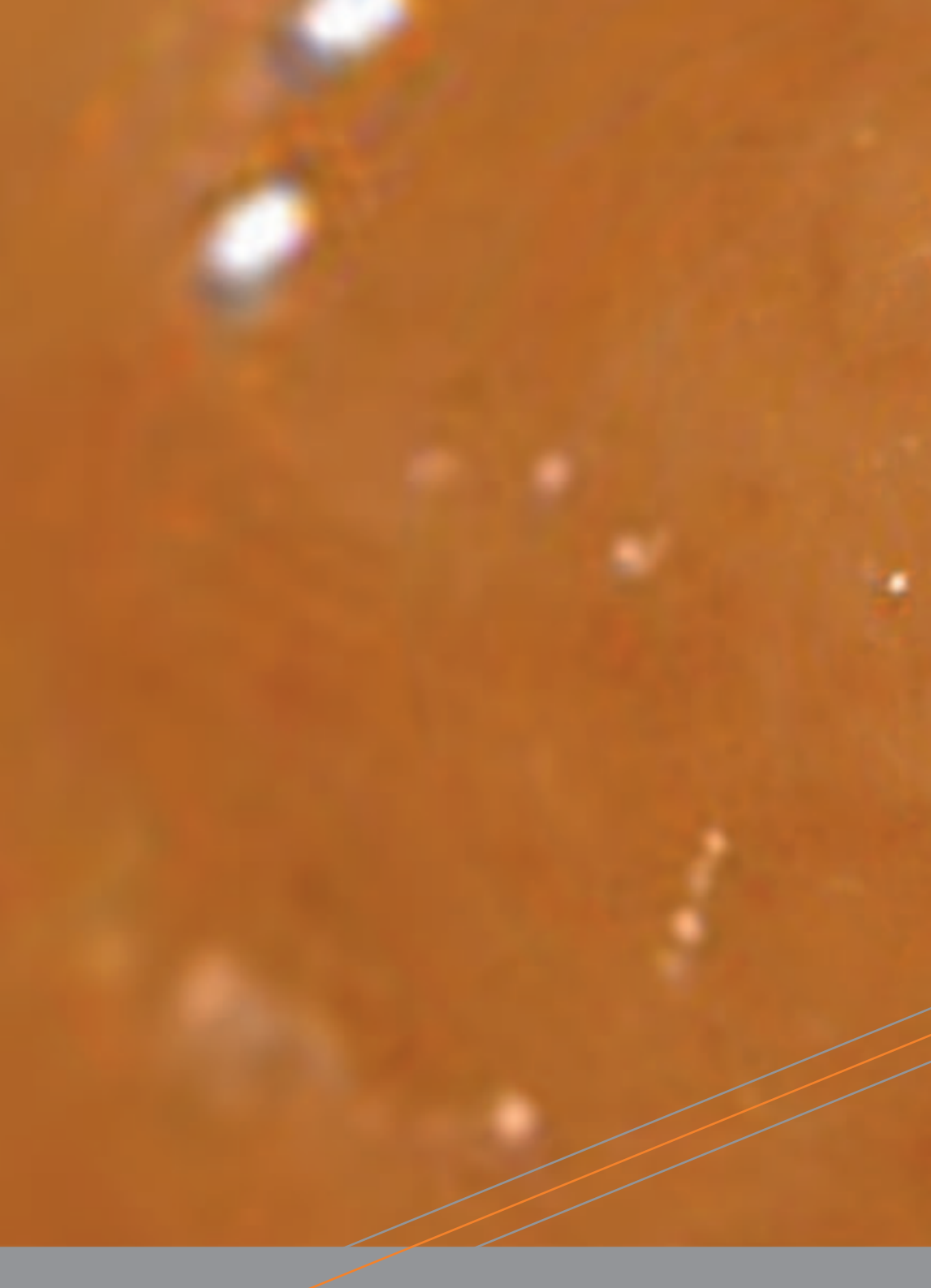
BEAP

BIENNALE OF ELECTRONIC ARTS PERTH

- IMMERSION
- BIOFEEL
- SCREEN



> SYMBIOTICA RESEARCH GROUP
> MEART (AKA FISH & CHIPS)

