenia, but it might as well havebeen elsewhere. Kac pointed out that centers are ephemeral and notpermanent.

Web cameras have a unique visual quality: their resolution is low and theirtransmission speed is limited. Precisely for this reason they have sparked a proliferation of distribution channels worldwide. Webcams represent global information without the luxury of the most sophisticated technology. That is why Kac decided to work with live still images, i.e., because he didn't need more than a portion of sky and the light they contain. He also avoided the slow transmission problems of telephone lines inseveral parts of the world.
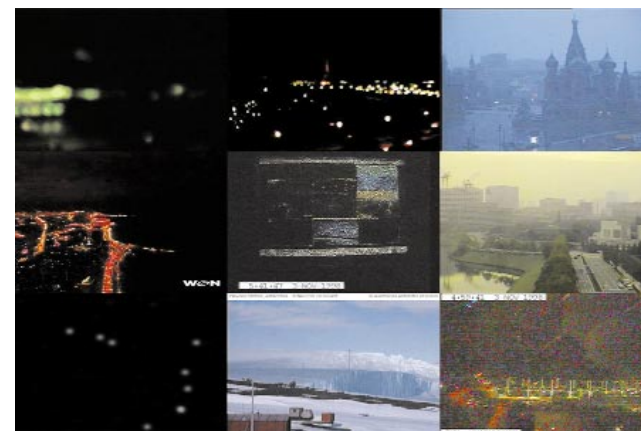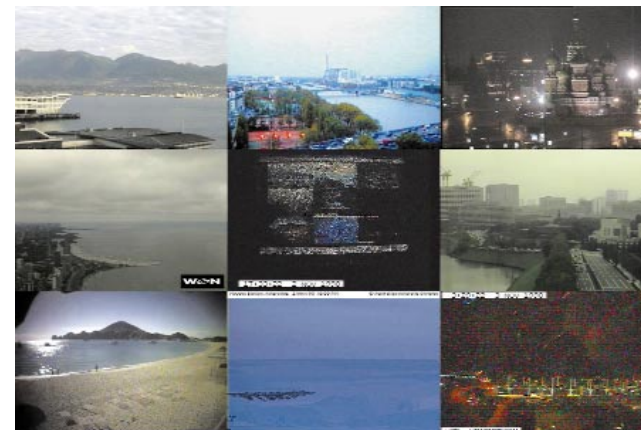
In "Teleporting an Unknown State" Kac uses the Internet in an unusual way. This unique piece contains several telecommunications aspects which connect the physical gallery space and the life in it, with the global technological infrastructure. There is also a certain dramatic suspense in questioning the possibility of a plant's survival. Adjacent to the Kibla Art Gallery there is the Kibla Internet Cafe. Gallery visitors also went to the Cafe and clicked on the web site, activating webcams which provided photons. The telecommunication segments are functionally used to feed the plant. Therefore "Teleporting an Unknown State" became a metaphor for the Internet as life support system.

Teleporting's Web site (1998) enabled the actions of web participants to have physical consequence in the gallery, so we candescribe it as a functional web site. As such it is a rare alternative to the standard, asynchronous, self-contained webart sites. In his project "Time Capsule" (1997) Kac implanted a microchip in his ankle, allowing the information in the chip tobe retrieved online. In "Time Capsule" Kac, for the first time, symbolically connected microbiological and social structures. In "Teleporting an Unknown State" Kac opened the domain of hypertextual links, which the Internet offers, but with highly controlled results,

keeping the project coherent and recognizable as an integrated whole. The unpredictable nature of global climate gave the project a unique rhythm and variability. The result was a negotiation between the coherence of the concept and the uncertain atmospheric conditions of the Earth itself. Providing energy, webvisitors worldwide had functional roles charged with the fundamental meaning of caretakers.

Two segments of the audience were established: teleaudience and localpublic. Together they formed a special synergy, captivated by the thrivingplant. For fourteen days the plant received the necessary energy in the dark Kibla gallery, which felt like an incubator. For gallery visitors "Teleporting an Unknown State" was amagical and mysterious installation. Because of its fragility the plant became a symbol of the tension between survival and extinction, for the world needs plants to survive as a whole. Kac's artwork exemplifies the capacity of the Internet to become a universal, poetic language.

Aleksandra Kostić is an art historian and a curator at the City Gallery, in Maribor. In 1995 she founded (with P.T. Dobrila) the TOX magazine, which focuses on new media art. In 1996 she co-initiated in Maribor The Multimedia Center Kibla: a gallery space, a bookstore, a cybercafe with free access to the internet and a graphic studio. In 1995 and 1997 she co-organized the International Festival for Computer Arts in Maribor. In 2000 Aleksandra Kostić became a final judge at the Webby Awards 2000 in the "arts" category.
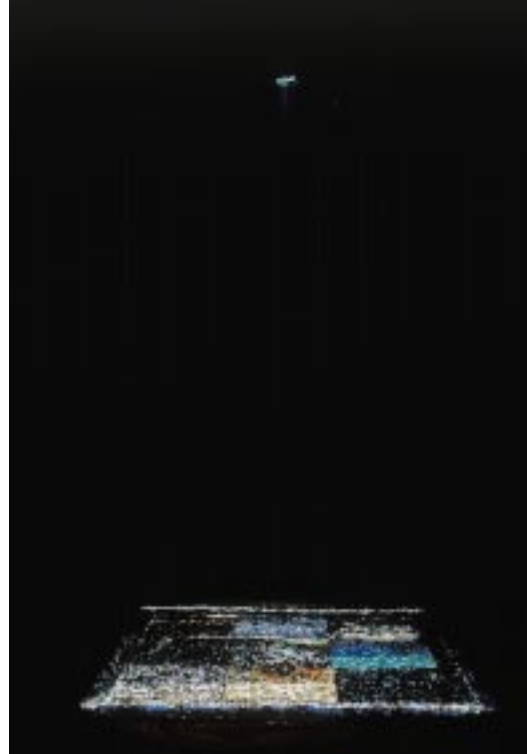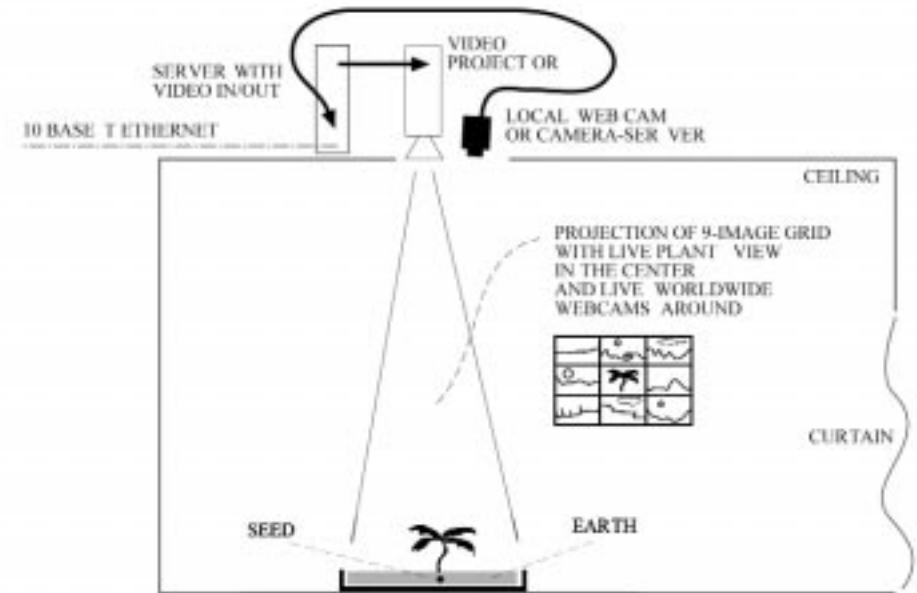
FROM A BAT'S POINT OF VIEW

Suzana Milevska

In his book The Conscious Mind, David J. Chalmers states that "from the physical facts about a bat we can ascertain all facts about a bat except the facts about the conscious experience. Knowing all the physical facts we still do not know what it is like to be a bat" [1]. We may agree with the assertion that if we know everything physical about certain creatures we can still not be certain if they are conscious (in the sense that we consider ourselves a conscious species). We may also agree that knowledge of physical facts about animals does not allow us to know what their experiences are like. Agreeing with both premises does not imply that we should give up on trying to get closer to those unfamiliar "others" and quit the attempt to explore the question "what it is like to be" [2] other than ourselves. For artist Eduardo Kac the question offers a unique opportunity to stimulate our imagination.

"Darker Than Night" was a telepresence artwork realized by Kac from June 17th to July 7th 1999 with a robotic bat ("batbot") and approximately three hundred Egyptian fruit bats living in the cave at the Blijdorp Zoological Gardens in Rotterdam [3]. This work is a profound attempt to investigate the possibility of empathy towards creatures (not necessarily only bats) that are different from us due to their specific sensory and motor system–the physical facts that determine their actions and experiences. In "Darker Than Night" Kac addresses the human-machine-animal relationship with a complex interface, enabling humans and bats to become mutually aware of their presence in the cave through the exchange of sonar emmissions. Humans can experience the cave through the batbot and can visualize the behavior of the bats through a special interface. The bats, on the other hand, can hear the sonar emmissions of the batbot.

Kac's provocative work is stimulated by the awareness that we cannot accomplish a thorough understanding even of our own consciousness and self and the fact that "no one has seen or ever will see a center of gravity, or a self either" [4]. This understanding echoes David Hume, who in 1740 wrote in his "Treatise of Human Nature": "I never can catch myself at any time without a perception and never can observe anything but the perception" [5]. In "Darker Than Night" Kac employs telepresence as a vehicle to investigate the link between perception and consciousness. "Darker Than Night" is not only about our ability to see or to adapt to conditions that are not ordinary for us and are natural to the bats but it is also about self-perception and the experience of perception and understanding of others.

The question posed here is not whether we can understand the physical facts about how bats move and communicate with each other. These facts are the subject of a body of scientific research which is widely available, and which Kac has studied. Through his writing [see note 3] the artist made sure that all details about echolocation as technique for orientation in dark space are transparently explained. In so doing, he makes us aware of the relevance of the scientific basis of the project and its establishing of a circuit of information, exchange and adjustment between the fruitbats, batbot and the visitors. However, the physical facts become only starting points for Kac's treatise on their own limitations. In "Darker Than Night" the biosonar echolocation system of the bats is converted to audible waves accessible to the human sensory system. As Eduardo Kac creates a world in which humans can have similar empathic experiences with another species, he expands the field of impact of his project from technology to culture.

Thomas Nagel warns us in his seminal article [see note 2] that it will not help us to try to imagine what it feels like to perceive the surrounding world by a system of reflected high frequency sound signals (fruitbats echolocate usually with 30,000 to 80,000 hertz that human ears can not hear). This warning is taken by Kac as an exciting challenge to our artistic (not scientific) imagination. Kac translated the sonar signals into the human audible range by a frequency converter placed inside of the head of the batbot. "Darker Than Night" is a network of relationships, a complex circuit of signals that circulate between human (visitor with a headset), animal (bats emitting and hearing ultrasounds as their "sense of vision"), and machine (batbot that simulates the real bats while echolocating in the same manner as them). This net of mutual experiences questions the prob-

lem of understanding the "other"–a member of another species, race, or culture.

"Darker Than Night" reminds us that all relevant physical facts are not enough to provide us with proficient answers to the question "what is it like to be". Given all accessible information, the problem of our unique experience (which forms the basis of our imagination) remains unsolved. It can obviously help us to try to understand what it would be like for us to behave as a bat behaves but it will not help us to know what it is like for a bat to be a bat [6]. Although the work extends our abilities beyond human perception, it seems that the main obstacle is still our restriction to the natural resources of our body and mind, which are, obviously, inadequate to the task. According to Maurice Merleau-Ponty, there is no method that permits us to extrapolate completely from our own condition to the inner life of another creature. We are determined by our own bodily structure and innate capacity, which sets limits to the human experience [7]. In other words, ultimately human experience can not be anything like the experience of other animals, no matter how close they are to humans on the phylogenetic tree.

The question of transferring data pertaining to one's inner experiences is closely related to the question of evidence for the existence of other minds pointed at the beginning of this text. The questions "what kinds of minds are there" and "how do we know" emerge from the fact that each of us know only one mind from the inside and no two of us know the same mind from the inside [8]. The substantial disagreements among scientists about the existence of other minds comes from the impossibility to confirm the coincidence of one's inner with one's outwardly observable capabilities for perceptual discrimination, introspective avowal or intelligent actions [9].

Obviously, this problem is not limited only to radically different creatures for it exists between one person and another. The subjective and nontransferable character of experience is evident among people and is an inescapable obstacle to any complete understanding of and communication with each other. Moreover, "once that the ability to represent your own structure has reached a certain critical point,

that is the kiss of death: it guarantees that you can never represent yourself totally" [10]. Cognition of self and in general "is not only representation but also embodied action: the world we cognize is not pregiven but enacted through our history of structural coupling" [11]. Therefore, the different subjective experiences prevent us from having the same "self" story to tell. Every human mind is culturally redesigned so that only our ability and desire to be engaged in "presenting ourselves to others, and ourselves" [12] and representing ourselves "in language and gesture, external and internal" [13] make us different from other creatures.

This idea that cognitive structures emerge from the kinds of recurrent sensorimotor patterns that enable actions and experiences to be perceptually guided might give the wrong impression that perception is direct and that there is no need for any kind of representation. In this sense, "Darker the Night" is more than a metaphor for the good human will to understand how it feels in one's skin. The batbot, the virtual reality headset, the converter of the high to low frequency sounds, the interface generated on a computer, all those elements may give the false impression that high technology is the "missing link" in the natural history drift that can help us to overcome the gap in the evolutionary history. However, Eduardo Kac has only used the technological devices to make and to provoke us to make the step forward to "a middle way" of understanding the relations between the mind and the world: not in opposition to each other but rather mutually constitutional. "Darker Than Night" shows how "knowledge depends on being in a world that is inseparable from our bodies, or language, and our social history - from our embodiment" [14].

The "middle way" would mean that we should accept as facts the capacities that are rooted in our biological embodiment but we should also accept that they are experienced within the domain of "consensual and cultural history"; that the idea of the world existing somewhere "out there" independent of the knower will never challenge our inherited conclusions of what the mind is. For the mind is not "a special inner arena populated by internal models and representations but is rather the operation of a profoundly interwoven system, incorporating aspects of brain, body and world" [15].

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NOTES:

[1] D. J. Chalmers, The Conscious Mind - In Search of a Fundamental Theory, Oxford University Press, New York, Oxford, 1996, p.103

[2] This question originates from the well known text by Thomas Nagel "What is it like to be a bat?", first published in 1974 and reproduced in Mortal Questions, Cambridge University Press, New York, 1979, pp.165-180

[3] The visitors view the bats and the batbot in the cave through a small window but they are given virtual reality headset so that they can receive the audio and visual information. Thus, the viewer's sight is transformed into the point of view of the batbot's sonar. The viewer sees a series of real-time kinetic white dots against a black background. The white dots represent obstacles encountered by the batbot's sonar. For more complete description of the project see: http://www.ekac.org/darker.html

[4] D. C. Dennett, "Self as a Center of Narrative Gravity" in F. Kessel, P. Cole and D. Johnson, eds, Self and Consciousness: Multiple Perspectives, Hillsdale, NJ: Erlbaum, 1992

[5] D. Hume, Treatise on Human Nature, I, IV, sec. 6, quoted acc. D. Dennett.

[6] T. Nagel, p.169

[7] H. L. Dreyfus, "The Current Relevance of Merleau-Ponty's Phenomenology of Embodiment", The Electronic Journal of Analytic Philosophy, 4 (Spring 1996)

[8] D. C. Dennett, Kinds of Minds - Toward an Understanding of Consciousness, Basic Books, New York, 1996, pp.1-19

[9] D. C. D. "Consciousness" in The Oxford Companion to the Mind, Ed. By Richard L. Gregory, Oxford University Press, New York, 1998, p.161

[10] D. R. Hofstadter, Gödel, Escher, Bach - an Eternal Golden Braid, Vintage Books, New York, 1989, p.697 There is interesting analogy between mind and ant colony that Hofstadter has developed in his book also questioning the existence of mind among animals.

[11] F. J. Varela, E. Thompson, E. Rosch, The Embodied Mind, MIT Press, Cambridge, Massachusetts, London, England, 1991, p.202

[12] D. C. Dennett, "The Origins of Selves", Cogito, 3, 1989, p.169.

[13] D. C. Dennett, "The Origins of Selves", p.169

[14] F. J. Varela, E. Thompson, E. Rosch, The Embodied Mind, p.149. Further on, in the chapter "Steps to a Middle Way" (pp.133-217) the authors discuss the Cartesian anxiety: in their opinion the extreme treating of "the world and mind as opposed objective and subjective poles".

[15] A. Clark, "Embodiment and the Philosophy of Mind", Trends in Neuroscience,19, 2 1996, p.36

Suzana Milevska is an art critic and curator. She publishes critical texts and reviews regularly in periodicals such as Flash Art, Index, Siksi, Nu, and Springerin. She has curated many individual and group projects in the Balkans, at the International Istanbul Biennial, in Turkey, and also in Sweden and the United States. She also participates in many art theory conferences and symposiums. Currently she works at the Museum of Skopje, Macedonia.
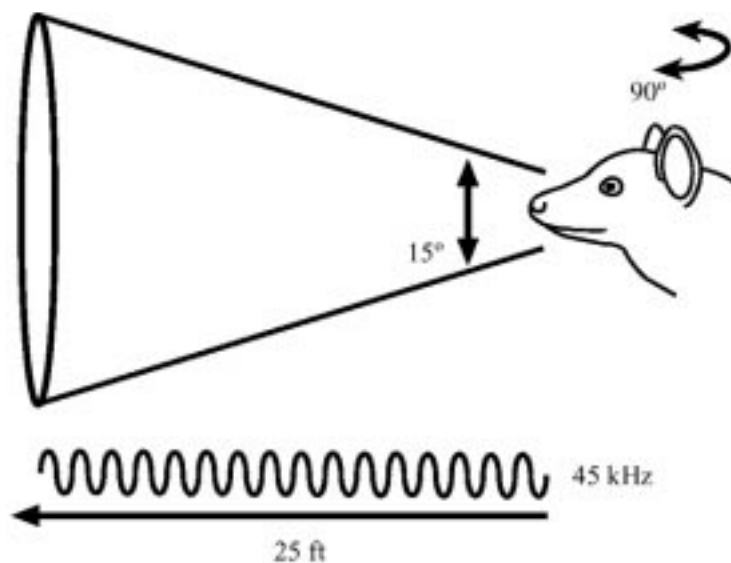
Morphology of the batbot's echolocation call. When the participant wears the VR headset the batbot's head swivels 90°, producing a 15° ultrasonic beam with 25 ft range. The batbot's emission signal peaks at 45 kHz.