> THE TISSUE CULTURE & ART PROJECT
>PIG WINGS
>TISSUE CULTURE & ART(IFICIAL) WOMBS

>ADAM ZARETSKY
>MMMM

>AMY YOUNGS
>REARMING THE SPINELESS OPUNTIA

>MARTA DE MENEZES
> PROTEIC PORTRAIT
NUCLEART

>HEDKIKR
>INTERXECTION

>ANDRÉ BRODYK
>DNART

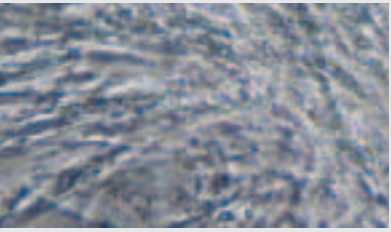
BIOFEEL

IMMERSION

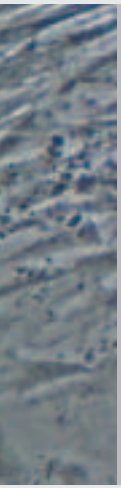
BIOFEEL >>

SCREEN

Oron Catts



Statement



The opening of new possibilities and alternative futures is at the core of the works presented in BioFeel. These are not merely representations about concepts. Rather they are tangible suggestions, employing new technologies yet to be subverted. This exhibition was originally conceived to present recent work created in SymbioticA by The Tissue Culture & Art Project and the SymbioticA Research Group. These works have been shown elsewhere, but never in Perth and never as a collection. In addition, BioFeel seemed an ideal vehicle to present the results of Adam Zaretsky's six-month residency in SymbioticA and to début his *MMMM* installation. Marta de Menezes' and Amy Youngs' works were chosen to be included in this show as they each raise issues concerning the practices that are being explored in SymbioticA. Marta is investigating the notion of the bio-medical lab as an artist's studio. Amy's *Rearming the Spineless Opuntia* deals with the responsibilities that might have to be exercised once living systems are deliberately manipulated.

SymbioticA was established in April 2000 with one of its main premises being that it would act as a porous membrane in which art and bio-medical sciences and technologies could mingle. This is an artist-run laboratory within a biological science department. Artists are encouraged to employ biological techniques as part of their practice.

The use of biological technologies is admittedly a contentious issue. These technologies are becoming a major part of our lives, and predictions claim that this will have a profound effect on our relationships with all living systems. The application of knowledge, acquired thorough directed research in life sciences, seems to be driven by forces that are interested in short term gains for the few, often neglecting long term risks. The utilisation of knowledge gained as part of both basic and profit driven research into living systems seems even more alarming in the light of the war clouds hovering

above. In addition to the obvious threat of biological warfare, the apparent decline in compassion to the Other makes our times perilous to make decisions about the manipulation and use of living systems. These decisions will determine the kinds of relationships we will form with the living world around us, be it a product of evolution or of human intervention.

Developments in technology are actualised possibilities, not necessarily the only ways knowledge can be utilised. As biological research departments in universities are encouraged by governments to partner with 'industry' and 'defence', the need for research into non-utilitarian purposes become urgent. The exploration of contestable possibilities is important to the understanding of the ways technology may develop. By fostering artistic critical engagements with biological research, SymbioticA provides a greenhouse for developing alternatives to the commercial mainstream. The art here goes beyond the fantasy of the surrealist project. The artists are dealing with the actual wet palette of possibilities of life manipulation offered by biotechnology.

The aesthetically driven and confronting treatment of these tools by the artists creates an uneasy feeling about the level of manipulation of fellow living beings humans have reached. This uneasiness seems to stem from a cultural and ethical ambiguity in regard to human engagement with life's processes. Our values and belief systems seem to be ill-prepared to deal with the consequences of applied knowledge in the life sciences.

The human-centric perception that guided our conduct towards other living beings since we started farming, did not diminish even after our origins were revealed as yet another branch of the evolutionary tree. The field of ethics still seems to be almost absolutely denominated by human-centric discourse, and things are not different in the relatively new area of bioethics. This self-obsessive trait might not be very useful as species barriers collapse and as new living entities appear. The level of manipulation of living systems that biotechnology is starting to provide is unprecedented in evolutionary terms. The ways in which humans choose to exercise their technologies on the world around them reflects on the ways they will use it on each other.

All work presented here deals in one way or another with the relationships we form with manipulated living systems. The resolution shifts from the protein through the chromosome, the cell and the tissue, to the whole organism. The accompanying symposium, *The Aesthetics of Care?*, will focus on these issues from academic, legal, ethical and artistic perspectives. It will provide a forum for deliberating on the artistic, social and scientific implications of the use of biological/medical technologies for artistic purposes. It will probe current models of practices and explore new roles and skills artists may acquire as they venture into this new realm of operation. This Symposium will deal with the relationships artists and audience form with works of art that consist of living biological systems.

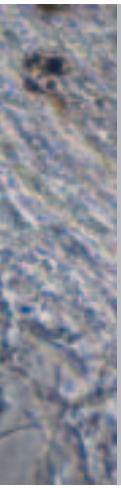
The Art and Science Collaborative Research Laboratory

School of Anatomy and Human Biology
University of Western Australia

By Stuart Bunt and Oron Catts, founders and directors
of SymbioticA

SymbioticA

http://www.symbiotica.uwa.edu.au



What is SymbioticA?

SymbioticA is a research laboratory dedicated to the exploration of scientific knowledge in general, and biological technologies in particular, from an artistic and humanistic perspective. It is located in The School of Anatomy & Human Biology at The University of Western Australia. SymbioticA is the first research laboratory of its kind, in that it enables artists to engage in wet biology practices in a biological science department. Developments in science and technology, in particular in the life sciences, are having a profound effect on society, its values, belief systems and treatment of individuals, groups and the environment. The interaction of art, science, industry and society is recognized internationally as an essential avenue for innovation and invention, and as a way to explore, envision and critique possible futures. Science and Art both attempt to explain the world around us in ways that are profoundly different but which can be complementary to each other.

Artists can act as important catalysts for creative and innovative processes and outcomes. They can also critically examine the various assumptions, and sometimes self delusions, built in to the 'scientific method'. There is a need for artists and other professionals in the humanities to actively participate in research into possible and contestable futures arising from these developments. While non-scientifically trained artists may have a limited ability to analyse the detailed veracity of scientific work, "outsiders" working in a different mental framework can bring both insights and distractions into the debates about the mechanisms, ethics and philosophy behind scientific work. This can only be effective if those same artists engage actively in the science and the debate so that they have enough understanding of the process and work to engage meaningfully with it.

SymbioticA sets out to provide a situation where this can happen, an opportunity in which interdisciplinary research and other knowledge and concept generating activities can take place. It provides an opportunity for researchers to pursue curiosity-based explorations free of the demands and constraints associated with the current culture of scientific

research. SymbioticA also offers a new means of artistic inquiry, one in which artists actively use the tools and technologies of science, not just to comment about them, but also to explore their possibilities.

SymbioticA welcomes undergraduate and postgraduate students from all disciplines, artists and scholars to work in interdisciplinary research teams exploring new directions for new technologies and the effects on society that they might have. It enables artists to access and explore a wide range of scientific materials and processes. SymbioticA is designed as an evolving place of artistic investigation that is accessible to people throughout Western Australia and beyond. SymbioticA aims to become a resource centre of investigation and research in the field of art and (mainly biological) science collaborations. It is a base for both short and long-term residencies. The first undergraduate course run by SymbioticA has been a very challenging and rewarding experience to all involved. Adam Zaretsky was the main driving force behind this course, drawing on his experiences teaching art and biology at Steven Wilson's Conceptual Information Arts Department at the San-Francisco State University. SymbioticA's Vivoarts course included lab visits and practices, field days to the zoo and breading farms, and many ethical discussions. Documentation of work produced in this course will be presented as part of Biofeel.

SymbioticA's Position in The University of Western Australia.

The School of Anatomy and Human Biology is quite unique in the scope and variety of the research interests of its staff. The department has a long tradition of working with artists. The departmental corridors are lined with art works. Hans Arkveld, a sculptor and painter, has been working with the department for the last three decades, other artists have come and gone on an ad hoc basis, but although many observed and gained inspiration there, none actually used the laboratories to produce their art work.

SymbioticA is now a research lab like any other in the department, or is it? The tension of the ambiguous position of SymbioticA in relation to the academic disciplines is generating collaborations that have no other place to evolve. With SymbioticA, artists can now work in the different laboratories in the department, such as the molecular biology, tissue culture, neuroscience, biomechanics laboratories and a biological imaging facility (IAAF). Artists will also have access to CTEC- the state of the art training facility for surgeons, including The Hill International Surgical & Medical Workshops, and a VR haptics room.

SymbioticA is a non-for profit organization, and as such, it is free to explore different modes of operation. However in order to survive in the harsh reality of the market economy environment it operates in, while maintaining its integrity and artistic freedom, it has to adapt some of the prevailing rhetoric and practices. This in spite of maintaining a critical outlook and insisting on a model of cooperation and collaboration rather than one of competition.

The West Australian Lotteries Commission and The University of Western Australia (UWA) jointly funded the set up for SymbioticA. SymbioticA provides a unique facility for Western Australia and enhances Western Australia's international positioning as a place that fosters innovations.