Egyptian fruit bats
in cave habitat
(180 ft X 90 ft)

- Custom-made sonar
(25 ft range) to track
bat position and movement

- Ultrasonic system
(75 to 200 ft range)
to convert bat echolocation
calls (25 kHz to 100 kHz)
to frequencies within human
range (200 Hz to 20 kHz)

- Computer-controlled neck
swivelling 90° (activated by
the participant)

Batbot

Computer with VGA to NTSC conversion

Participant with
VR headset

FROM/TO BODY TO/FROM ROBOT
Machiko Kusahara

When Eduardo Kac showed his piece "Teleporting an Unkown State" at Siggraph 96, the public might have wondered how one could transfer sunlight via the Internet. A young plant was in total darkness in the Siggraph Art Gallery. If it did not receive enough light it would die.

In this project any participant from all over the world could capture the "photons" using one's own web camera and "send the photons" via Internet. The signals were transferred immediately to the computer at the exhibition site thus giving power to a projector hanging above the young plant. It was only the participants' collaborative will that kept the plant alive and growing. This plant grew from a seed without knowing the outer world and real sunlight.

"Teleporting an Unknown State" can be compared to Ken Goldberg's "Telegarden" in the sense that it involved a real plant, and that visitors from the network shared the responsibility in taking care of it. However, there is something very different in "Teleporting an Unknown State". It is an element that can be associated with the latter part of the title, "Unknown State". While non-material elements such as photons and the network are the medium or vehicle for such physical phenomenon as people sending enough light to a plant, we observe a strong desire for committment toward physical entity and the involvement of one's own body.

It might be deeply related to the fact that Kac was born and grew up in Brazil and then moved to US. Certain similarity can be observed with Stelarc who was born in Australia and lived in Japan for a while before he started using eletronic technology in his performances. Confrontation with different cultures inevitably brings a concern toward one's identity including the role of physical body. Also, artists such as Kac or Stelarc would say that they do not fully believe in the Utopia of cyberspace. In appreciating Kac's works, we gain a renewed sense of connec-

tion between the real and physical world and our own bodies, plants and animals.

Looking from the point of view of telerobotics, no mechanical or kinetic output was realized by participants via the Net in "Teleporting an Unknown State". Yet, the nature of physical (in this case optic) interaction it involves and the clever way to transmit such physical interaction over the Net can be regarded as another possibility in telerobotic art. However, among projects by Kac who is known as "telepresence artist", works such as "Ornitorrinco" and "Rara Avis" are more directly related to the notion of telerobotics.

The "Ornitorrinco" project started in 1989 and was developed with Ed Bennett. It was shown in many different configurations until 1996. In this project, participants could move around remotely on the body of a small robot using a live-video conferencing connection. "Ornitorrinco in Eden" took place in 1994, and was, together with Goldberg's "Mercury Project" (1994), the first telerobotic artwork on the Internet. The main issue in the "Ornitorrinco" project was the participants' experience and the process itself in real time over real space. The robot reacted to each input from participants rather than being programmed for certain goal or action, realizing "democracy" in the multi-user environment, according to Kac. Again, such awareness of democracy and real time/space shows Kac's basic attitude toward technology, interactive art, and society.

In "Rara Avis" (1996), a gallery visitor walks into a triangular room and finds a large aviary in front of her. There is a group of monochrome birds in the cage and a colorful large telerobot macaw. There is a VR headset on the pedestal. When the visitor wears the headset, she discovers that she is seeing through the eyes of the electronic macaw. The visitor then recognizes herself on the Head-Mounted Display (HMD) screen through the robot-bird's eyes, seen from inside the cage. As the viewer moves her head the same movement takes place with the macaw's head thus causing a change of viewpoint on the HMD.

Here, the identity of the viewer and its position is trapped in an endless loop

involving inside and outside, freedom and captivity, seeing and being seen, to manipulate and to be manipulated. The front of the cage separates the free space that opens to the outer world (remember, the room is triangular) from the captured state inside the cage that leads to a narrow end. The configuration of the space is metaphorical both in psychological and social aspect. From an epistemological point of view, telerobotic technology places the viewer both inside and outside the cage. It is said that we receive approximately 90% of the information we get from outside through our visual system. And our cognition is formed based on the input we get. Then, the consciousness of the viewer, in this case, should be floating in the cage, while her body remains outside the cage.

The work brings up questions about the reality of our life through contradictions, as is shown in the contrast between monochrome real birds and the colorful artificial (robot) bird in the cage. In our daily life we take it for granted that we live in a single, real world, with a single body and conscisouness – but is our condition really that secure?

With the advent of the Internet, living virtually in another community (or another space) is becoming an ordinary aspect of life. Having another 'self' in another world as an avatar is also possible. But then, where do we live – where are our bodies? Is the reality of life attached to the space one belongs with the physical body, or to the space one's consciousness belong to? Or do we belong to different spaces at the same time in a loop of switching realities? With his life belonging to different cultures in the real world, Kac visualizes the problems we will face in the near future with the layered metaphors in his work. Rara Avis is a work that can really be read in multidimensional ways.

Further expanding his previous telepresence work, in 1999 Kac realized a new telerobotic piece, entitled "Uirapuru". The piece was shown at the InterCommunication Center (ICC) in Tokyo, and won a major award at its Biennale. Roy Ascott, who was a member of the jury, commented as follows:

"Eduardo Kac eschews consolidation in favour of a kind of risk-taking hybridization, irreverently mixing not only communications media but modalities of myth, metaphor and representation. It is a risk that pays off poetically, providing us with a kind of Roussel/Rousseau world, in which pockets of cyberspace punctuate an almost mall-like plastic reality. Here the pingbirds sing the song of the Internet, the telerobotic blimp rises over a forest of fake vegetation, awakening us to the dawn of a new world, a multi-user universe, of VRML, streaming video and telepresence. In this jungle of communications complexity, the duality of being is celebrated with a lighthearted and brilliantly orchestrated joy." [1]

It was a breathtaking sight that a visitor encountered at ICC, as one entered Kac's space on the fifth floor of the Tokyo Opera City Building, in Shinjuku, the heart of the business district in central Tokyo. An enormous fish, which was a radio controlled blimp in tropical colors, floated in the sky above the canopy of palm trees and other tropical vegetation inhabited by a few tropical artificial birds. The trees looked quite realistic, but a closer look revealed they were artificial as well. There were two winding paths in the forest which led to a bench. The visitor was invited to stop and rest. The physical world in the gallery was simulated in the VRML world which one could see on one of the flat screens at the rim of the artifical rain forest. Visitors experienced seamless interactivity both in real space and virtual space on the Net, forming their own narratives as they negotiated the multiple layers of agency enabled by "Uirapuru".

Kac explained the piece as follows:

"The word "Uirapuru" is the name of both an actual Amazonian bird and a mythical creature. In the rain forest the bird Uirapuru sings once a year, when it builds its nest; even then, only from five to ten minutes early in the morning. According to the legend, Uirapuru's song is so beautiful that all other birds stop singing to listen to it. Both in legend and reality Uirapuru is a symbol of rarefied beauty. (...) My version of the legend presents Uirapuru as a flying fish and reinvents Uirapuru's dual status as a real animal and a mythical creature through an expe-

rience that is at once local and remote, virtual and physical. Uirapuru's own spirit is hosted by a virtual fish, who flies and interacts online in virtual space with other virtual fish. (...) The telerobotic fish hovers above a forest populated by colorful pingbirds. Pingbirds are telerobotic birds that send ping commands to servers geographically located in the Amazon region (where the rainforest is located). The pingbirds sing the songs of real Amazonian birds according to the rhythm of global network traffic. In "Uirapuru" greater Internet traffic results in the telerobotic birds singing more often." [2]

As I sat down on the bench, watching the whimsical fish hovering peacefully above the forest canopy while listening to the "pingbirds" sing, the strange feeling I already had since I had entered the space grew stronger. The strange feeling was about the "physical reality" of the space. The artistic/artificial walk-in diorama of the Amazonian rain forest is the multiple layered interface between the real, physical world, and the virtual world. We believe the Amazon rain forest is natural. We believe we live in a real, physical world. But the physical world in the gallery, the rain forest, is already totally artificial. The bird which sings the spirit of the rain forest in the Amazonian myth has turned into a plastic fish, floating in the air.

But that's not all. Everything in the gallery, the physical space, seems to have a double meaning or a double state. The two worlds interact with one another via both physical and digital interfaces. Uirapuru, which is a bird in reality and in legend, is represented as a fish, which usually lives in a different world. Birds in this physical space represent the information flow on the Internet with digitally recorded songs of the real Amazonian birds. In the gallery we can manipulate the blimp, which observes us from above and broadcasts what it sees. The blimp resists complete control, as it is not possible to make it stop in mid air with absolute precision. At the same time the blimp is being observed, under constant surveillance. Here again, like in Rara Avis, we find ourselves within an endless loop of contradicting states, to see and to be seen. Our consciousness seems to hover above the edge of physical space and its counterpart in virtual reality.

Artificial Reality, was the term we used before the phrase Virtual Reality became popular. Maybe the term should come back. In "Uirapuru" Kac offers a mythical world in an intentionally lighthearted way. In this world, experience oscillates between being present and being telepresent, between being oneself and being something else. In this work Kac shows that real and virtual constitute each other and that their boundaries are no longer firm or evident.

NOTES:

[1] Ascott, Roy. "Judge's Review", in ICC Biennale '99; Interaction. (eds.) Komatsuzaki, Takuo. Kawai, Haruko. (Tokyo: InterCommunication Center, 1999), p. 55.
[2] Kac, E. "Uirapuru", published by the InterCommunication Center as a gallery leaflet and distributed during the Biennial (1999). Also published online at: http://www.ekac.org/uirapuru.html.

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Local blimp control

Sonar

Uirapuru

Video

pingbirds

Local a vatar control

Virtual world

Blimp control from Web

Virtual world data from Web

ping commands

Audio and Video to Web

Virtual world data to Web

INTERNET

18 ft (6 m)

For local Uirapura navigation please pick up and move the fish

For navigation in the virtual world please pick up and move the fish
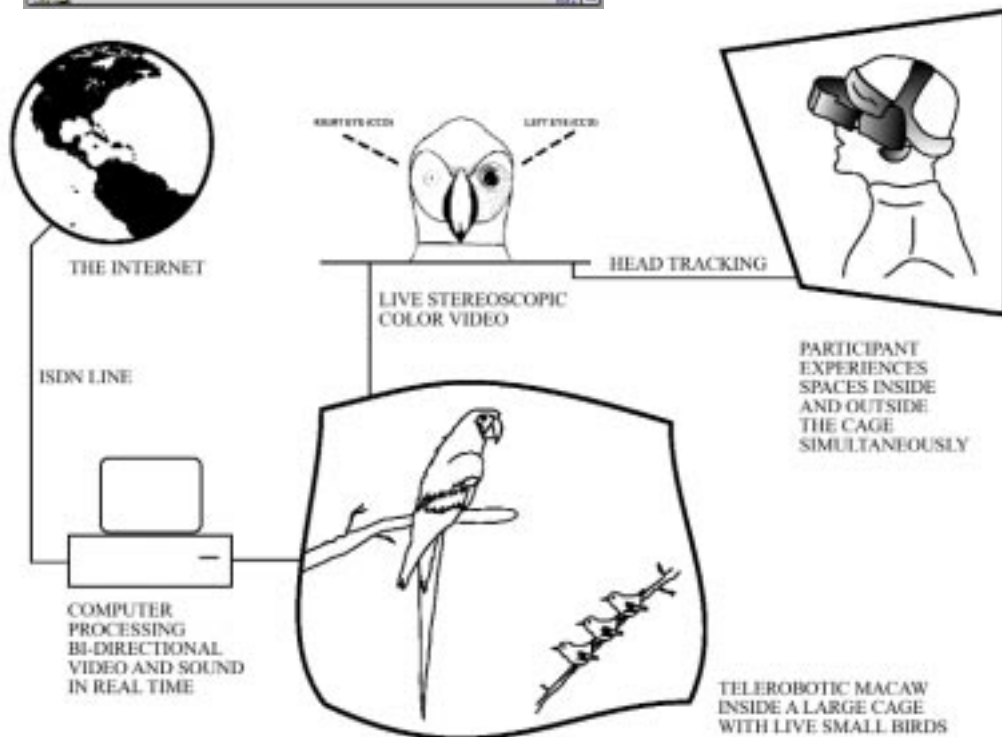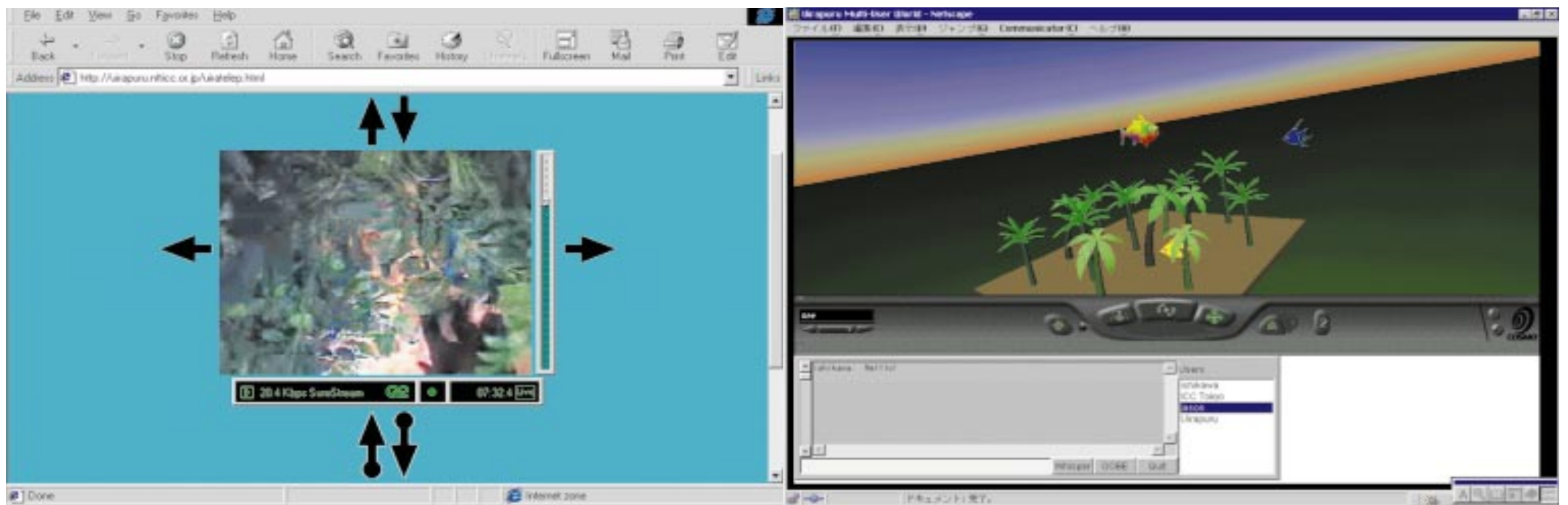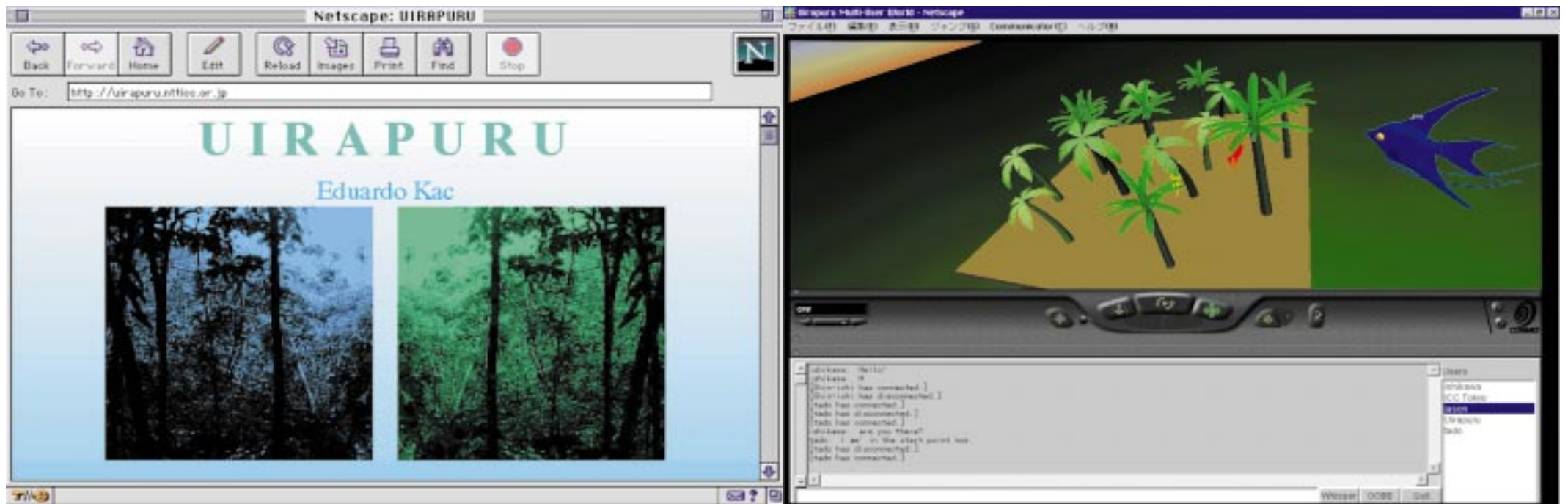
UPRISING

Gefried Stocker

"It is less a question of the artist interpreting the world than of allowing existing or hypothetical biological processes, mathematical structures, social or collective dynamics, to speak directly. In this sense art no longer involves the composition of a 'message' but the creation of a mechanism..."

Pierre Levy

Eduardo Kac could be described as a prototypical representative of the new art that has emerged as a direct analogy to the digital revolution and the information theories and technologies, on which it is based.

Like a researcher, he is constantly in search of new methods and tools, scanning the territories of technical science with in-depth analysis to find new forms of expression for his artistic intentions and to expand his repertoire of artistic material. Now, following holography, telerobotics and the Internet, molecular biology is the new field of natural science in which his artistic work is located.

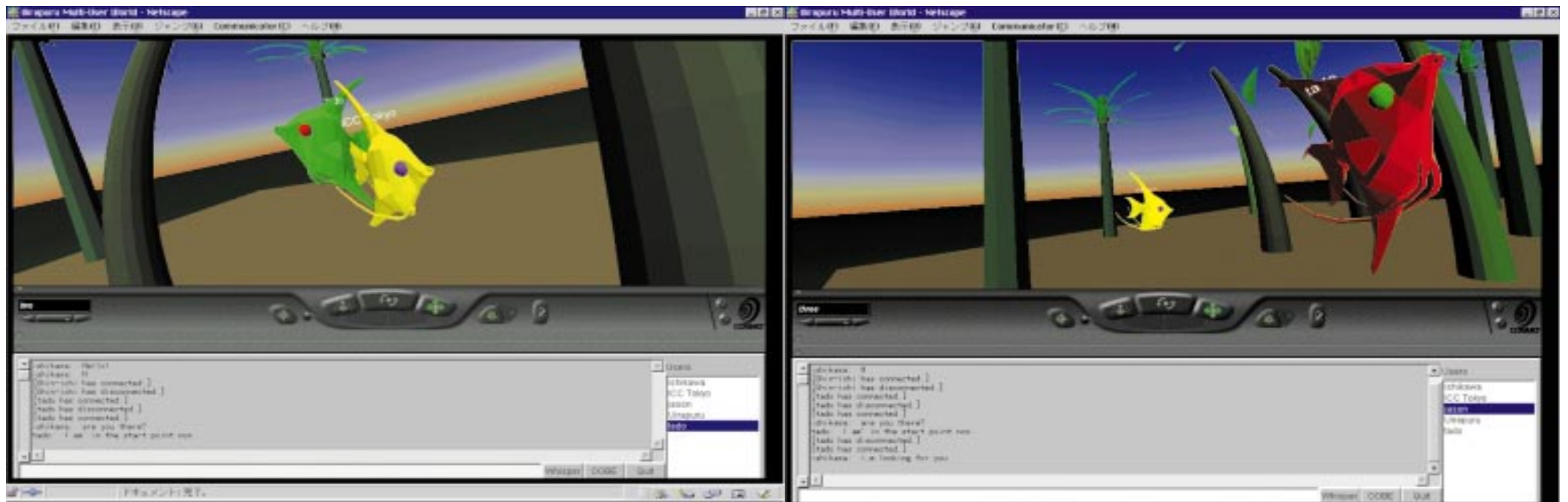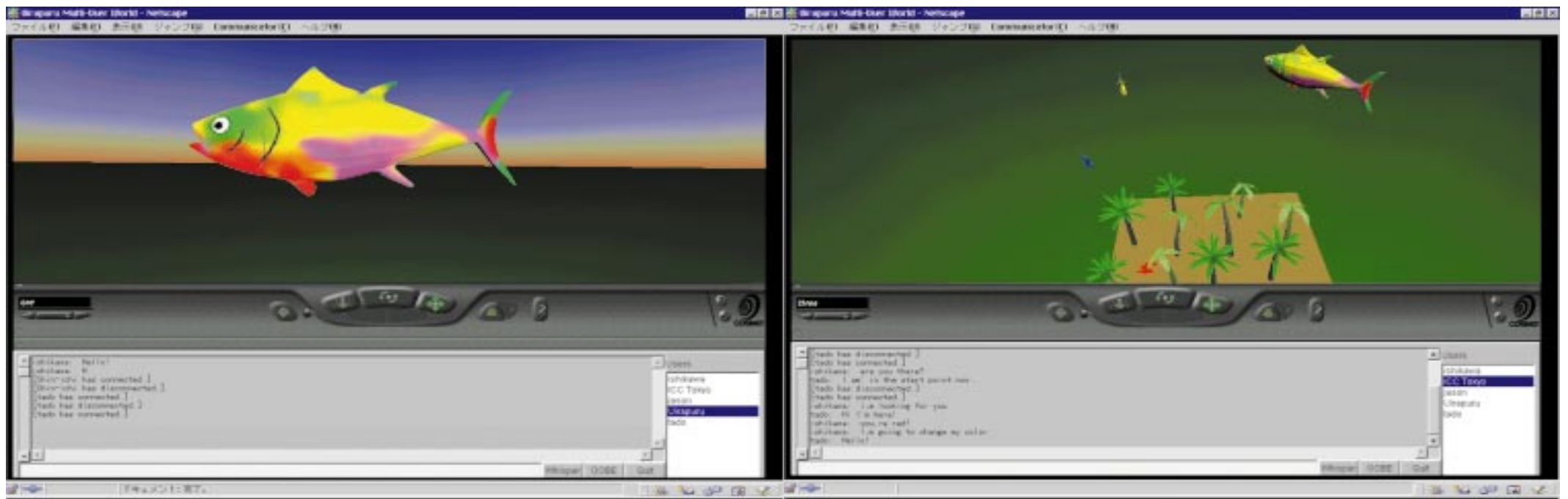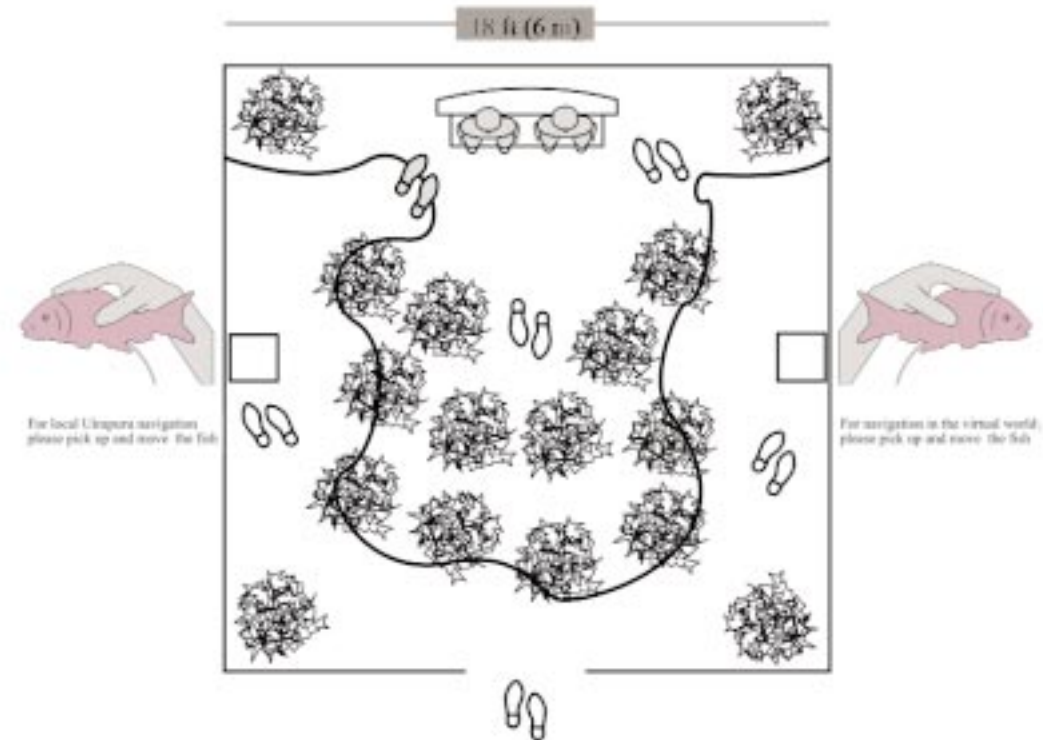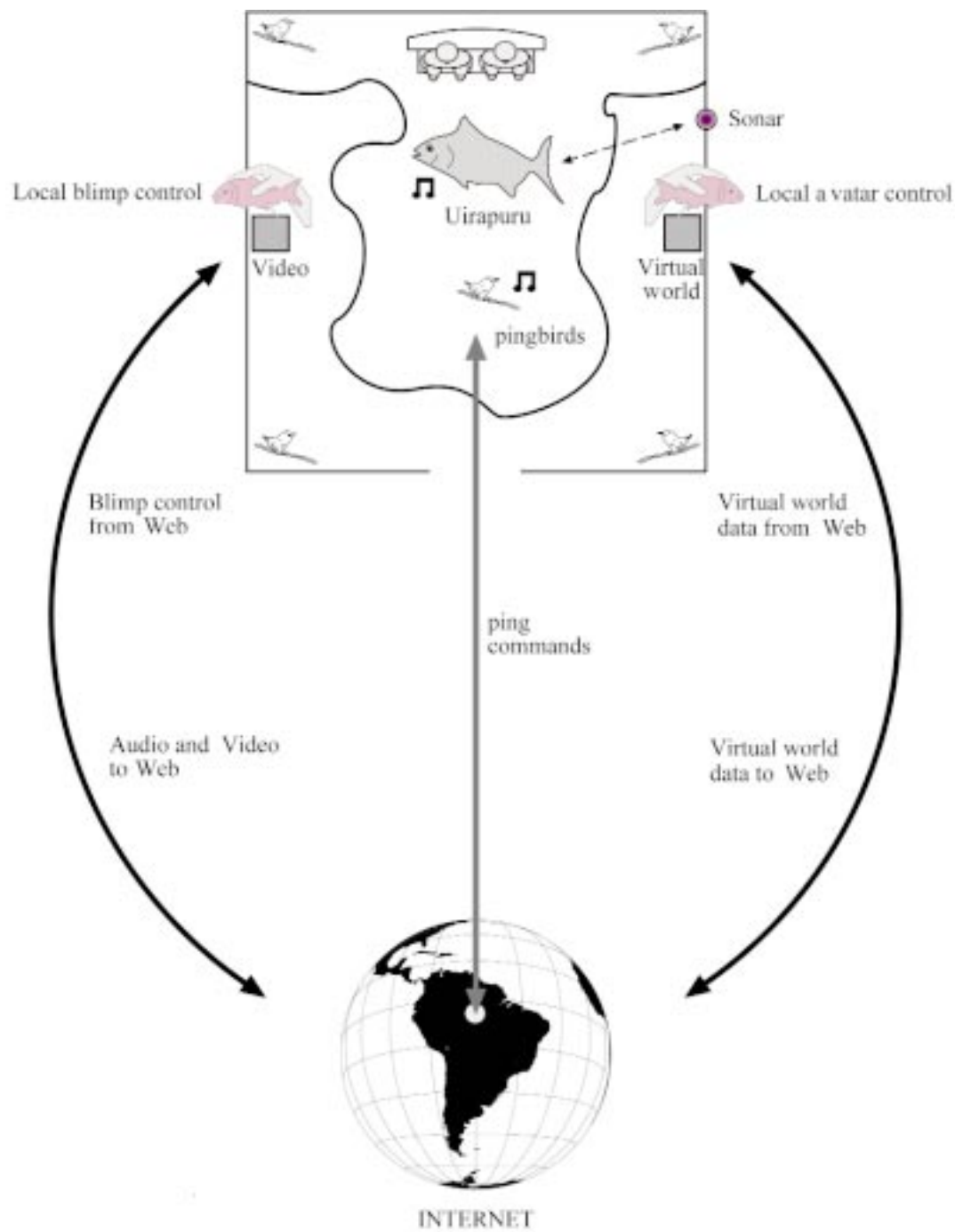Rather than limiting himself to the role of interpreting or commenting, he intervenes directly in the technical-systemic and social-structural constituents, not merely to change traditional artistic patterns and behavioral schemata, but rather to re-invent them. His strategy for this is to approach the topic with ever new premises from constantly changing perspectives.

Even in his holographic works in the early eighties, which he characterized as "holopoetry", he was not so much concerned with the possibility of the three-dimensional representation of objects as with the use of temporal processes for language in an image-based medium. He dissolved the linearity of the work, in favor of an almost hypertextual presentation, in which the role of the observer is expanded into that of an active recipient. These holographic language pieces are among the few attempts to develop new directions for experimental poetry with the technical possibilities of new media.

The majority of his previous work has involved telecommunications and telepresence. Kac's central concern has been the perception 'of reality at a distance and the communication of presence. Consequently, even in his early telerobotic projects the body and its sensorial potential has always been the focal point.

The human-machine interface, taken in a broader sense as a context for experience, is also seen in works such as "Ornitorrinco" (1989), developed with Ed Bennett, or even more elaborately in "Rara Avis" (1996), an interactive telepresence installation in which a telerobotic bird-machine is enclosed in a gallery aviary with real birds. Using data glasses or via Internet, visitors are not only able to control the head of the cybernetic bird, but also to assume its perspective and observe themselves from the point of view of its camera-eyes.

In addition to the biorobotic work "A-Positive" at ISEA 97 in Chicago, Eduardo Kac has opened up new artistic territory in particular with his "Time Capsule." As part of an exhibition project, on November 11, 1997, he implanted an identification microchip (like those used to find and identify lost or stolen animals) in his ankle and registered the code stored in this chip in an international database. What this work questions, in addition to the issue of the unremitting surveillance of the visible human, who is made so through information and genetic technologies, is primarily the increasingly more complex and far-reaching processes of connecting living beings with machines.

Eduardo Kac calls "transgenic art" the new artistic terrain that he traverses with genetic engineering, and with his project "Genesis", shown for the first time at Ars Electronica 99, he demonstrates how this is to be understood. In "Genesis" a synthetic gene crafted by the artist and embodied by bacteria encodes a passage from the Bible. The gene mutates live through the Internet as Web participants activate a source of ultraviolet light in the gallery, thus changing the original meaning of the text.

Artists such as Eduardo Kac are working on proposals for our immediate future, in which the traditional differentiation between natural and artificial, which has been constructed along the lines of the concepts organic and self-organized for living beings and externally determined for machines, will no longer be valid. This is a development that challenges us to a new self-comprehension as human beings not only at a philosophical level, but also and at least as much at the level of so-called ordinary common sense.

If we go on from the representation and simulation of life to the creation and shaping of life, then this is an area from which art cannot abstain.

Originally published in the catalogue of "Genesis", O.K. Center for Contemporary Art, Linz, 1999, pp. 41-43.

Gerfried Stocker is an artist and co-editor of several books, including ZERO–The Art of Being Everywhere (Graz : Vertrieb, Leykam, 1993) and LifeScience (Vienna ; New York : Springer, 1999). Since 1995 he has been the artistic director of the Ars Electronica Festival and the managing director of the Ars Electronica Center, Linz, Austria.
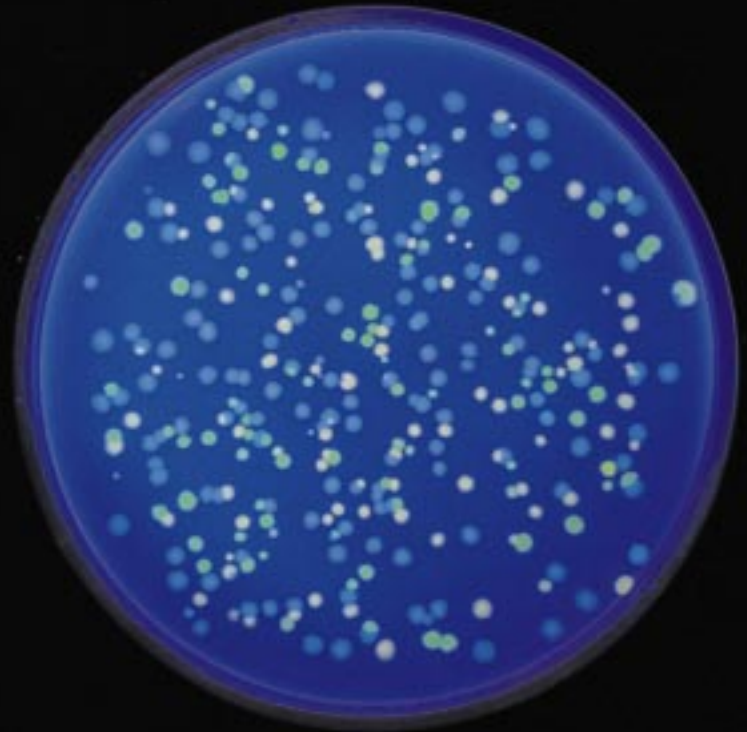
(GENE)SIS

Steve Tomasula

In the Beginning, God said, "Let us make man in our image, after our likeness," and He formed man of clay and breathed into his nostrils the breath of life, punning adam, Hebrew for "man," with adamah, "earth." Soon afterwards, Adam, in God's image, created language-Man's first creation-his every utterance the birth of another word as he cried out names for the other animals in Eden. Some seven thousand generations after Adam (according to DNA theory), Eduardo Kac creates the transgenic art work Genesis, re-enacting these primal conflations of language and earth and by doing so reanimating the myth that is most central to the West's conception of humankind, nature and progress.

Entering the exhibition space of Genesis, the viewer stands before a large projected image: a circular field suspended in blackness and reminiscent of astronomical photographs-a sky filled with galaxies, each composed of millions of suns-circled by how many Edens? As in those photographs, though, scale belies creation. For the God's-eye view afforded by Kac's Genesis comes from a micro-videocamera not a telescope, and the "galaxies" are actually bacteria in a petri dish. Each bacterial body is written in the same genetic language as our bodies, as are all bodies, even if some of them carry a gene unlike the genes of any body. That is, in Kac's eden, some of the animals carry a synthetic gene he fashioned, not from mud, but by arranging genetic material into an order that did not exist in Eden, and today does not exist in nature.