SymbioticA Research Group
Guy Ben-Ary Phil Gamblen Dr. Stuart Bunt Ian Sweetman
Oron Catts Ionat Zurr Gil Weinberg and Matt Richards in collaboration with Steve M Potter, Tom DeMarse and Alexander Shkolnik

MEART – the semi living artist (AKA Fish & Chips) Stage 2.

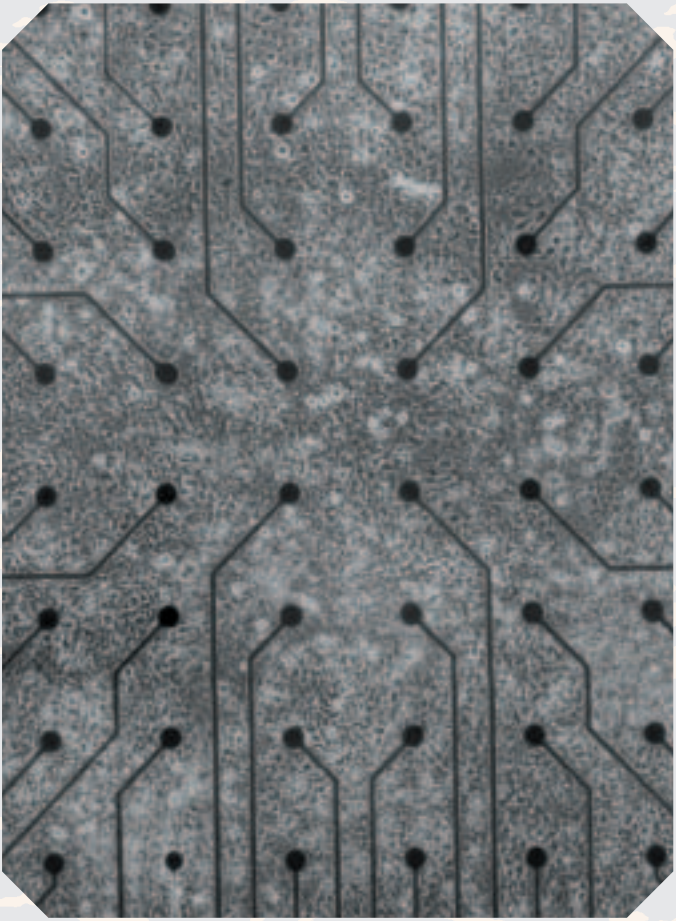
http://www.fishandchips.uwa.edu.au

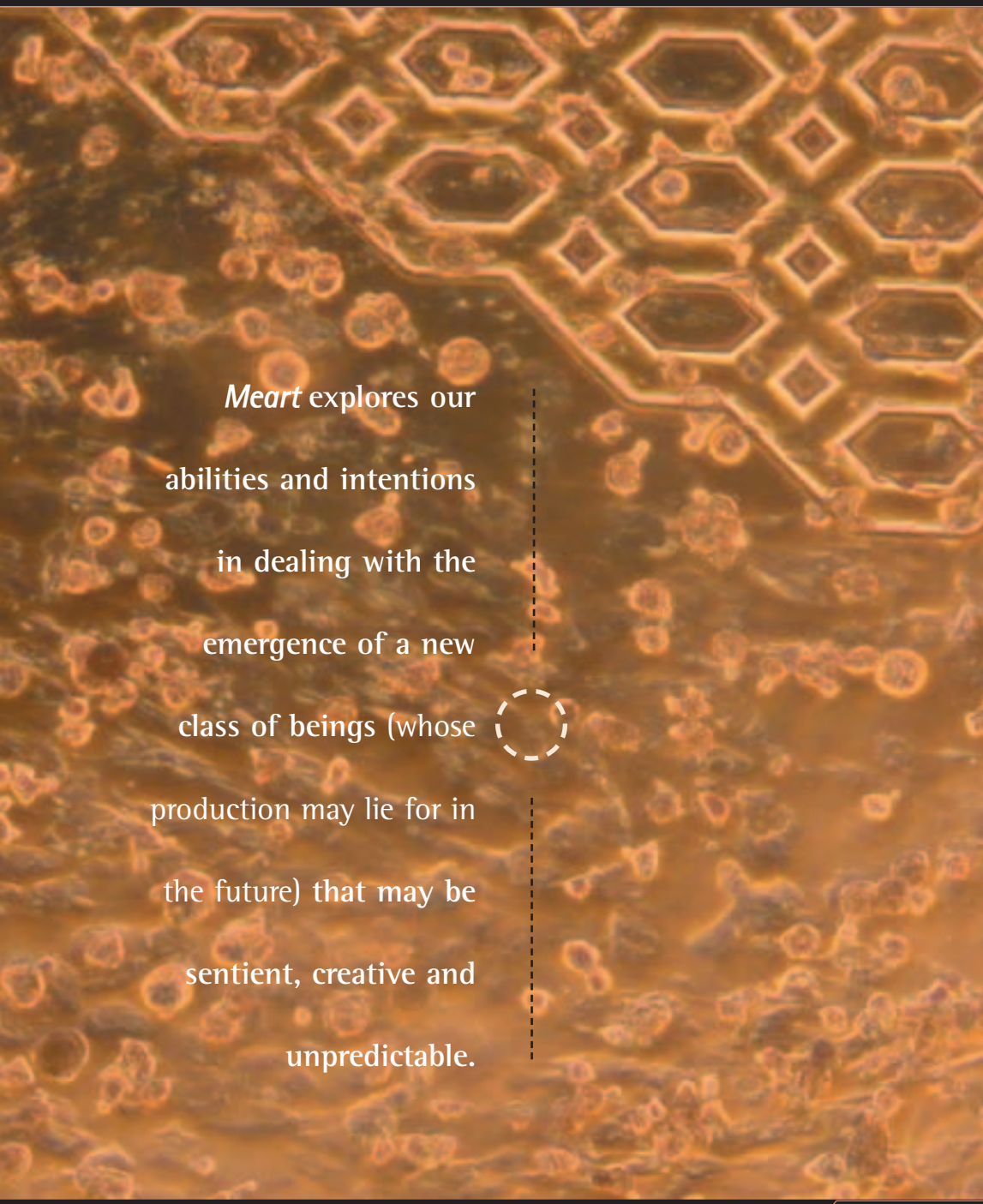
The current status of the research into
Meart – the semi living artist
(AKA Fish & Chips) – Stage 2.
SymbioticA Research Group in collaboration with Steve M Potter, Tom DeMarse and Alexander Shkolnik.