Specifically, Kac's genesis begins with the genetic alphabet: the chemical bases, Adenine, Guanine, Cytosine and Thymine, abbreviated as A, G, C, T. By chaining together, these chemical bases make up the rungs of the DNA molecule, the double-helix whose sequences of letters-genes-serve as both blueprint and material for the creation of life. Just as the dot-dot-dot | dash-dash-dash | dot-dot-dot of Morse Code can form a message, here an S-O-S, sequences of three genetic bases, e.g., AGC | GCT | ACC, form particular amino acids. Particular strings of
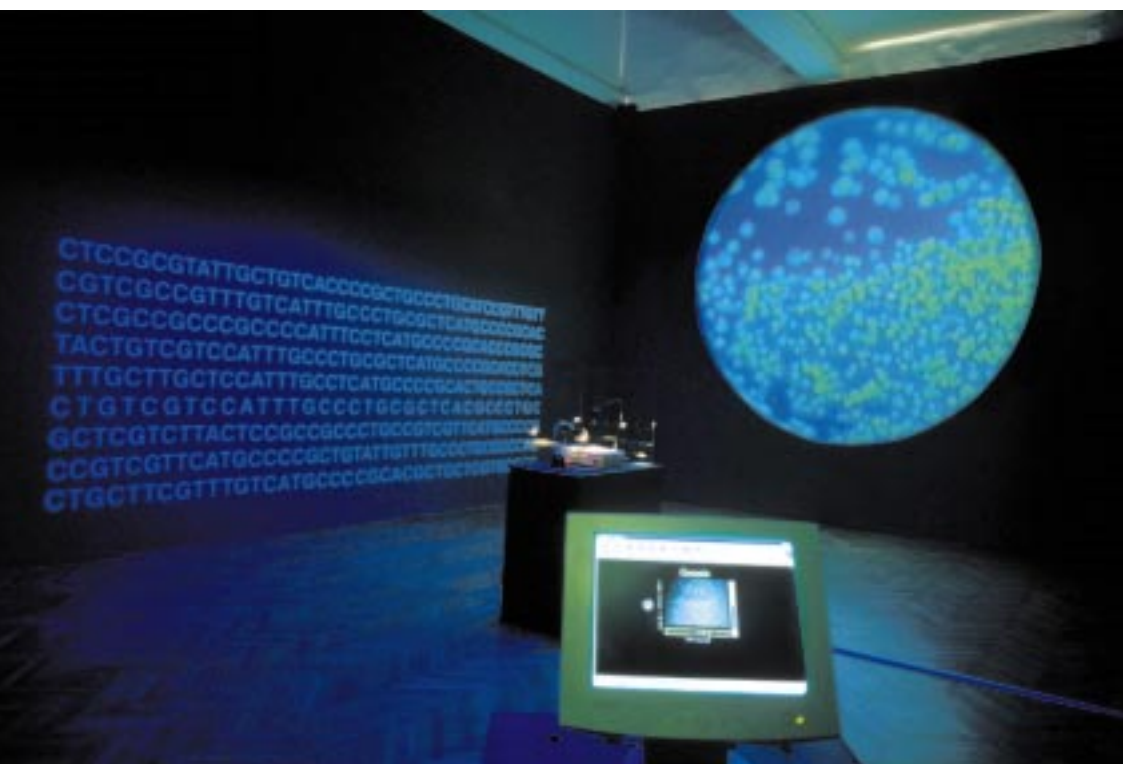
amino acids form particular proteins, while particular proteins form the particular cells of particular organisms, be they a serpent, an apple, or the rib of a man. Thus each DNA molecule is both material and message, both the book and its content: a book that is its message embodied. Alter this sequence, and the new message will produce a different book: a mutation, for example, that brings into existence the larynx that allows human speech, or a Frankenfruit, as environmentalists refer to genetically engineered fruits and vegetables. Or the cells that make up the bacteria in Genesis.

While the sequence of letters that make up the "artist gene" in Genesis are artificial, though, they were not arbitrary. Significantly, they embody a sentence from the Biblical Genesis: "Let man have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moves upon the earth." To translate this natural language into the language of the cell, the AGCTs of DNA, Kac used Morse Code as an algorithm. The dots and dashes of Morse Code easily translate into the 1s and 0s used by a digital computer to represent the alphabet-information in a form that can easily be sent around the globe or across the microscopic distances within an integrated circuit. Similarly, in Genesis, information is given its physical corollary: after translating the biblical passage into the dots and dashes of Morse Code, the dots were replaced by the genetic base Cytosin (C); dashes were substituted with Thymine (T); word spaces were replaced by Adenine (A); while letter spaces replaced by Guanine (G). This unique string of AGCTs constitutes a gene that does not exist in nature, an "art gene."

The "art gene" carrying the coded biblical passage was then combined with a protein that glows cyan when illuminated by ultraviolet light. Both protein and art gene were inserted into a species of E. coli similar to that found in the human intestinal tract but which is unable to live outside of the medium in the petri dish. Art and science are thus collapsed into one another through two characteristics of E. coli: its ability to carry DNA from unrelated organisms, and its facility for self-replication. Together they make E. coli useful as a living factory for geneti-

cally engineered products, such as insulin; they also allow it to function as a microscopic "scribe" copying out the narrative carried within the "artist gene." These genetically engineered bacteria were then placed in a petri dish along with a strain of E. coli that will glow yellow under an ultraviolet lamp but that do not carry the Genesis gene.

Like one of the seventy scholars who first translated Genesis from Hebrew into Greek, then, Kac has translated Genesis into a new language, and like them, embodied it in a "book" that is both a product and reflection of his times. Consider the illuminated manuscript, and how its body expressed medieval culture. Its materials were all natural, its text linked to the earth by inks and pigments extracted from minerals, berries or flowers, and scratched onto sheepskin with quills from a goose. Writing the text was an act of physical as well as mental labor. The words themselves were written with no separation just as creation was thought to be a single parchment, God's book, an uninterrupted Great Chain of Being from the lowest dregs to the celestial spheres where, as Augustine put it, "the angelic and blessed pass their nontime reading a language without syllables, a text that is unequivocal and eternal because it is the face of the Word itself." In Eden, it was believed, God, man, and animals all spoke the same language in which words and things had the direct one-to-one correspondence Adam gave them. Or as Emerson later put it, "Every word was once an animal." In this way, written words were natural objects: visible traces of God's mind, as was the rest of the world, shapes that could be read for meaning just as a later age taught itself to read the history of weather in the rings of trees. Letters, words, sentences, pages merged into sacred books of mysteries serene as the primum mobile in their gilt capitals and painted illustrations, their ornaments and imposing page layouts, displayed on high altars for the adoration of the faithful.

Few of the materials of Kac's "book" are natural-even its biological materials are highly mediated by technology. Yet this fact is barely noticeable, seeing as it has become "natural" for us to spend most of our time in artificial light, artificial heat, eating and sleeping not when we are hungry or tired but when the clock says it

is time. In the dim temple-like atmosphere of a gallery, viewers are drawn closer by the beauty of Genesis, its projection of the petri dish, round as a rose window, and luminous as stained glass. A diffuse blue light reflects off lettering on walls that complete what can be thought of as a triptych: on the right-hand panel are the words extracted from the biblical text, "Let man have dominion over every living thing." The left-hand panel displays its genetic translation-the string of AGCTs used to encode the biblical passage in the bacteria, printed out in a computer's block letters without separation just as genes are found before mapping reveals the mystery of their identity and function. The gallery space is thus transformed into a polyglot in which the same passage is presented in three languages: a natural language, a language of chemicals, and Morse Code, that first electronic language, whose first transmitted words-"What hath God wrought?"-ushered in an age of global communication. Reading this polyglot, we begin to understand how to a contemporary sensibility all the world is a text-even unto the lowest dregs commonly found in the colon-and how, like that world, Kac's book is densely coded. Standing at a pulpit that presents the petri dish as if it were an open book, viewers/readers realize that what they have been admiring in Kac's staging is the beauty of bacteria, the beauty of the flower in the crannied wall, that if understood, could reveal all in all.

Yet the artistry and significance of Genesis is not in Kac's creation of aesthetic objects. Rather, its meaning unfolds as its viewers participate in the social situation he has orchestrated. Visiting Genesis at home via the Internet, or by using a computer in the gallery that is likewise networked through the Internet, viewers constitute a world-wide community able to write upon Kac's text. By clicking their mouses, they control an ultraviolet light trained on the petri dish. When they do, the "rose window" flashes blue as if animated by a primordial spark, the bacteria glow. The bacteria carrying the text of Genesis as part of their bodies give off cyan light; those without it give off yellow. More importantly, as viewers activate the ultraviolet light they become Kac's co-authors by accelerating the natural mutation rate of the bacteria. Some descendants retain their original color, others exchange plasmids with one another and give off color combina-

tions, such as green, while still more lose their color. Operating the light to observe this evolution within Kac's microcosm, the viewer realizes how impossible it is to walk in the Garden without altering it. Looking down upon this microcosm, finger on the button, it's hard to not want to alter the bacterial garden if for no other reason than to see what will happen. Understanding that changing the bodies of the bacteria also changes the message they carry, we realize that the seduction of Genesis is also the seduction of science-word and body, art and world-all intimately linked.

No one knows the origins of Genesis-the biblical text Kac incorporates into his microcosm. For centuries it circulated in various forms along with other creation myths until it was written down, sometime in the 8th century BCE. Thus, as is said of the Odyssey and other scribal texts, the "author" was the aggregate of all the people who wove and rewove oral teachings, reworking, corrupting and embellishing the stories to fit their circumstances. This is why the inconsistencies we find in Genesis today, including two contradictory stories of creation, were of so little consequence to those first "users" that they could all be taken up and passed on together. As biblical historian Karen Armstrong writes, believers of all three monotheist religions regarded the creation of a myth in the best sense of the word: as a symbolic account which helped people to orient themselves to ontological, and theological questions as well as their present circumstances. It was only long after Genesis was written down that it began to ossify into an official doctrine believed to be factually true.

Indeed, contemporary scholars distinguish between the open text of scribal cultures, and the closed text of print cultures: that is, between the text that is continually turning into new versions of itself, and the text that has reached its final form and is thus closed to revision. In the middle ages it was common for readers to add their comments to a manuscript by writing between its lines, or in its margins, altering a text as they saw fit and passing it on as though the alterations were part of the original book. Since "original" was thought to be "that which was there since The Origin," writing was an act of proliferation, not the "cre-

ation" of a unique utterance. Conversely, reading was the act of eliciting from a text that which had remained hidden, or unspoken. In this sense, every text was ripe with more than it said, with myths being the most open of texts, the most incomplete in that myths held the most potential meaning. Conversely, the authority of a text resided in its ability to remain fecund, to be the first word, not the last word. Midrash, the Jewish practice of scriptural explication, was (and to this day still is) the practice of incorporating all of the previous commentary into the text. The text itself was conceived of always being in need of refiguring to present circumstance. That is, the point of Midrash was not literal interpretation, but to guide people through the complexities and contradictions of their own lives, their own moment in history. The text in this sense was always being made new. And since making it new was figured as a way of life, it was obvious who had the authority to say what the text meant. It was obvious who had the responsibility to understand what it meant: Everyone.

Similarly, Kac's Genesis opens itself up as a myth for our times in the sense of poet John Dryden's description of translations as "transfusion," i.e. the transfusion of new life into an old text. The thousands of people who transmitted the Biblical Genesis as oral teachings, its co-authors, finds its corollary in Kac's co-authors: the thousands of engineers, scientists and technicians upon whom Genesis's existence depends. Their labor offers up a vocabulary of "gene splicing," and "interactivity," and "nucleotide polymorphisms" without which Kac's Genesis couldn't be written. Incorporating the traces of this labor as layers in his own palimpsest, Kac creates an allegory of Origins, of Nature, and man's relation to them. By enabling ordinary readers all over the globe to join in the rewriting of this text, he stresses the communal nature of allegory-how authorship itself has become communal in an age when physical diaspora is mitigated by global communication, a development anticipated by Morse Code. Indeed, at the turn of our century, the increased speed and interaction of global communication has accelerated an evolution of reading as the practice of reading between the lines, to reveal all that is unsaid. Grande Historie has become petite histoires in which the body has been the only closed book-a naturally impermeable text that could be re-read, but not re-written.

But biotechnology has opened up ever wider spaces for new authors to write between the lines, just as biotechnology revealed how the structure of E. coli bacteria would allow Kac to copy in the text of Genesis. With the sequencing of the gene, the practice of rewriting "the fish of the sea, fowl of the air and every other living thing" is becoming so common as to precipitate a shift in our conception of nature analogous to the shift in the conception of earth at the advent of the telescope. Those critics of Copernicus who refused to accept that the earth revolved around the sun, Thomas Khun wrote, were not entirely wrong. To them, "earth" meant "fixed, immovable position." Looking through Galileo's telescope and seeing evidence for the earth's orbit and rotation thus entailed a semantic leap as well as a shift in perspective. The world could only change, after Galileo, to the degree that language changed. Similarly, it's becoming easy to think of animals not as fixed "objects" in nature but as re-arrangeable packets of DNA. Over the past decade, the list of patents issued world-wide for bioengineered products is long and varied and includes the combination of cow embryos with human genes in attempts to grow human replacement parts and tomatoes with the genes of a codfish to make them less susceptible to freezing. Chickens carry the genes of the salmon while sheep receive tobacco genes, and worms, after Methuselah, have been engineered to increase their life span to the equivalent of 600 human years. Using a genetically altered bacteria (trade name "messenger") basic crops like wheat and corn are engineered to protect themselves by killing insects.

As our garden becomes populated with more, and more extreme, varieties of transgenic plants and animals, as these techniques are increasingly applied to humans, can the Adamic conception of the self remain any more constant? Dramatic advances such as the cloning of our primate cousins receive the most attention. But it is perhaps the thousands of small steps that coalesce, like myths, into habits of mind that have the most profound effects: calls for genetic national identity cards; the permission we give on the back of our driver's license for our bodies to become recyclable material, permission that allowed Matthew Scott to receive the hand of a cadaver by transplant, the hand that John Doe, it's

previous "owner" had used to write his name, to clasp in prayer, now taking up a new name, new prayers. Artificial skin; artificial bone. In petri dishes like the one used in Genesis, researchers at the University of Massachusetts Medical School have been able to grow cartilaginous ears and noses. Other labs claim to have discovered genes that determine everything from shyness to rape to altruism; first steps to practical applications soon follow, such as those taken by researchers at Yale University who by manipulating a gene identified as important to memory have created a strain of super-smart mice. Once the genetic tree of knowledge is completely sequenced, won't we begin in earnest to rewrite genes to increase longevity, manipulate skin color, personality, indeed, all the traits that make us us?-to completely throw off the original sin and destiny of biology? Considering how conceptions of the self have had profound consequences for laws, for customs-for how people order society and conduct themselves and behave toward others-can we do without springboards to meditation such as Kac's Genesis?

When the prospect of "personal evolution," the prospect of individuals altering the genes of their descendants became a reality, the U.S. National Bioethics Advisory Commission turned to religious traditions as one factor in formulating its recommendations on how public policy should react. Its members cited the centuries people have used these traditions to guide their own behavior in the face of a changing world. By putting a global audience in collective control of his Genesis, by making their actions impinge upon an excerpt from the Biblical Genesis, Kac puts his audience in a position to consider tradition-or its erasure-as one factor in their response to the biological course we are just beginning to navigate. The evolution in a petri dish we communally alter underscores how the use of technology is not always planned, its consequences not always foreseen, nor benign. Standing in the box formed by the walls of Genesis, it's easy for viewers to reverse the scale and think of themselves in the position of the bacteria with ultraviolet light streaming down (possibly through a hole in the ozone layer?). We're invited to contemplate consequences of interfering with evolution when Kac translates, at the end of the exhibit, the DNA code of his original message back into English:

LET AAN HAVE DOMINION OVER THE FISH OF THE SEA AND OVER THE FOWL OF THE AIR AND OVER EVERY LIVING THING THAT IOVES UA EON THE EARTH

The now corrupted sentence calls to mind other literatures of constraint: those texts, such as Raymond Queneau's One Hundred Million Million Poems, that have been generated out of a self-imposed rule. In Queneau's work, a traditional fourteen-line sonnet is combined with ten other fourteen-line sonnets in such a way that any one line can be combined with the thirteen lines of any of the other sonnets. Thus, the poem as a whole allows the meaning held as a potential within the dull mass of language to emerge: a potential of 1014 sonnets, a quantity of text, as François Le Lionnais notes, "far greater than everything man has written since the invention of writing, including popular novels, business letters, diplomatic correspondence, private mail, rough drafts thrown into the wastebasket, and graffiti." Conversely, Kac's corruption also calls to mind literatures of non-constraint, such as Luis Borges's hypothetical 1,000 monkeys typing on 1,000 typewriters in the hopes of producing an exact copy of Don Quixote. With over 3,000,000,000 genetic letters in the book that is the human, Genesis asks us to consider the ramifications of typos-and their transmission to future generations. Unbridled, typos cumulate into gibberish quickly, for as Alice learned in Wonder Land, even a sentence of only ten words has 3,628,800 combinations, only one or two of which will make sense. Mutating any three letter word, say APE, into another three letter word, say MAN, by randomly switching one letter at a time takes thousands of generations to hit the right combination. But if the changes are governed by the constraint that each step must make sense, then the mutation can be made in only eight steps:
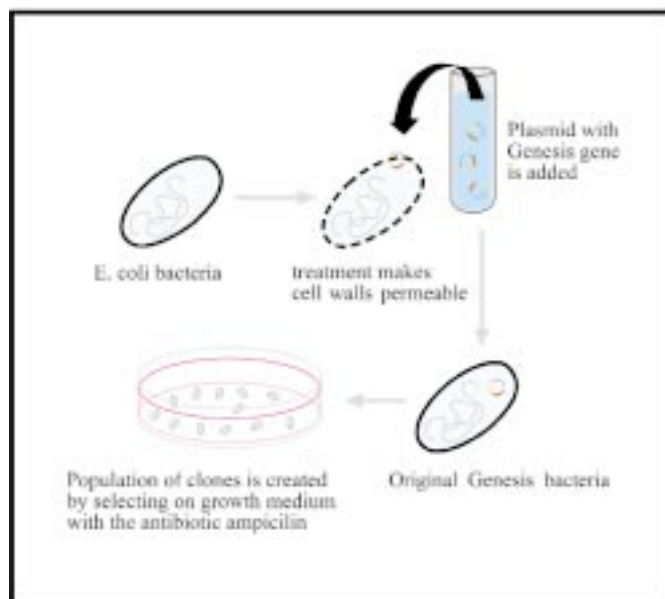
APE
ARE
ARM
AIM
RIM
RAM
RAN
MAN

Thus can be seen the apparent paradox of how the application of a constraint directs rather than stifles creation: the application of a constraint allows the process to ignore all the other constraints that would take it into other directions. Before man's intervention, "survival of the fittest" was the dominate constraint under which changes were made to the book of each organism, including humans. While gene management has resulted in hairless Chihuahuas, seedless watermelons, indeed every strain of plant and animal not seen in Eden, it is only with the advent of bio-engineering that changes could be made that skip intervening steps. As Kac's genesis illustrates, which potential literature will be offered up from among the thousands of potentials dormant in the mud of genetic language will depend on the constraints under which change operates. So it's instructive to note how much of both the Biblical and the artist's Genesis is concerned with lineage. Indeed, the Hebrew innovation in regards to the creation myths that circulated among the Israelites was to use them to shape their identity as a people-an identity traced through their bodies in a direct line of descendancy to Adam and Eve who were fashioned in the likeness of God. Thus, the mother of this people was named Eve, hawwa in Hebrew, related to hay "living," the mother of all the living to follow. Reconstruction of genetic trees estimate that this woman-not the first woman, but the last woman every person now alive on earth is descended from-lived 143,000 years ago. For 5,700 generations, then, or 120,000,000 years if we count our ancestry back to the original cells, our biological identity has been shaped one letter at a time. In Kac's Genesis, though, we see an icon for our new-found ability to rewrite ourselves-

instantly, and in ways whose ramifications might not become apparent for generations. In an age when people are increasingly looking to chromosome stains to explain the difference between Cain and Able-as well as differences in sexual orientation, intelligence, personality, and hundreds of other human traits-Kac's Genesis reminds viewers of the wisdom in tempering change with reflection.
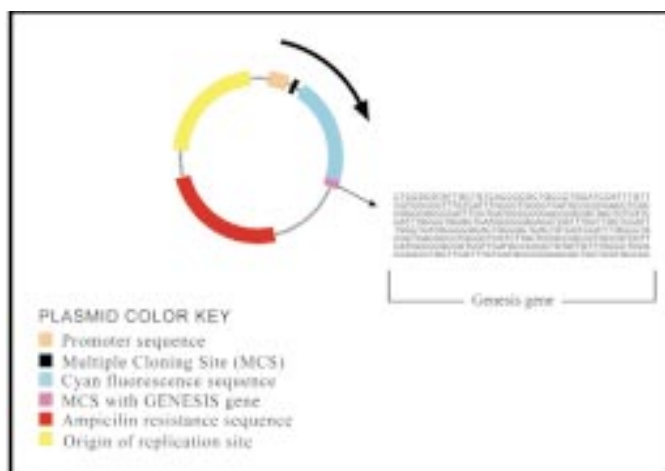
That is, Kac's Genesis calls us to consider which identity we are fashioning for ourselves, for our species, for nature, by the constraints we do or do not place on the potential literature of our bodies. Will the constraint of survival be replaced by economic gain? It wasn't until 1967 that the U.S. Federal Trade Commission ruled that blood could be bought and sold. Up until then, blood with all of its metaphorical richness was considered a gift that could be given, like life, but was too sacred to be bought and sold. Today, the world market for blood is a $19-billion business and constitutes only a small segment of a bio-trade that includes on-line auctions for human eggs and sperm (www.ronsangels.com) among other human "components," from whole corpses to fetal "products."

Will the only constraint placed on these new potential literatures of the body be technological progress? Can constraints not be political? Does the ability to manipulate a gene, say for one of the 5,000 diseases now known to be inherited, carry with it the responsibility to do so? Who has the authority to alter the germ line of future generations? Who has the authority to determine the fate of the tens of thousands of embryos accumulating in storage tanks, the leftovers of reproduction technologies that allow couples to select the most genetically viable embryos while abandoning the rest? Will the constraints of bio-technology be social?-preferences for skin color or hair texture? Will they be legal?-such as the legal fights over who can copyright a person's genetic information? Kac's Genesis asks us to consider these issues by having us revisit the language of "dominion over every living thing." By making us his co-authors, he emphasizes how the name we give ourselves can be in the spirit of "masters" or "caretakers" of our garden, how our collective actions will be our Midrash.

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Caption

Genesis, Eduardo Kac, 1998/99. The Genesis gene was created by first converting the bible sentence to Morse code. The next step was the conversion of the Morse code into DNA: Dashes were represented by the letter T (thymine); Dots were represented by the letter C (cytosin); Word spaces were replaced by the letter A (adenine); Letter spaces were substituted by the letter G (guanine).

Caption

Genesis, Eduardo Kac, 1998/99. The plasmid with the Genesis gene was incorporated into E. coli bacteria. Genesis bacteria have cyan fluorescence and share a Petri dish with another colony of E. coli bacteria that have yellow fluorescence but which do not have the Genesis gene.

PLASMID COLOR KEY
- Promoter sequence
- Multiple Cloning Site (MCS)
- Cyan fluorescence sequence
- MCS with GENESIS gene
- Ampicilin resistance sequence
- Origin of replication site

Genesis, Eduardo Kac, 1998/99. This diagram shows the plasmid (left) and the gene used in the transgenic artwork "Genesis". A plasmid is an extrachromosomal ring of DNA. The black circular arrow at the top of the plasmid indicates the direction of transcription (i.e., the process by which one strand of DNA is copied into a single strand of RNA). Shown in the illustration are: 1) Promoter sequence (sequence of DNA where RNA polymerase binds on to begin transcription); 2) Multiple Cloning Site (part of the plasmid that has been engineered to accept the insertion of other sequences); 3) Cyan fluorescence sequence (sequence of DNA that codes for cyan fluorescent protein); 4) MCS with GENESIS gene (site where the Genesis gene was inserted); 5) Ampicilin resistance sequence (gene that codes for resistance to the antibiotic ampicilin); 6) Origin of replication site (site where the process of replication of DNA molecules originates, by one single strand being used as a template for the production of another single strand). This plasmid, with the Genesis gene, was incorporated into E. coli bacteria. Genesis bacteria share a Petri dish with another colony of E. coli bacteria that have yellow fluorescence but which do not have the Genesis gene.

CAPTION

The illustration above shows the structure of the Genesis gene. The initiation codon (ATG, in dark blue) is the site where translation begins, i.e., where the protein starts to be built. Before the ATG initiation codon we see an untranslated region (in green) with a promoter sequence (TATT, in purple). After the ATG initiation codon we see an open reading frame (in brown), i.e., codons that do not code for termination. The Genesis gene is completely synthetic and does not exist in nature.

Caption

GENESIS, Eduardo Kac, 1998/99. A sentence from the book of Genesis was converted to Morse code before translation into DNA.

GFP BUNNY
Eduardo Kac

My transgenic artwork "GFP Bunny" comprises the creation of a green fluorescent rabbit, its social integration, and the ensuing public debate. GFP stands for green fluorescent protein. "GFP Bunny" was realized in 2000 and first presented publicly in Avignon, France. Transgenic art, I proposed elsewhere [1], is a new art form based on the use of genetic engineering to transfer natural or synthetic genes to an organism, to create unique living beings. This must be done with great care, with acknowledgment of the complex issues thus raised and, above all, with a commitment to respect, nurture, and love the life thus created.

WELCOME, ALBA

I will never forget the moment when I first held her in my arms, in Jouy-en-Josas, France, on April 29, 2000. My apprehensive anticipation was replaced by joy and excitement. Alba – the name given her by my wife, my daughter, and I – was lovable and affectionate and an absolute delight to play with. As I cradled her, she playfully tucked her head between my body and my left arm, finding at last a comfortable position to rest and enjoy my gentle strokes. She immediately awoke in me a strong and urgent sense of responsibility for her well-being.

Alba is undoubtedly a very special animal, but I want to be clear that her formal and genetic uniqueness are but one component of the "GFP Bunny" artwork. The "GFP Bunny" project is a complex social event that starts with the creation of a chimerical animal that does not exist in nature (i.e., "chimerical" in the sense of a cultural tradition of imaginary animals, not in the scientific connotation of an organism in which there is a mixture of cells in the body) and that also includes at its core: 1) ongoing dialogue between professionals of several disciplines (art, science, philosophy, law, communications, literature, social sciences) and the public on cultural and ethical implications of genetic engineering; 2)

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) 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) examination of the notions of normalcy, heterogeneity, purity, hybridity, and otherness; 7) consideration of a non-semiotic notion of communication as the sharing of genetic material across traditional species barriers; 8) public respect and appreciation for the emotional and cognitive life of transgenic animals; 9) expansion of the present practical and conceptual boundaries of artmaking to incorporate life invention.

GLOW IN THE FAMILY

"Alba", the green fluorescent bunny, is an albino rabbit. This means that, since she has no skin pigment, under ordinary environmental conditions she is completely white with pink eyes. Alba is not green all the time. She only glows when illuminated with the correct light. When (and only when) illuminated with blue light (maximum excitation at 488 nm), she glows with a bright green light (maximum emission at 509 nm). She was created with EGFP, an enhanced version (i.e., a synthetic mutation) of the original wild-type green fluorescent gene found in the jellyfish Aequorea Victoria. EGFP gives about two orders of magnitude greater fluorescence in mammalian cells (including human cells) than the original jellyfish gene [2].

The first phase of the "GFP Bunny" project was completed in February 2000 with the birth of "Alba" in Jouy-en-Josas, France. This was accomplished with the invaluable assistance of zoosystemician Louis Bec [3] and scientists Louis-Marie Houdebine and Patrick Prunnet [4]. Alba's name was chosen by consensus between my wife Ruth, my daughter Miriam, and myself. The second phase is

from June 19 to 25, 2000, the period of a public presentation in Avignon with Alba and me together, with a public debate on June 20. The third phase starts in July 2000, when the bunny comes home to Chicago, becoming part of my family and living with us from this point on.

Resembling the familial living room, the public presentation with Alba occurs in an environment designed to maximize her comfort. It takes place at the Grenier `a Sel, in Avignon, from June 15 to 25, 2000, in the context of the Avignon Numerique festival. When the public arrives at the gallery, they find a room with seats, furniture, and television, in which Alba and I can be seen together for the entire duration of the show. My objective in living with Alba in the gallery during the exhibition is to affirm our relationship through daily care and communication and to prevent the public from seeing and treating her as an object. Alba and I will look and interact with the public as much as the public will interact with us. For a limited time daily, the public will be able to see her glow. A pair of special GFP goggles will enable the audience to illuminate her with the correct light and see her fluoresce in green. Alba and I will spend our time playing, resting, eating, interacting with visitors, and living our lives together in the gallery until the end of the show, when she returns home with me.

FROM DOMESTICATION TO SELECTIVE BREEDING

The human-rabbit association can be traced back to the biblical era, as exemplified by passages in the books Leviticus (Lev. 11:5) and Deuteronomy (De. 14:7), which make reference to saphan, the Hebrew word for rabbit. Phoenicians seafarers discovered rabbits on the Iberian Peninsula around 1100 BC and, thinking that these were Hyraxes (also called Rock Dassies), called the land "i-shepan-im" (land of the Hyraxes). Since the Iberian Peninsula is north of Africa, relative geographic position suggests that another Punic derivation comes from sphan, "north". As the Romans adapted "i-shepan-im" to Latin, the word Hispania was created – one of the etymological origins of Spain. In his

book III the Roman geographer Strabo (ca. 64 BC - AD 21) called Spain "the land of rabbits". Later on, the Roman emperor Servius Sulpicius Galba (5 BC - AD 69), whose reign was short-lived (68-69 AD), issued a coin on which Spain is represented with a rabbit at her feet. Although semi-domestication started in the Roman period, in this initial phase rabbits were kept in large walled pens and were allowed to breed freely.

Humans started to play a direct role in the evolution of the rabbit from the sixth to the tenth centuries AD, when monks in southern France domesticated and bred rabbits under more restricted conditions [5]. Originally from the region comprised by southwestern Europe and North Africa, the European rabbit (Oryctolagus cuniculus) is the ancestor of all domestic breeds. Since the sixth century, because of its sociable nature the rabbit increasingly has become integrated into human families as a domestic companion. Such human-induced selective breeding created the morphological diversity found in rabbits today. The first records describing a variety of fur colors and sizes distinct from wild breeds date from the sixteenth century. It was not until the eighteenth century that selective breeding resulted in the Angora rabbit, which has a uniquely thick and beautiful wool coat. The process of domestication carried out since the sixth century, coupled with ever increasing worldwide migration and trade, resulted in many new breeds and in the introduction of rabbits into new environments different from their place of origin. While there are well over 100 known breeds of rabbit around the world, "recognized" pedigree breeds vary from one country to another. For example, the American Rabbit Breeders Association (ARBA) "recognizes" 45 breeds in the U.S.A., with more under development.

In addition to selective breeding, naturally occurring genetic variations also contributed to morphological diversity. The albino rabbit, for example, is a natural (recessive) mutation which in the wild has minimal chances of survival (due to lack of proper pigmentation for camouflage and keener vision to spot prey). However, because it has been bred by humans, it can be found widely today in

healthy populations. The human preservation of albino animals is also connected to ancient cultural traditions: almost every Native American tribe believed that albino animals had particular spiritual significance and had strict rules to protect them [6].

FROM BREEDING TO TRANSGENIC ART

"GFP Bunny" is a transgenic artwork and not a breeding project. The differences between the two include the principles that guide the work, the procedures employed, and the main objectives. Traditionally, animal breeding has been a multi-generational selection process that has sought to create pure breeds with standard form and structure, often to serve a specific performative function. As it moved from rural milieus to urban environments, breeding de-emphasized selection for behavioral attributes but continued to be driven by a notion of aesthetics anchored on visual traits and on morphological principles. Transgenic art, by contrast, offers a concept of aesthetics that emphasizes the social rather than the formal aspects of life and biodiversity, that challenges notions of genetic purity, that incorporates precise work at the genomic level, and that reveals the fluidity of the concept of species in an ever increasingly transgenic social context.

As a transgenic artist, I am not interested in the creation of genetic objects, but on the invention of transgenic social subjects. In other words, what is important is the completely integrated process of creating the bunny, bringing her to society at large, and providing her with a loving, caring, and nurturing environment in which she can grow safe and healthy. This integrated process is important because it places genetic engineering in a social context in which the relationship between the private and the public spheres are negotiated. In other words, biotechnology, the private realm of family life, and the social domain of public opinion are discussed in relation to one another. Transgenic art is not about the crafting of genetic objets d'art, either inert or imbued with vitality. Such an

approach would suggest a conflation of the operational sphere of life sciences with a traditional aesthetics that privileges formal concerns, material stability, and hermeneutical isolation. Integrating the lessons of dialogical philosophy [7] and cognitive ethology [8], transgenic art must promote awareness of and respect for the spiritual (mental) life of the transgenic animal. The word "aesthetics" in the context of transgenic art must be understood to mean that creation, socialization, and domestic integration are a single process. The question is not to make the bunny meet specific requirements or whims, but to enjoy her company as an individual (all bunnies are different), appreciated for her own intrinsic virtues, in dialogical interaction.

One very important aspect of "GFP Bunny" is that Alba, like any other rabbit, is sociable and in need of interaction through communication signals, voice, and physical contact. As I see it, there is no reason to believe that the interactive art of the future will look and feel like anything we knew in the twentieth century. "GFP Bunny" shows an alternative path and makes clear that a profound concept of interaction is anchored on the notion of personal responsibility (as both care and possibility of response). "GFP Bunny" gives continuation to my focus on the creation, in art, of what Martin Buber called dialogical relationship [9], what Mikhail Bakhtin called dialogic sphere of existence [10], what Emile Benveniste called intersubjectivity [11], and what Humberto Maturana calls consensual domains [12]: shared spheres of perception, cognition, and agency in which two or more sentient beings (human or otherwise) can negotiate their experience dialogically. The work is also informed by Emmanuel Levinas' philosophy of alterity [13], which states that our proximity to the other demands a response, and that the interpersonal contact with others is the unique relation of ethical responsibility. I create my works to accept and incorporate the reactions and decisions made by the participants, be they eukaryotes or prokaryotes [14]. This is what I call the human-plant-bird-mammal-robot-insect-bacteria interface.

In order to be practicable, this aesthetic platform–which reconciles forms of social intervention with semantic openness and systemic complexity–must

acknowledge that every situation, in art as in life, has its own specific parameters and limitations. So the question is not how to eliminate circumscription altogether (an impossibility), but how to keep it indeterminate enough so that what human and nonhuman participants think, perceive, and do when they experience the work matters in a significant way. My answer is to make a concerted effort to remain truly open to the participant's choices and behaviors, to give up a substantial portion of control over the experience of the work, to accept the experience as-it-happens as a transformative field of possibilities, to learn from it, to grow with it, to be transformed along the way. Alba is a participant in the "GFP Bunny" transgenic artwork; so is anyone who comes in contact with her, and anyone who gives any consideration to the project. A complex set of relationships between family life, social difference, scientific procedure, interspecies communication, public discussion, ethics, media interpretation, and art context is at work.

Throughout the twentieth century art progressively moved away from pictorial representation, object crafting, and visual contemplation. Artists searching for new directions that could more directly respond to social transformations gave emphasis to process, concept, action, interaction, new media, environments, and critical discourse. Transgenic art acknowledges these changes and at the same time offers a radical departure from them, placing the question of actual creation of life at the center of the debate. Undoubtedly, transgenic art also develops in a larger context of profound shifts in other fields. Throughout the twentieth century physics acknowledged uncertainty and relativity, anthropology shattered ethnocentricity, philosophy denounced truth, literary criticism broke away from hermeneutics, astronomy discovered new planets, biology found "extremophile" microbes living in conditions previously believed not capable of supporting life, molecular biology made cloning a reality.

Transgenic art acknowledges the human role in rabbit evolution as a natural element, as a chapter in the natural history of both humans and rabbits, for domestication is always a bidirectional experience. As humans domesticate rabbits, so do rabbits domesticate their humans. If teleonomy is the apparent purpose in the organization of living systems [15], then transgenic art suggests a non-utilitarian and more subtle approach to the debate. Moving beyond the metaphor of the artwork as a living organism into a complex embodiment of the trope, transgenic art opens a nonteleonomic domain for the life sciences. In other words, in the context of transgenic art humans exert influence in the organization of living systems, but this influence does not have a pragmatic purpose. Transgenic art does not attempt to moderate, undermine, or arbitrate the public discussion. It seeks to offer a new perspective that offers ambiguity and subtlety where we usually only find affirmative ("in favor") and negative ("against") polarity. "GFP Bunny" highlights the fact that transgenic animals are regular creatures that are as much part of social life as any other life form, and thus are deserving of as much love and care as any other animal [16].

In developing the "GFP Bunny" project I have paid close attention and given careful consideration to any potential harm that might be caused. I decided to proceed with the project because it became clear that it was safe [17]. There were no surprises throughout the process: the genetic sequence responsible for the production of the green fluorescent protein was integrated into the genome through zygote microinjection [18]. The pregnancy was carried to term successfully. "GFP Bunny" does not propose any new form of genetic experimentation, which is the same as saying: the technologies of microinjection and green fluorescent protein are established well-known tools in the field of molecular biology. Green fluorescent protein has already been successfully expressed in many host organisms, including mammals [19]. There are no mutagenic effects resulting from transgene integration into the host genome. Put another way: green fluorescent protein is harmless to the rabbit. It is also important to point out that the "GFP Bunny" project breaks no social rule: humans have determined the evolution of rabbits for at least 1400 years.