Meart is a bio-cybernetic research & development project exploring aspects of creativity and artistry in the age of new biological technologies. Meart is assembled from: Neurons from embryonic rat cortex – 'Wetware' – grown over Multi Electrode Array (MEA)[1] , 'Software' – that interfaces between the wetware and the 'Hardware' – the robotic (drawing) arm. In this paper we will discuss our goals, vision and the current state of research (Stage 2) into the development of a 'semi-living artistic entity'.

The first public outcome of the project (Fish & Chips – Stage 1) was presented in the Ars Electronica Festival, *Takeover*, 2001[2] . In this case we used the real time electrical activity of fish neurons (some cultured over silicon and pyrex chips) to control a robotic arm that produced 'visual art' and a sound piece. We closed the feedback loop by determining the frequency of stimulation of the neurons according to the music that was generated on the fly. The installation featured a laboratory/studio set-up, prototypes and documentation of the project, and was an example of the research being conducted in SymbioticA.

In *BioFeel* we will present the outcomes of the second stage of the project. We decided to change its name as we will not be using fish neurons and silicon chips rather neurons from embryonic rat cortex grown over a Multi Electrode Array (MEA). In this stage we are collaborating with Dr. Steve M Potter, a neuroscientist from the Laboratory for Neuroengineering, Georgia Institute of Technology. Steve and his group are developing a new paradigm for neurobiology research, that will bring together top-down