ALTERNATIVES TO ALTERITY

As we negotiate our relationship with our lagomorph companion [20], it is nec-essary to think rabbit agency without anthropomorphizing it. Relationships are not tangible, but they form a fertile field of investigation in art, pushing interac-tivity into a literal domain of intersubjectivity. Everything exists in relationship to everything else. Nothing exists in isolation. By focusing my work on the inter-connection between biological, technological, and hybrid entities I draw atten-tion to this simple but fundamental fact. To speak of interconnection or inter-subjectivity is to acknowledge the social dimension of consciousness. Therefore, the concept of intersubjectivity must take into account the complexity of animal minds. In this context, and particularly in regard to "GFP Bunny", one must be open to understanding the rabbit mind, and more specifically to Alba's unique spirit as an individual. It is a common misconception that a rabbit is less intelli-gent than, for example, a dog, because, among other peculiarities, it seems dif-ficult for a bunny to find food right in front of her face. The cause of this ordi-nary phenomenon becomes clear when we consider that the rabbit's visual sys-tem has eyes placed high and to the sides of the skull, allowing the rabbit to see nearly 360 degrees. As a result, the rabbit has a small blind spot of about l0 degrees directly in front of her nose and below her chin [21]. Although rabbits do not see images as sharply as we do, they are able to recognize individual humans through a combination of voice, body movements, and scent as cues, provided that humans interact with their rabbits regularly and don't change their overall configuration in dramatic ways (such as wearing a costume that alters the human form or using a strong perfume). Understanding how the rabbit sees the world is certainly not enough to appreciate its consciousness but it allows us to gain insights about its behavior, which leads us to adapt our own to make life more comfortable and pleasant for everyone.

Alba is a healthy and gentle mammal. Contrary to popular notions of the alleged monstrosity of genetically engineered organisms, her body shape and coloration are exactly of the same kind we ordinarily find in albino rabbits. Unaware that

Alba is a glowing bunny, it is impossible for anyone to notice anything unusual about her. Therefore Alba undermines any ascription of alterity. It is precisely this productive ambiguity that sets her apart: being at once same and different. As is the case in most cultures, our relationship with animals is profoundly reveal-ing of ourselves. Our daily coexistence and interaction with members of other species remind us of our uniqueness as humans. At the same time, it allow us to tap into dimensions of the human spirit that are often suppressed in daily life–such as communication without language–that reveal how close we really are to nonhumans. The more animals become part of our domestic life, the further we move breeding away from functionality and animal labor. Our relationship with other animals shifts as historical conditions are transformed by political pres-sures, scientific discoveries, technological development, economic opportuni-ties, artistic invention, and philosophical insights. At the beginning of the twen-ty-first century, as we transform our understanding of human physical bound-aries by introducing new genes into developed human organisms, our com-munion with animals in our environment also changes. Molecular biology has demonstrated that the human genome is not particularly important, special, or different. The human genome is made of the same basic elements as other known life forms and can be seen as part of a larger genomic spectrum rich in variation and diversity.

Western philosophers, from Aristotle [22] to Descartes [23], from Locke [24] to Leibniz [25], from Kant [26] to Nietsche [27] and Buber [28], have approached the enigma of animality in a multitude of ways, evolving in time and elucidating along the way their views of humanity. While Descartes and Kant possessed a more condescending view of the spiritual life of animals (which can also be said of Aristotle), Locke, Leibniz, Nietsche, and Buber are – in different degrees – more tolerant towards our eukaryotic others [29]. Today, our ability to generate life through the direct method of genetic engineering prompts a re-evaluation of the cultural objectification and the personal subjectification of animals, and in so doing it renews our investigation of the limits and potentialities of what we call humanity. I do not believe that genetic engineering eliminates the mystery of

what life is; to the contrary, it reawakens in us a sense of wonder towards the living. We will only think that biotechnology eliminates the mystery of life if we privilege it in detriment to other views of life (as opposed to seeing biotechnology as one among other contributions to the larger debate) and if we accept the reductionist view (not shared by many biologists) that life is purely and simply a matter of genetics. Transgenic art is a firm rejection of this view and a reminder that communication and interaction between sentient and nonsentient actants lies at the core of what we call life. Rather than accepting the move from the complexity of life processes to genetics, transgenic art gives emphasis to the social existence of organisms, and thus highlights the evolutionary continuum of physiological and behavioral characteristics between the species. The mystery and beauty of life is as great as ever when we realize our close biological kinship with other species and when we understand that from a limited set of genetic bases life has evolved on Earth with organisms as diverse as bacteria, plants, insects, fish, reptiles, birds, and mammals.

TRANSGENESIS, ART, AND SOCIETY

The success of human genetic therapy suggests the benefits of altering the human genome to heal or to improve the living conditions of fellow humans [30]. In this sense, the introduction of foreign genetic material in the human genome can be seen not only as welcome but as desirable. Developments in molecular biology, such as the above example, are at times used to raise the specter of eugenics and biological warfare, and with it the fear of banalization and abuse of genetic engineering. This fear is legitimate, historically grounded, and must be addressed. Contributing to the problem, companies often employ empty rhetorical strategies to persuade the public, thus failing to engage in a serious debate that acknowledges both the problems and benefits of the technology. [31] There are indeed serious threats, such as the possible loss of privacy regarding one's own genetic information, and unacceptable practices already underway, such as biopiracy (the appropriation and patenting of genetic material from its owners without explicit permission).

As we consider these problems, we can not ignore the fact that a complete ban on all forms of genetic research would prevent the development of much needed cures for the many devastating diseases that now ravage human and nonhumankind. The problem is even more complex. Should such therapies be developed successfully, what sectors of society will have access to them? Clearly, the question of genetics is not purely and simply a scientific matter, but one that is directly connected to political and economic directives. Precisely for this reason, the fear raised by both real and potential abuse of this technology must be channeled productively by society. Rather than embracing a blind rejection of the technology, which is undoubtedly already a part of the new bioscape, citizens of open societies must make an effort to study the multiple views on the subject, learn about the historical background surrounding the issues, understand the vocabulary and the main research efforts underway, develop alternative views based on their own ideas, debate the issue, and arrive at their own conclusions in an effort to generate mutual understanding. Inasmuch as this seems a daunting task, drastic consequences may result from hype, sheer opposition, or indifference.

This is where art can also be of great social value. Since the domain of art is symbolic even when intervening directly in a given context [32], art can contribute to reveal the cultural implications of the revolution underway and offer different ways of thinking about and with biotechnology. Transgenic art is a mode of genetic inscription that is at once inside and outside of the operational realm of molecular biology, negotiating the terrain between science and culture. Transgenic art can help science to recognize the role of relational and communicational issues in the development of organisms. It can help culture by unmasking the popular belief that DNA is the "master molecule" through an emphasis on the whole organism and the environment (the context). At last, transgenic art can contribute to the field of aesthetics by opening up the new symbolic and pragmatic dimension of art as the literal creation of and responsibility for life.

NOTES:

[1] Kac, Eduardo. "Transgenic Art", Leonardo Electronic Almanac, Vol. 6, N. 11, December 1998. Republished in: Gerfried Stocker and Christine Schopf (eds.), Ars Electronica '99 - Life Science (Vienna, New York: Springer, 1999), pp. 289-296. See also: Kac, Eduardo. "Genesis", in Spike/Genesis, exhibition catalogue, O. K. Center for Contemporary Art, Linz, Austria, pp. 50-55.

[2] After green fluorescent protein (GFP) was first isolated from Aequorea victoria and used as a new reporter system (see: Chalfie, M., Tu, Y., Euskirchen, G., Ward, W., Prasher, D. (1994). Green Fluorescent Protein as a Marker for Gene Expression. Science 263, 802-805) it was modified in the laboratory to increase fluorescence. See: Heim, R., Cubitt, A. B. and Tsien, R.Y. (1995) Improved green fluorescence. Nature 373:663-664; and Heim, R., Tsien, R. Y. (1996). Engineering green fluorescent protein for improved brightness, longer wavelengths and fluorescence resonance energy transfer. Current Biology 6, 178-182. Further work altered the green fluorescent protein gene to conform to the favored codons of highly expressed human proteins and thus allowed improved expression in mammalian cells. See: Haas, J, Park, EC and Seed, B. (1996). Codon usage limitation in the expression of HIV-1 envelope glycoprotein. Current Biology 6: 315-24. More recently, new mutations with greater fluorescence have been developed. See: Yang, Te-Tuan et al. (1998). Improved fluorescence and dual color detection with enhanced blue and green variants of the green fluorescent protein. The Journal of biological chemistry, V. 273, N. 14, p. 8212. For a comprehensive overview of green fluorescent protein as a genetic marker, see: Chalfie, Martin. Kain, Steven. Green fluorescent protein : properties, applications, and protocols (New York : Wiley-Liss, 1998). Since its first introduction in molecular biology, GFP has been expressed in many organisms, including bacteria, yeast, slime mold, many plants, fruit flies, zebrafish, many mammalian cells, and even viruses. Moreover, many organelles, including the nucleus, mitochondria, plasma membrane, and cytoskeleton, have been marked with GFP.

[3] Artist, curator, and cultural promoter Louis Bec coined the term zoosystémicien (zoosystemician) to define his artistic practice and his sphere of interest, i.e., the digital modeling of living systems. Formerly Inspecteur à la création artistique chargé des Nouvelles Technologies, Ministère de la Culture (Coordinator of Art and Technology for the French Ministry of Culture), Louis Bec was the Director of the festival Avignon Numerique (Digital Avignon), celebrated in Avignon, France, from April 1999 to November 2000, on the occasion of Avignon's status as European cultural capital of the year 2000.

[4] Louis-Marie Houdebine and Patrick Prunet are scientists who work at the Institut National de la Recherche Agronomique-INRA (National Institute of Agronomic Research), France. Louis-Marie Houdebine is the Director of Research of the Biology of Development and Biotechnology Unit, INRA, Jouy-en-Josas Center, France. Among his books in French we find: Le génie génétique, de l'animal `a l'homme : un exposé pour comprendre, un essai pour réfléchir (Paris : Flammarion, 1996); Les biotechnologies animales : une nécessité ou une révolution inutile (Paris : Cachan : France agricole, 1998); and Les animaux transgéniques (Paris : Cachan : Tec et Doc, 1998). In English: Transgenic Animals - Generation and Use (Amsterdam: Harwood Academic Publishers, 1997). Patrick Prunet is a researcher in the Group in Physiology of Stress and Adaptation, INRA, Campus de Beaulieu, Rennes, France.

[5] For an account of the history of domestication, see: Zeuner, Frederick Everard. A History of Domesticated Animals (New York : Harper & Row, 1963); Clutton-Brock, Juliet. Domesticated Animals from Early Times (London: British Museum, 1981); Caras, Roger A. A Perfect Harmony: The Intertwining Lives of Animals and Humans Throughout History (New York: Simon and Schuster, 1996); Gautier, Achilles. La domestication. Et l'homme créa ses animaux.(Paris: Editions Errance, 1990); Helmer, Daniel. La domestication des animaux par les hommes préhistoriques (Paris: Masson, 1992).; and Sawer, Carl O. Agricultural Origins and Dispersals: The Domestication of Animals and Foodstuffs (Cambridge, MA: MIT Press, 1970). For specific references on the domestication

of rabbits see: Biadi, F. and Le Gall, A., Le lapin de garenne (Paris: Hatier, 1993); Bianciotto, G., Bestiaires du Moyen Íge (Paris: Stock, 1980); Brochier, J. J., Anthologie du lapin (Paris: Hatier, 1987); Le lapin, aspects historiques, culturels et sociaux.- Ethnozootechnie, nˇ 27, 1980.

[6] Detailed information about the spiritual values of individual tribes can be found in: Gill, Sam D., Dictionary of Native American mythology (New York : Oxford University Press, 1994). See also: Hirschfelder, Arlene B., Encyclopedia of Native American religions : an introduction (New York : Facts on File, 2000). Richard Erdoes and Alfonso Ortiz (Editors). American Indian Myths and Legends (New York: Pantheon Books, 1985). A recent case that well illustrates the sacred qualities of albino animals for Native American tribes was the birth of "Miracle", the white buffalo calf. "Miracle" was born on the Heider farm, in Janesville, Wisconsin, on August 20, 1994. The announcement of Miracle's birth prompted the American Bison Association to say that the last documented white buffalo died in 1959. Miracle is held sacred by buffalo-hunting Plains Indians, including the Lakota, the Oneida, the Cherokee, and the Cheyenne. Soon after her birth, Joseph Chasing Horse, traditional leader of the Lakota nation, visited the site of Miracle's birth and conducted a Pipe ceremony there, while telling the story of White Buffalo Calf Woman, a legendary figure who brought the first Pipe to the Lakota people. Following suit, more than 20,000 people come to see Miracle, and the gate to the Heider's pasture and the trees next to it soon became covered with offerings: feathers, necklaces and pieces of colorful cloth. News of the calf spread quickly through the Native American community because its birth fulfilled a 2,000-year-old prophecy of northern Plains Indians. Joseph Chasing Horse explained in a newspaper interview that 2,000 years ago a young woman who first appeared in the shape of a white buffalo gave the Lakota's ancestors a sacred pipe and sacred ceremonies and made them guardians of the Black Hills. Before leaving, she also prophesied that one day she would return to purify the world, bringing back spiritual balance and harmony; the birth of a white buffalo calf would be a sign that her return was at hand. Owen Mike, head of the Ho-Chunk (Winnebago) buffalo clan, said in the same

article that his people have a slightly different interpretation of the white calf's significance. He added, however, that the Ho-Chunk version of the prophecy also stresses the return of harmony, both in nature and among all peoples. "It's more of a blessing from the Great Spirit," Mike explained. "It's a sign. This white buffalo is showing us that everything is going to be okay." See: "Miracle", Tom Laskin, Isthmus Newspaper, Madison, Wisconsin; Nov. 25-Dec 1, 1994.

[7] In the twentieth century, dialogical philosophy found renewed impetus with Martin Buber, who published in 1923 the book I-Thou, in which he stated that humankind is capable of two kinds of relationship: I and Thou (reciprocity) and I-It (objectification). In I and Thou relations one fully engages in the encounter with the other and carries on a real dialogue. In I-It relations "It" becomes an object of control. The "I" in both cases is not the same, for in the first case there is a non-hierarchical meeting while in the second case there is detachment. See: Buber, Martin. I and Thou (New York: Collier, 1987). Martin Buber's dialogical philosophy of relation, which is very close to Phenomenology and Existentialism, also influenced Mikhail Bakhtin's philosophy of language. Bakhtin stated in countless writings that ordinary instances of monological experience–in culture, politics, and society–suppress the dialogical reality of existence.

[8] Cognitive ethology can be defined as "the evolutionary and comparative study of nonhuman animal thought processes, consciousness, beliefs, or rationality, and is an area in which research is informed by different types of investigations and explanations." See: Bekoff, Marc (1995). "Cognitive Ethology and the Explanation of Nonhuman Animal Behavior", in Comparative Approaches to Cognitive Science. J. A. Meyer and H. L. Roitblat, eds. (Cambridge, Mass. : MIT Press, 1995), 119-150. A pioneer of ethology, the Estonian zoologist Jakob von Uexküll (1864-1944) devoted himself to the problem of how living beings subjectively perceive their environment and how this perception determines their behavior. In 1909 he wrote "Umwelt und Innenwelt der Tiere", introducing the German word 'umwelt' (roughly translated, "environment") to refer to the subjective world of an organism. The book has been excerpted in Foundations of

Comparative Ethology, ed. G. Burghardt (New York: Van Nostrand Reinhold, 1985). Since Uexküll emphasized the fact that signs and meanings are of the utmost importance in all aspects of biological processes (at the level of the cell or the organism), he also anticipated the concerns of cognitive ethology and biosemiotics (the study of signs, of communication, and of information in living organisms). See: Uexkull, Jacob von. Mondes animaux et monde humain : suivi de théorie de la signification (Paris : Deno'l, 1984). Further contributing to the subjective world of other animals, Donald Griffin first demonstrated that bats navigate the world using biosonar, a process he called "echolocation". See: Griffin, Donald R. Listening in the dark : the acoustic orientation of bats and men (Ithaca ; London: Comstock Publishing, 1986). First published in 1958. Griffin has since contributed to cognitive ethology with many books, most notably: The Question of Animal Awareness: Evolutionary Continuity of Mental Experience. (New York : The Rockefeller University Press, 1976), Animal Thinking (Cambridge, MA: Harvard University Press, 1984) and Animal Minds (Chicago: University of Chicago Press, 1992). Another important pioneering contribution was: Nagel, T. 1974. What is it like to be a bat? Philosophical Review 83: 435-405. In this paper Nagel offered a critique of physicalist explanations of the mind, pointing out that they do not take into account consciousness, i.e. what is the actual life experience of an organism. In this paper, a classic both of cognitive ethology and consciousness studies, Nagel reminds us that what science professes to be objective accounts inevitably omit points of view. In recognition of Griffin's pioneering work, which exhibited the problems of behaviorist and cognitive thinking that fails to acknowledge conscious awareness in mammals and thinking in small animals, several researchers pushed forward the research agenda of cognitive ethology. See: Ristau, Carolyn A. (ed.) Cognitive ethology : the minds of other animals : essays in honor of Donald R. Griffin (Hillsdale, N.J. : L. Erlbaum Associates, 1991). A comprehensive discussion of the multiple views that inform the debate around cognitive ethology, including the critique of those who oppose the very foundational principles of this science, can be found in: Bekoff, M., and Allen, C. "Cognitive ethology: Slayers, skeptics, and proponents", in R. W. Mitchell, N. Thompson, and L. Miles, eds.

Anthropomorphism, Anecdote, and Animals: The Emperor's New Clothes? (Lincoln, Nebraska: University of Nebraska Press, 1993). In his book Kinds of Minds, Daniel Clement Dennett makes a general attempt to explain consciousness irrespective of species. He takes the "intentional stance", i.e., the strategy of interpreting the behavior of something (a living or non living thing) as if it were a rational agent whose actions are determined by its beliefs and desires. He examines the "intentionality" of a molecule that replicates itself, that of a dog that mark territory, and that of a human that wishes to do something in particular. In the end, for Dennett it is our ability to use language that forms the particular mind humans have. Dennett believes that language is a way to unravel the representations in our mind and extract units of them. Without language, an animal may have exactly the same representation, but it doesn't have access to any unit of it. See: Dennett, D. C. Kinds of Minds: Toward an Understanding of Consciousness. (New York: Basic Books, 1996). For an examination of the rapport between philosophical theories of mind and empirical studies of animal cognition, see: Allen, C., & M. Bekoff. Species of Mind, The philosophy and biology of cognitive ethology (Cambridge, MA: MIT Press, 1997). Focused studies on the intelligence of non-primate species have also contributed to demonstrate the unique mental abilities of creatures such as marine mammals, birds, and ants. See: Schusterman, R. J., Thomas, J. A., and Wood, F. G. eds. Dolphin Cognition and Behavior: A comparative Approach (Hillsdale, New Jersey: Erlbaum, 1986); Skutch, A. F. The Minds of Birds (College Station, TX: Texas A. & M. University Press, 1996); Pepperberg, Irene Maxine. The Alex studies : cognitive and communicative abilities of grey parrots (Cambridge, Mass. ; London : Harvard University Press, 2000). For the question of communication in ants see Gordon, D. M. 1992. Wittgenstein and ant-watching. Biology and Philosophy 7: 13-25. On page 23, Deborah Gordon points out that "the way that scientists see animals' behavior occurs... [in] a system embedded in the social practices of a certain time and place." Gordon's field studies of interactions between neighboring colonies have shown that ants learn to recognize not only their own nestmates but also ants from neighboring, unrelated colonies. Her field studies have led to further research concerning communication networks within ant colonies.

For a more exhaustive examination of the problem, see: Gordon, D. M. . Ants at Work: how an insect society is organized. New York: Free Press, 1999). The key contribution of Gordon's book is to undue the popular perception that ant colonies run according to rigid rules and to show (based on her fieldwork with harvester ants in Arizona) that an ant society can be sophisticated and change its collective behavior as circumstances require. Finding inspiration in Charles Darwin's book The Expression of Emotions in Man and Animals (New York: D. Appleton and Company, 1872), Jeffrey M. Masson and Susan McCarthy make a convincing case for animal emotion. See: Masson, J. M. and S McCarthy. When Elephants Weep: The Emotional Lives of Animals (New York: Bantam Doubleday Dell, 1995). On the minds of nonhuman primates, see: Cheney, D. L., and Seyfarth, R. M. How Monkeys See the World: Inside the Mind of Another Species. (Chicago: University of Chicago Press, 1990); Montgomery, S. 1991. Walking With the Great Apes: Jane Goodall, Dian Fossey, and Birut`e Galdikas. New York: SUNY Press; Savage-Rumbaugh, , S. and R. Lewin 1994. Kanzi, The ape at the brink of the human mind. New York: Wiley; Russon, A. E., K. A. Bard & s. T. Parker eds. 1996. Reaching into Thought, the Minds of the Great Apes. Cambridge U. Press; Waal, F. M. de 1997 Bonobos: The Forgotten Ape. Berkeley, CA: University of California Press.

[9] Buber, Martin. I and Thou (New York: Collier, 1987), p. 124. According to Michael Theunissen, "Buber sought to outline an "ontology of the between" in which individual consciousness can only be understood within the context of our relationships with others, not independent of them." See: Theunissen, Michael. The Other: Studies in the Social Ontology of Husserl, Heidegger, Sarte, and Buber. Trans. Christopher Macann. (Cambridge, MA: MIT Press, 1984), pp. 271-272.

[10] Bakhtin, M. Problems of Dostoevsky's Poetics. Trans. Caryl Emerson. (Minneapolis: U of Minnesota P, 1984), p. 270. For Bakhtin, dialogic relationships "are an almost universal phenomenon, permeating all human speech and all relationships and manifestations of human life – in general, everything that has meaning and significance." Op.cit., p. 40.

[11] On the formation of "ego" or subjectivity through language, and the notion that it is only through language that we are conscious (i.e., are "subject" at all), see: Emile Benveniste, "Subjectivity in Language," chap. 21 in Problems in General Linguistics, trans. Mary Elizabeth Meek (1966; Coral Gables, Florida: Univ. of Miami Press, 1971), pp. 223-230. Echoing Buber, Benveniste's position is that when a person says "I" (i.e., when an individual occupies a subject position in discourse), he or she takes one's place as a member of the intersubjective community of persons. Thus, in being a subject/person, he or she is not simply an object/thing.

Benveniste was certainly not the only to consider the intersubjective nature of human experience. Wlad Godzich wrote: "For Kant, the fact that the individual could not experience the object as it was in itself required the postulation of another dimension among individuals: intersubjectivity". See: Arac, Jonathan and Godzich, Wlad (eds.) The Yale Critics: Deconstruction in America (Minneapolis: University of Minnesota Press, 1983), p. 46. When Edmund Husserl considered in retrospect his lectures of 1910/11, he wrote: "My lectures at Göttingen in 1910-11 already presented a first sketch of my transcendental theory of empathy, i.e. the reduction of human existence as mundane being-with-one-another to transcendental intersubjectivity." See: Husserl, E. Ideas Pertaining to a Pure Phenomenology and a Phenomenological Philosophy, Second Book, Phenomenological Investigations Concerning Constitution (Dordrecht: Kluwer, 1989), pg. 417. For Maurice Marleau-Ponty our not-sameness to each other is not a flaw, but is the very condition of communication: "the body of the other – as bearer of symbolic behaviors and of the behavior of true reality – tears itself away from being one of my phenomena, offers me the task of a true communication, and confers on my objects the new dimension of intersubjective being." For Marleau-Ponty it is in the ambiguity of intersubjectivity that our perception "wakes up." See: Merleau-Ponty, M. Primacy of Perception (Chicago: Northwestern University Press, 1964), 17-18. For a critical analysis of Merleau-Ponty's position on intersubjectivity, see: Friedman, Robert

M "Merleau-Ponty's Theory of Intersubjectivity", Philosophy Today 19: 228-42 (Fall 1975). Jurgen Habermas also gave the concept of intersubjectivity a central place in his work. Giving continuation to one of the projects of the Frankfurt School (the critique of the notion that valid human knowledge is restricted to empirically testable propositions arrived at by means of systematic inquiry professed to be objective and devoid of particular interests), Habermas finds in intersubjectivity a means of opposing theories which base truth and meaning on individual consciousness. For him, intersubjectivity is a communication situation in which "the speaker and hearer, through illocutionary acts, bring about the interpersonal relationships that will allow them to achieve mutual understanding". See: Habermas, J. (1976). Some distinctions in universal pragmatics. Theory and Society, 3, (2), p. 157. Habermas further explained his view of intersubjective communication: "When a hearer accepts a speech act, an agreement comes about between at least two acting and speaking subjects. However this does not rest only on the intersubjective recognition of a single, thematically stressed validity claim. Rather, an agreement of this sort is achieved simultaneously at three levels.... It belongs to the communicative intent of the speaker (a) that he perform a speech act that is right in respect to the given normative context, so that between him and the hearer an intersubjective relation will come about which is recognized as legitimate; (b) that he make a true statement (or correct existential presuppositions), so that the hearer will accept and share the knowledge of the speaker; and (c) that he express truthfully his beliefs, intentions, feelings, desires, and the like, so that the hearer will give credence to what is said." See: Jürgen Habermas, The Theory of Communicative Action, Vol. 1 Reason and the Rationalization of Society (Boston: Beacon Press, 1984), pp. 307-308.

[12] From the perspective of his unique and systematic branch of theoretical biology, Maturana explains the notion of consensual domain with great clarity: "When two or more organisms interact recursively as structurally plastic systems, each becoming a medium for the realization of the autopoiesis of the other, the result is mutual ontogenic structural coupling. From the point of view of the observer, it is apparent that the operational effectiveness that the various modes of conduct of the structurally coupled organisms have for the realization of their autopoiesis under their reciprocal interactions is established during the history of their interactions and through their interactions. Furthermore, for an observer, the domain of interactions specified through such ontogenic structural coupling appears as a network of sequences of mutually triggering interlocked conducts that is indistinguishable from what he or she would call a consensual domain. In fact, the various conducts or behaviors involved are both arbitrary and contextual. The behaviors are arbitrary because they can have any form as long as they operate as triggering perturbations in the interactions; they are contextual because their participation in the interlocked interactions of the domain is defined only with respect to the interactions that constitute the domain. Accordingly, I shall call the domain of interlocked conducts that results from ontogenic reciprocal structural coupling between structurally plastic organisms a consensual domain." See: Maturana, Humberto R. "Biology of Language: The Epistemology of Reality", in G. Miller & E. Lenneberg (Eds.) Psychology and Biology of Language and Thought (New York: Academic Press, 1978), p. 47. For an earlier discussion of "consensual domains", see: Maturana, H. R. The organization of the living: a theory of the living organization. The International journal of Man-Machine Studies, 1975, 7, 313-332.

Still in "Biology of Language: The Epistemology of Reality", Maturana explains the term autopoiesis: "There is a class of dynamic systems that are realized, as unities, as networks of productions (and disintegrations) of components that: (a) recursively participate through their interactions in the realization of the network of productions (and disintegrations) of components that produce them; and (b) by realizing its boundaries, constitute this network of productions (and disintegrations) of components as a unity in the space they specify and in which they exist. Francisco Varela and I called such systems autopoietic systems, and autopoietic organization their organization. An autopoietic system that exists in physical space is a living system (or, more correctly, the physical space is the space that the components of living systems specify and in which they exist)". Op. cit., p. 36. See also: Maturana, H.R. & Varela, F.G. Autopoiesis and

Cognition: The Realization of the Living. (Dordrecht, Holland: Boston: London : Reidel, 1980). This book was originally published in Chile as: De Maquinas y Seres Vivos, Editorial Universitaria, 1972.

[13] Emmanuel Levinas wrote: "Proximity, difference which is non-indifference, is responsibility." See Levinas, E. Otherwise than Being or Beyond Essence, translated by Alphonso Lingis (Boston: Martinus Nijhoff Publishers, 1981), p. 139. Partially influenced by the dialogical philosophy of Martin Buber, Levinas sought to go beyond the ethically neutral tradition of ontology through an analysis of the 'face-to-face' relation with the Other. For Levinas, the Other can not be known as such. Instead, the Other arises in relation to others, in a relationship of ethical responsibility. For Levinas, this ethical responsibility must be regarded as prior to ontology. For his insights on Buber's work, see: Levinas, E. "Martin Buber and the Theory of Knowledge", in Schilpp, P. (ed.) The philosophy of Martin Buber (La Salle, IL: Open Court , 1967), pp. 133-150.

[14] There are three types of cell: Prokaryotes, Eukaryotes, and Archae. Prokaryotes are unicellular organisms (e.g., bacteria) that lack a nuclear membrane and membrane-bound organelles. Eukaryotes are unicellular (e.g., yeast) or multicellular organisms (e.g., humans) that have a nuclear membrane surrounding genetic material and numerous membrane-bound organelles dispersed in a complex cellular structure. All cells in multicellular organisms are eukaryotic. Eukaryotes include most organisms (algae, fungi, protozoa, plants, and animals) except viruses, bacteria, and blue-green algae. Another major domain of life is called Archaea, microorganisms with genetic features distinct from prokarya and eukarya. The DNA of Archea is not contained within a nucleus. Many Archae live in harsh environments, such as thermal vents in the Ocean and hot springs. Most methane-producing bacteria are actually Archae.

[15] Teleo-nomic means regulatory principle (nomic) guided by an objective or intention (teleo), without implying any vitalistic connotations. For the concept of teleonomy, see: Ayala, F., "Teleological Explanations in Evolutionary Biology" in Philosophy of Science, (1970), v. 37, pp. 1-15; Lorenz, Konrad. Foundations of Ethology (New York: Springer, 1981), pp. 23-35; Lorenz, K. Behind the Mirror (New York: London: Harcourt Brace Jovanovich, 1977), pp. 21-25. Maturana and Varela advocate the "elimination of teleonomy as a defining feature of living systems", because they believe this concept does not accomplish much more than revealing "the consistency of living systems within the domain of observation". See : Maturana, H.R. & Varela, F.G. Autopoiesis and Cognition: The Realization of the Living. (Dordrecht, Holland: Boston: London : Reidel, 1980), pp. 85-87.

[16] On the question of the welfare of transgenic animals, see: L.F.M. van Zutphen, M. van der Meer, (Eds.) Welfare Aspects of Transgenic Animals (New York: Springer, 1997).

[17] By this I mean that the process was expected to be (and in fact was) as common as any other rabbit pregnancy and birth. This is due to the fact that transgenic technology has been successfully and regularly employed in the creation of rabbits since 1985. See: Hammer, R. E., Pursel, V. G., Rexroad, C. E., Jr., Wall, R. J., Bolt, D. J., Ebert, K. M., Palmiter, R. D., and Brinster, R. L. Production of transgenic rabbits, sheep and pigs by microinjection. Nature 315, 680-683 (1985).

[18] The zygote is the cell formed by the union of two gametes. A gamete is a reproductive cell, especially a mature sperm or egg capable of fusing with a gamete of the opposite sex to produce the fertilized egg. Direct microinjection of DNA into the male pronucleus of a rabbit zygote has been the method most extensively used in the production of transgenic rabbits. As the foreign DNA integrates into the rabbit chromosomal DNA at the one-cell stage, the transgenic animal has the new DNA in every cell. For detailed discussion of the methods and applications of microinjection technology, see: Lacal, J.C., Perona, R. , and Feramisco, J. Microinjection (New York: Springer, 1999). The first successful creation of transgenic mice using pronuclear microinjection was reported in

1980: Gordon, J.W. et al., 1980. Genetic transformation of mouse embryos by microinjection of purified DNA. Proc. Natl. Acad. Sci. USA 77: 7380-7384. The new gene was proven to have been integrated into the mouse genome, but it did not express. The first visible phenotypic change in transgenic mice was described in 1982 for animals expressing the rat growth hormone sequence: Palmiter, R.D. et al., 1982. Dramatic growth of mice that develop from eggs microinjected with metallothionein-growth hormone fusion genes. Nature 300: 611-615. Following transgenic mice creation, rabbits, sheep and pigs were also created (see note 17). Currently, several hundred transgenic expression papers are published each year.

[19] See note 2.

[20] A lagomorph is one of the various gnawing mammals in the order Lagomorpha, including rabbits, hares, and pikas.

[21] Krempels, Dana M., "What Do Rabbits See?" House Rabbit Society: Orange County Chapter Newsletter 5 (Summer 1996), 1. For a more comprehensive examination of vision in rabbits and other animals, see: Smythe, R.H., Vision in the Animal World, St. Martin's Press, New York (1975).

[22] In Part I of Book IX of his "The History of Animals", written ca. 350 BC, Aristotle recognized the complexity of animal emotional states: "Of the animals that are comparatively obscure and short-lived the characters or dispositions are not so obvious to recognition as are those of animals that are longer-lived. These latter animals appear to have a natural capacity corresponding to each of the passions: to cunning or simplicity, courage or timidity, to good temper or to bad, and to other similar dispositions of mind." See: Aristotle. History of Animals. Books VII-X. (Cambridge, MA: London : Harvard University Press, 1991). Although in the first chapter of the Metaphysics Aristotle attributes forms of reason and intelligence to animals, in another book (Politics) he claims that humans are the only animal capable of logos (Book VII, Part XIII): "Animals lead for the most part a life

of nature, although in lesser particulars some are influenced by habit as well. Man has rational principle, in addition, and man only." Also in the Politics, he compares animals to slaves (Book I, Part V): "the use made of slaves and of tame animals is not very different; for both with their bodies minister to the needs of life. " See: Aristotle. The works of Aristotle (London, Oxford Univ., 1966).

[23] In his 1637 Discourse on the Method, Descartes insists on an absolute separation between human and animal. For him, consciousness and language create the boundary of being between humankind and animals. Descartes stated that "beasts have less reason than men," and that in fact "they have no reason at all". See: Descartes, Rene. 1637. "Discourse on the Method," in Descartes: Selected Philosophical Writings. Trans. John Cottingham, Robert Stoothoff and Dugald Murdoch. (Cambridge: Cambridge University Press, 1988), p. 45. For Descartes, since animals do not have a recognizable language they lack reason, and as a result are in his view like automata, capable of mimicking speech but not truly able to engage in discourse that enables and supports consciousness. The byproduct of this view is the ascription of animality to the domain of the unconscious. This maneuver did not escape the attention of semiotician Charles Sander Peirce, who criticized Descartes: "Descartes was of the opinion that animals were unconscious automata. He might as well have thought that all men but himself were unconscious" See: Peirce, Charles Sanders. 1901. "Minute Logic," in Peirce on Signs: Writings on Semiotic by Charles Sanders Peirce. Ed. James Hoopes. (Chapel Hill: University of North Carolina Press, 1991), p. 234.

[24] In An Essay Concerning Human Understanding (Book II, Chapter XI), John Locke wrote: "If it may be doubted whether beasts compound and enlarge their ideas that way to any degree; this, I think, I may be positive in that the power of abstracting is not at all in them; and that the having of general ideas is that which puts a perfect distinction betwixt man and brutes, and is an excellency which the faculties of brutes do by no means attain to. For it is evident we observe no footsteps in them of making use of general signs for universal ideas; from which we have reason to imagine that they have not the faculty of abstracting, or mak-

ing general ideas, since they have no use of words, or any other general signs." Even though Locke denied animals the faculty of abstract thought, he still did not agree with Descartes in considering animals automata. Still in the same chapter, Locke wrote: " if they [animals] have any ideas at all, and are not bare machines, (as some would have them,) we cannot deny them to have some reason." In his partial rejection of the Cartesian theory of knowledge John Locke proposed two sources of ideas: sensation and reflection. By means of the difference between ideas of sensation and ideas of reflection, Locke distinguished man from animals: animals had certain sensory ideas and a degree of reason but no general ideas (i.e., abstraction ability) and as a result no language for their manifestation. For Locke, abstraction is firmly beyond the capacity of any animal, and its is precisely abstract thought that plays a fundamental role in forming the ideas of mixed modes, on which morality depends.

[25] For Gottfried Leibniz, animals did not have self-consciousness and the power to recognize eternal truths, which for him were characteristics of the souls of men. He wrote: "I am also inclined to believe that there are souls in the lower animals because it pertains to the perfection of things that when all those things are present which are adapted to a soul, the souls also should be understood to be present." [...] But no one should think that it can with equal justice be inferred that there must also be minds in the lower animals; for it must be known that the order of things will not allow all souls to be free from the vicissitudes of matter, nor will justice permit some minds to be abandoned to agitation. So it was sufficient that souls should be given to the lower animals, especially as their bodies are not made for reasoning, but destined to various functions – the silkworm to weave, the bee to make honey, and the others to the other functions by which the universe is distinguished." See: Leibniz, G., "A Specimen of Discoveries About Marvellous Secrets" (c. 1686), in Philosophical Writings (London : Melbourne: Dent, 1984), p. 84.