Meart explores our abilities and intentions in dealing with the emergence of a new class of beings (whose production may lie for in the future) that may be sentient, creative and unpredictable.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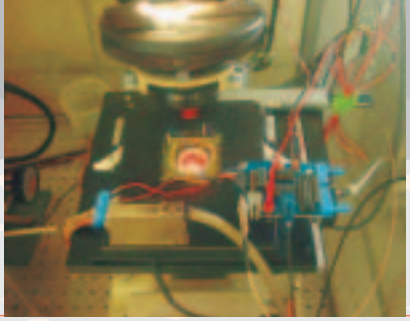
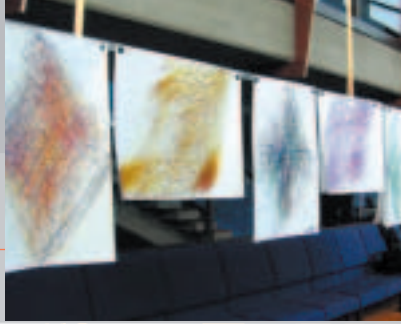
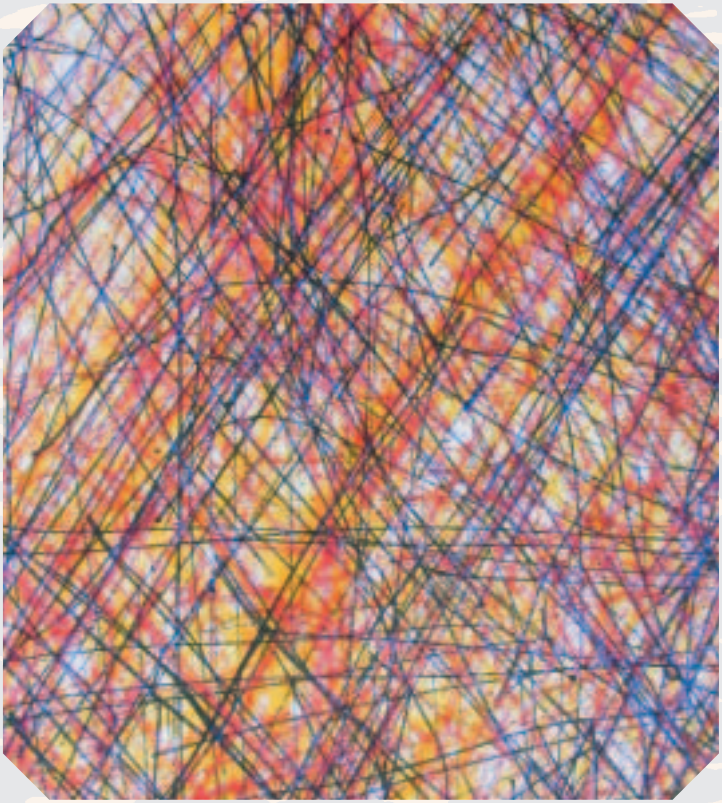


(cognitive, behavioral, ethological) and bottom-up (cellular, molecular) approaches to studying the brain. He is applying different technologies to study dissociated cultures of hundreds or thousands of mammalian neurons. Furthermore he is developing a real-time feedback system for 2-way communication between a computer and a cultured neural network. In this installation we will record the electric signals from a culture that will be set up for *Meart*, in Steve's lab. The data received from the neural activity will be processed both in Atlanta & Perth to control in real time the robotic (drawing) arm. We will close the feedback loop by stimulating the neurons (64 electrodes) when various events in the gallery space occur. As no one has ever done this before, we will treat this installation as an experiment – scientific as well as artistic. We will be interested to see if any emergent or 'creative' behavior occurs, or trace any change in the pattern of behavior of the neurons that occurs as a result of the stimulations.

Meart takes the basic components of the brain (isolated neurons) attaches them to a mechanical body through the mediation of a digital processing engine to attempt and create an entity that will seemingly evolve, learn and become conditioned to express its growth experiences through 'art activity'.

Meart explores our abilities and intentions in dealing with the emergence of a new class of beings (whose production may lie far in the future) that may be sentient, creative and unpredictable. It is grown/constructed to evolve and create visual artistic outcome and by that means, to explore the notions of creativity and the nature of art. This hybrid is set to perform an open task, reveal its inner workings as drawings. The assimilation of 'wetware (neurons) / software (digital components) / hardware (robotic arm)', is intended to literally deconstruct creativity into its basic elements while stimulating and manipulating it through the different stages in order to observe and explore what and how the 'artist' will react and what it will do. *Meart* takes the basic components of the brain (isolated neurons) attaches them to a mechanical body





"... the MEA system (electro-physiological system) will record the electrical activity generated by the developing neuron and send sets of data indicating the locations of neuron activity over the MEA to the robotic arm. This will be converted into movement of the arm towards the corresponding areas of the canvas or the choice of how many and which out of the 3 pens will draw in a certain point of time. "

through the mediation of a digital processing engine to attempt and create an entity that will seemingly evolve, learn and become conditioned to express its growth experiences through 'art activity'. The combined elements of unpredictability and 'temperament' with the ability to learn and adapt, create an artistic entity that is both dependent, and independent, from its creator and its creator's intentions.

Meart (AKA Fish & Chips) in BioFeel

What are we going to do?

A series of experiments will be performed in order to explore the relationships between the input/stimulation to the neuronal culture and the output/drawings.

For example, a web cam (set up in the gallery space) will capture portraits of some of the viewers within the gallery space. This image will be then converted into a 64 pixels image. This pixel structure will correspond to the 64 electrode array on which the neurons are growing. This pixel map will be used to stimulate the neurons. Each turned on pixel will initiate a stimulation of the corresponding electrode of the multi electrode array. The initiation of this process will be the beginning of the drawing. The stimulation will be constant per one drawing session and will be sent to the cultures in a predefined iteration.

Then the MEA system (electro-physiological system) will record the electrical activity generated by the developing neuron and send sets of data indicating the locations of neuron activity over the MEA to the robotic arm. This will be converted into movement of the arm towards the corresponding areas of the canvas or the choice of how many and which out of the 3 pens will draw in a certain point of time.

Multi Electrode Array and the feedback mechanism:

The Potter lab at Georgia Tech[3] is developing tools to study learning, memory, and information processing in networks of cultured brain cells. These are obtained from the cortex of embryonic rats, and grown for months in Petri dishes that have a multi-electrode array (MEA) of 64 microelectrodes embedded in them (Made by Multi-channel Systems). Through these electrodes, they can send sensory inputs (electrical stimuli) and read out responses (action potentials) to and from the cultured neural networks. The neural signals are used to control an artificial body, whether simulated on the computer or built of mechanical actuators such as the robotic drawing arm of *Meart*. Sense data from the body's sensors are used to trigger stimulation of the network, via the electrodes. By closing the loop, from neural activity, to behavior, to sensing, to stimulation, it is hoped that it will learn something about itself and its environment. The fact that the cultured networks are growing flat on a glass substrate allows them to be observed in minute detail. The goals are both to learn more about how brains work, and to apply what is learned to designing fundamentally different types of artificial computing systems.

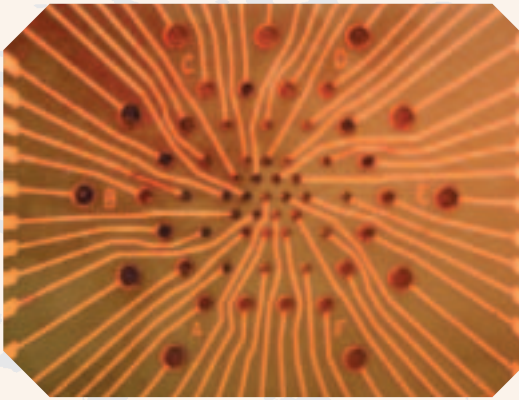
Data Processing

Discretely sampled information of the action potentials exhibited by the cultured neurons will be sent via direct TCP/IP link to the control interface of the drawing arm (an IBM clone PC). From this data a vector will be calculated that represents the relationship between the current position of the drawing arm and the position on the culture plate of the highest neural activity.

This vector will then be used to move the arm (via a parallel port interface controlling 16 pneumatic valves). Information on the movement of the arm (or any other visual environmental phenomenon) will be produced by recording a digital video frame on the host computer. The frame (a 320 by 240 32 bit JPEG image) will be reduced to an 8 by 8, 8 bit array which will be sent using a direct TCP/IP link to the laboratory at Georgia Tech and used to stimulate the cultured neurons. This mechanism differs greatly from that used in Fish and Chips phase 1 where multiple extra-cellular actions potentials were recorded with one electrode and this was continuously sampled at 44khz. The resulting sampled data was transferred into the frequency domain using the standard Fast Fourier Transform (FFT). The relative power of a number of frequency bands was then measured and, if higher than a predetermined threshold, were used to generate control signals to the arm interface.

Output module (Robotic Arm):
The robotic drawing device receives the processed data from the computer software and translates it into movement. The software processes the input data and controls an array of valves in a binary way signaling them to open or close. These valves allow compressed air to flow into the artificial muscles, which are pneumatic. As the muscles are inflated they contract with sufficient force to move three pens across the surface of a paper. The muscles are made out of two major components – an internal air bladder which causes contractions in an outer casing.

By creating a temporal 'artist' that will perform art-producing activities *Meart* explores questions concerning art and creativity, and the relationships we will form with constructed entities that express



creative and intuitive qualities. It sets out to explore these themes while referring to the ever-increasing pace of the evolution of biological technologies. How are we going to interact with such cybernetic entities considering the fact that their emergent behavior may be creative and unpredictable? How will society treat notions of artistry and creativity produced by semi-living entities?

Notes
1. A substrate fitted with an array of 8x8 electrodes on which neurons are cultured. The multielectrode arrays are transparent, therefore the neuronal morphology can be observed. The dish is connected to amplifiers and a computer that allows continuous stimulation of and recording from neurons lying on or near electrodes.
2. For more information about *Takeover* see http://www.aec.at/takeover
3. http://www.neuro.gatech.edu/potter.php
4. DeMarse et al., 2001

The Tissue Culture & Art Project
Oron Catts, Ionat Zurr and Guy Ben Ary

WORRY DOLLS

http://www.tca.uwa.edu.au

In collaboration with SymbioticA (The Art and Science Collaborative Research Lab) at the School of Anatomy and Human Biology, University of Western Australia, and The Tissue Engineering and Organ Fabrication Laboratory, Massachusetts General Hospital/Harvard Medical School.