[26] In The Metaphysics of Morals (Metaphysical First Principles of the Doctrine of Virtue) Kant states that we as human beings are distinguished from other ani-

mals by our capacity to set ends for ourselves, which is only possible for a rational being. See: The Metaphysics of Morals (Cambridge: Cambridge University Press, 1991), pp. 381, 384-85, 392. For Kant the moral faculty of humans was directly connected to the fundamental property of reason. He did not find in nature the origin of morality, and thus denied animals membership in the (moral) kingdom of ends. For Kant, the sense of moral duty is inherent in humans (but not animals): "animals are not self conscious and are there merely as a means to an end. That end is man." He continued: "our duties towards animals are merely indirect duties towards humanity". In other words, Kant believed one should not harm animals because in doing so one indirectly would damage humanity (one might see another human as less human and become prone to other kinds of cruelty).   See: Kant, I. "Duties to Animals", in Animal Rights and Human Obligations. Eds. T. Regan & P. Singer. (New Jersey: Prentice Hall, 1976), p. 122.

[27] In his seminal essay On Truth and Lies in a Nonmoral Sense (1873), Friedrich Nietzsche (who once stopped a man from beating his horse) wrote: "As a "rational" being, [a person] now places his behavior under the control of abstractions. He will no longer tolerate being carried away by sudden impressions, by intuitions. First he universalizes all these impressions into less colorful, cooler concepts, so that he can entrust the guidance of his life and conduct to them. Everything which distinguishes man from the animals depends upon this ability to volatilize perceptual metaphors in a schema, and thus to dissolve an image into a concept." In this essay, Nietzsche states that what we call "truth" is only "a mobile army of metaphors, metonyms, and anthropomorphisms." For him arbitrariness prevails within human experience: what one ordinarily calls "truth" is nothing but the invention of fixed conventions for practical purposes, particularly those of security and consistency.

[28] Buber expounds on the I-Thou relationship between human and non-human animals: "Man once "tamed" animals, and he is still capable of this singular achievement. He draws animals into his atmosphere and moves them to accept him, the stranger, in an elemental way, and to respond to him. He wins

from them an often astonishing active response to his approach, to his address-ing them, and moreover a response which in general is stronger and directer in proportion as his attitude is a genuine saying of Thou. Animals, like children, are not seldom able to see through any hypocritical tenderness. But even outside the sphere of taming a similar contact between men and animals sometimes takes place--with men who have in the depths of their being a potential partnership with animals, not predominantly persons of "animal" nature, but rather those whose very nature is spiritual". See: Buber, Martin. I and Thou (New York: Collier, 1987), p. 125.

[29] For a comprehensive examination of the approaches to animality within the Western tradition, and for a philosophical contribution towards a more respect-ful understanding of non-human animals, see: Fontenay, Elisabeth. Le silence des betes (Paris: Fayard, 1998).

[30] For the first time, gene therapy has unequivocally succeeded. French doc-tors used the treatment, which involves adding working genes to cells, to save the lives of several children who might otherwise have died of a severe immune disorder. See: Marina Cavazzana-Calvo, Salima Hacein-Bey, Geneviève de Saint Basile, Fabian Gross, Eric Yvon, Patrick Nusbaum, Françoise Selz, Christophe Hue, Stéphanie Certain, Jean-Laurent Casanova, Philippe Bousso, Françoise Le Deist, and Alain Fischer. "Gene Therapy of Human Severe Combined Immunodeficiency (SCID)-X1 Disease", Science 2000 April 28; 288: 669-672. For a popular account, see: Petitnicolas, Catherine. "Premier succès de la thérapie génique", Le Figaro, April 28, 2000, p. 16.

[31] A case in point is the notorious example of Monsanto's claim that it seeks to feed the world, and the rebuke from 24 African delegates to the Food and Agriculture Organization (FAO) negotiations on the International Undertaking for Plant Genetic Resources, June 1998. See: Bruno, Kenny. "Monsanto's Failing PR Strategy", in The Ecologist, Vol. 28, N. 5, Sept/Oct 1998, p. 291.
[32] Here I use the word "symbolic" in the sense that the artwork is not just an

entity to be regarded for its intrinsic and unique properties or just a pragmatic way of accomplishing a goal, but also (and always) a means of producing a world of understanding. My use of the word is partially motivated by Erwin Panofky's application of Ernst Cassirer's Philosophy of Symbolic Forms (3 vol., 1923-29). See: Panofsky, E. Perspective as Symbolic Form (New York: Zone Books, 1991). On pages 40-41 Panofky says that perspective is "one of those 'symbolic forms' in which 'spiritual meaning' is attached to a concrete, material sign and intrinsi-cally given to this sign."

Excitation spectrum of EGFP (488nm)

Emission spectrum of EGFP
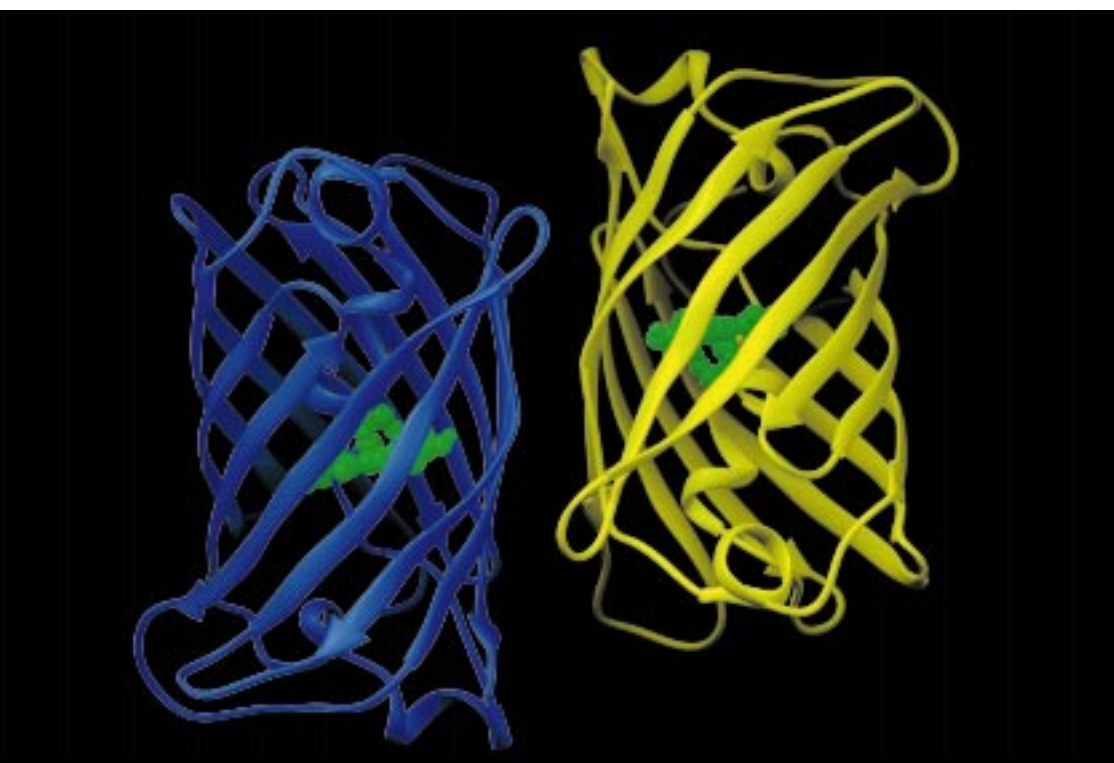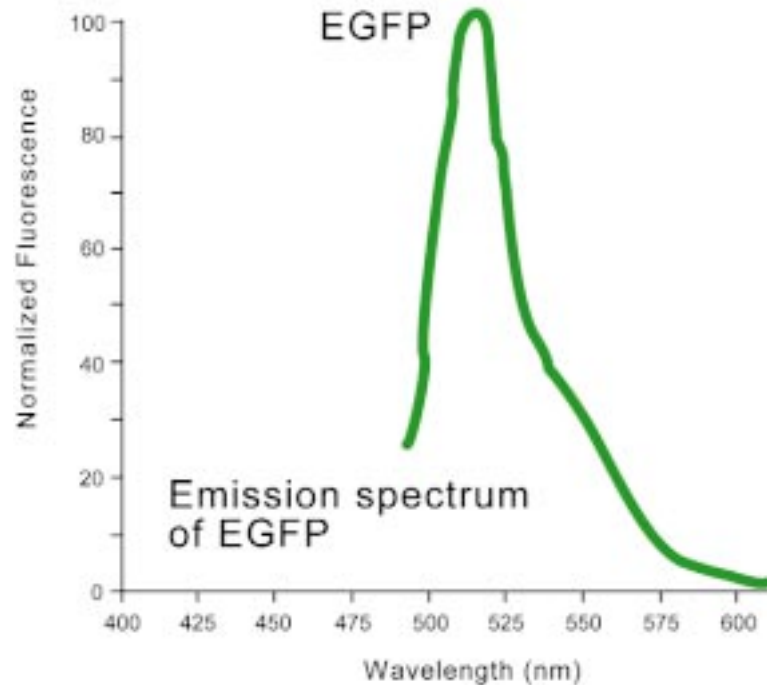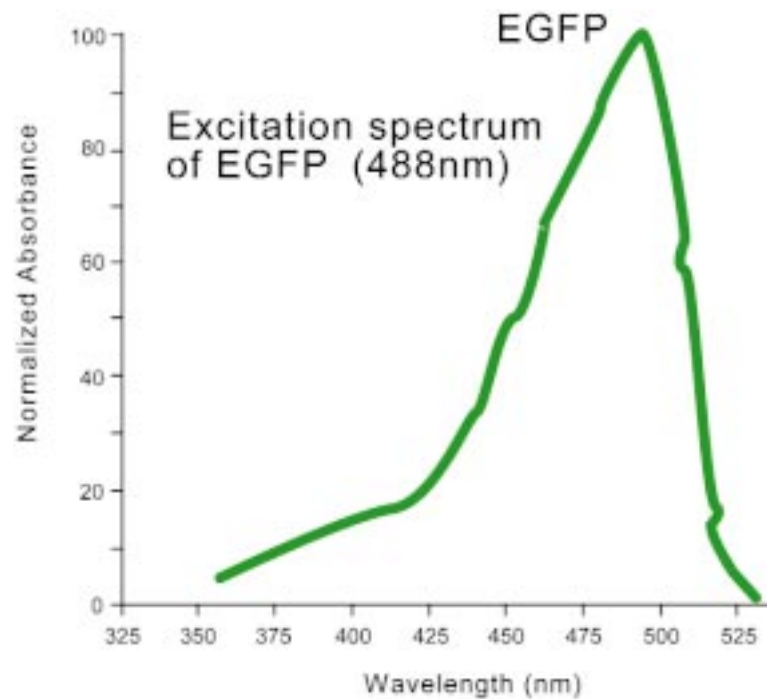
BIOGRAPHY

1962   July 3, Born in Rio de Janeiro, Brazil
1980   Creates a performance group focused onpublic interventions and per
        forms regularly on beaches,squares, theaters, television
1982   Conclusion of performance series on Ipanemabeach Experiments with
        multiple media and processes,including graffiti, photography, visual
        poetry, artist'sbook, rubber stamps, photocopiers, clothing, billboards
1983   Invention of Holopoetry; creation of first holopoem Publication of
        artist's book Escracho
1984   Participates in the landmark exhibition Como VaiVocî, GeraȚo 80?, at
        Escola de Artes Visuais do parque Lage, Rio de Janeiro
1985   First Holopoetry solo show, at Museum ofImage and Sound, Sâo Paulo
        Presents digital language pieces in the Brazilian videotext network (a
        precursor of the Internet)
        Acquisition Award at the National Salon of Fine Arts, Museum of
        Modern Art, Rio de Janeiro
        Finishes his studies in communications theory, linguistics, and semiotics
        at Rio's Catholic University
1986   Organizes the group show Brasil High Tech at the Galeria Empresarial
        Rio, Rio de Janeiro
        First telepresence experiments with wirelessradio-controlled robot
        shown at Brasil High Tech; participants could converse with the public
        through the body of the mobile robot
        Resident Artist at the Museum of Holography,New York
1987   Works with fax, televison, Slow Scan TV
1988   Holopoetry solo show at Funarte, Rio de Janeiro
        Studies philosophy and contemporary theory at Universidade, Rio de
        Janeiro
1989   Moves to Chicago
        Creates the Ornitorrinco telepresence project with Ed Bennett
1990   First international Ornitorrinco event, linking Chicago and Rio de Janeiro

Solo show, Museum of Holography, New York

1992   Ornitorrinco in Copacabana, shown at Siggraph ArtShow, Chicago

1993   Ornitorrinco on the Moon, shown at Kźnstlerhaus,Graz, Austria, linking Chicago to Graz

1994   First wireless telerobotic artwork on the Internet: Ornitorrinco in Eden, shown online and simultaneously in galleries in Chicago, Lexington (KY), and Seattle
First biotelematic work: Essay Concerning Human Understanding

1995   Escracho enters the collection of theMuseum of Modern Art, New York

1996   Ornitorrinco, the Webot, travels around the world in eighty nanoseconds going from Turkey to Peru and back, shown on the Internet and at Otso Gallery, in Espoo, Finland
Creates the Telepresence Garment
Ornitorrinco in the Sahara, shown at St. Petersburg Biennale, in Russia, linking Chicago and St. Petersburg
Rara Avis premieres on the Internet and at Nexus Contemporary Art Center, Atlanta
Teleporting An Unknown State premieres on the Internet and at the Contemporary Art Center, New Orleans
Kac's anthology New Media Poetry is published as a special issue of the journal Visible Language

1997   A-positive (with Ed Bennett) premieres at Gallery 2, Chicago
First microchip implant tracked online: Time Capsule is live on televison, as a webcast, and at Casa das Rosas, a cultural center in Sâo Paulo
Joins the full-time faculty at The School of the Art Institute of Chicago

1998   First proposes transgenic art
Publishes "Transgenic Art" text in LeonardoElectronic Almanac proposing the creation of a green fluorescent dog and its social integration
Teleporting An Unknown State - Web Version premieres on the Internet and at KIBLA Art Gallery, Maribor, Slovenia
Beginning ofrepresentation by Julia Friedman and Associates, Chicago

1999   Darker Than Night is shown in a bat cave at the Rotterdam Zoo, as part of the exhibition "Fables of a Technological Era"
First transgenic artwork: Genesis premieres at Ars Electronica, Linz, Austria, and on the Internet
Presents and discusses transgenic art in a lecture at Ars Electronica
Uirapuru premieres at ICC Biennial, InterCommunication Center, Tokyo, and on the Internet

2000   Alba, the green fluorescent rabbit, is born in Jouy-en-Josas, France, as part of the work GFP Bunny
GFP Bunny presented publicly at Grenier à Sel, inAvignon, in the context of the Avignon Numerique festival
Transgenic Art exhibition premieres at KIBLA Art Gallery, , Slovenia
Genesis is shown at Itau Cultural Center, Sâo Paulo
Fellowship at Institute for Studies in the Arts, University of Tempe, to develop and exhibit "The Eighth Day" Genesis is shown at Exit Art, NewYork

Many grants and awards including ArtsLink (New York), Illinois Arts Council (Chicago), The Daniel Langlois Foundation (Montreal), Leonardo Award for Excellence (San Francisco), InterCommunication Center Biennale '99 Award (Tokyo).

Lectures and publishes worldwide.

TELEPRESENCE, BIOTELEMATIC AND TRANSGENIC ART

Telepresence Art
Art that promotes remote agency through a combination of telecommunications and robotics

RC Robot, Galeria de Arte do Centro Empresarial Rio, Rio de Janeiro, 1986

Ornitorrinco: Experience I, The School of the Art Institute of Chicago, 1990
(The Ornitorrinco Series was developed with Ed Bennett)

Ornitorrinco in Copacabana, Siggraph Art Show, Chicago, 1992

Ornitorrinco on the Moon, Künstlerhaus, Graz, Austria, 1993

Ornitorrinco in Eden, The School of the Art Institute of Chicago, Center for Contemporary Art, Lexington, Kentucky, and Seattle Center, 1994

The Telepresence Garment, St. Petersburg Biennale, Russia, 1996

Ornitorrinco in the Sahara, St. Petersburg Biennale, Russia, 1996

Ornitorrinco, the Webot, travels around the world in eighty nanoseconds going from Turkey to Peru and back, Otso Gallery, Espoo, Finland, 1996

Rara Avis, Nexus Contemporary Art Center, Atlanta, 1996

Rara Avis, Huntington Art Gallery, Austin, Texas, 1997

Rara Avis, Centro Cultural de Belém, Lisbon, Portugal, 1997

Rara Avis, Mercosul Biennial, Porto Alegre, Brazil, 1997

Darker Than Night, Fables of a Technological Era, Blijdorp Zoological Gardens, Rotterdam, 1999

Uirapuru, ICC Biennial, InterCommunication Center, Tokyo, 1999

Biotelematic Art
Art in which a biological process is intrinsically connected to digital telecommunications

Essay Concerning Human Understanding, Center for Contemporary Art, Lexington, Kentucky and Science Hall, New York, 1994 (with Ikuo Nakamura)

Teleporting An Unknown State, Contemporary Art Center, New Orleans, 1996

Time Capsule , Casa das Rosas Cultural Center, Sâo Paulo, 1997

Teleporting An Unknown State, Kibla Art Gallery, Maribor, Slovenia, 1998

Transgenic Art
Art form based on the use of genetic engineering techniques to transfer synthetic genes to an organism or to transfer natural genetic material from one species into another, to create unique living beings

Genesis, O.K. Center for Contemporary Art, Linz, Ars Electronica, 1999

GFP K-9, Public Presentation, Brucknerhaus, Linz, Ars Electronica, 1999

The Eighth Day, Institute for Studies in the Arts, Arizona State University, Tempe, 2000

Genesis, Itau Cultural Center, Sâo Paulo, 2000

Transgenic Art, Kibla Art Gallery, Maribor, Slovenia, 2000

GFP Bunny , Grenier à Sel, Avignon, 2000

Genesis, Exit Art, New York, 2000

Genesis, San Francisco Museum of Modern Art, San Francisco, 2001

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