The Tissue Culture and Art Project (initiated in 1996), is an on-going artistic research and development project into the use of tissue culture and tissue engineering as a medium for artistic expression.

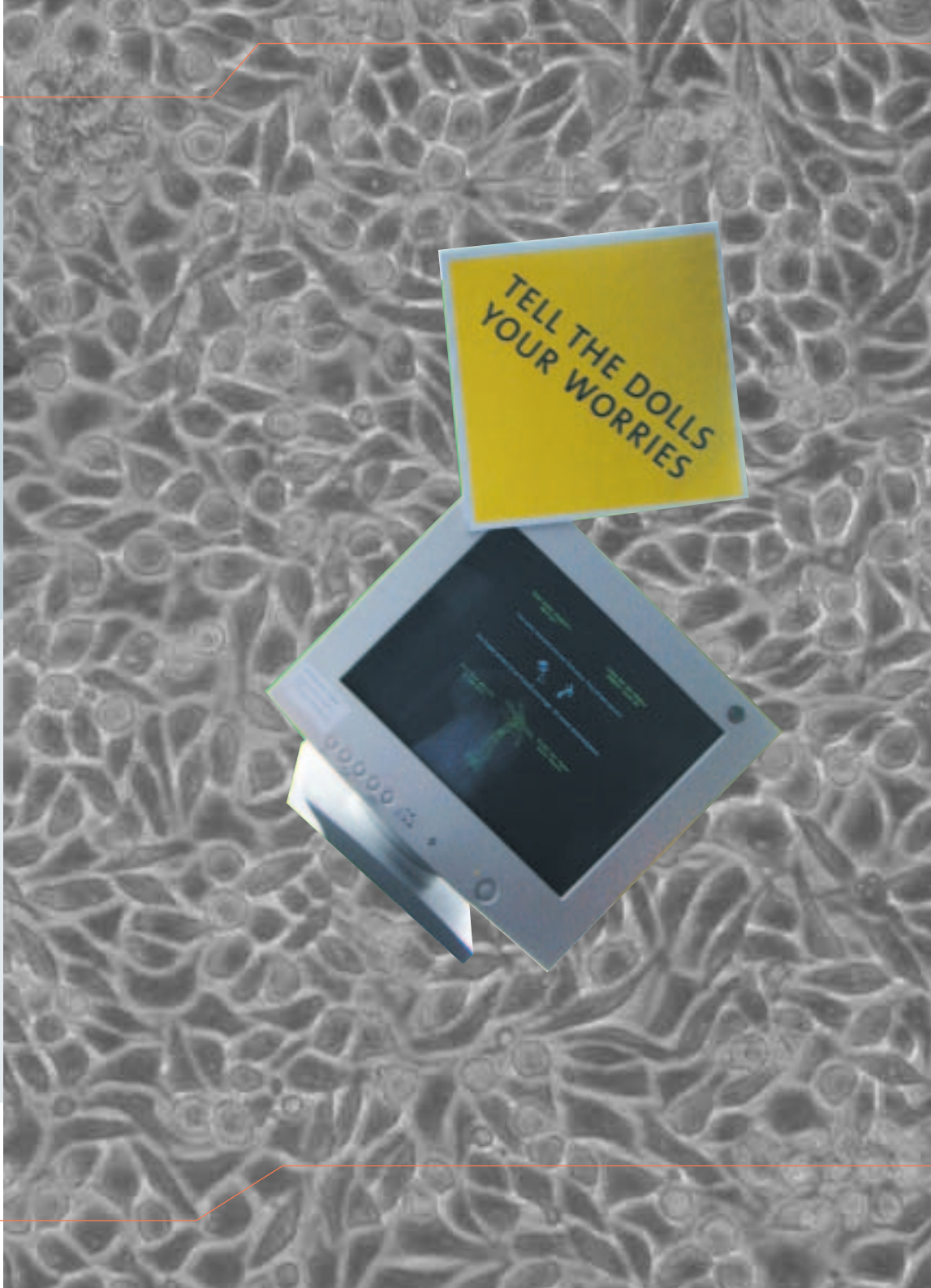
The Tissue Culture & Art project (TC&A) utilizes biologically related technologies (mainly tissue culture and tissue engineering) as a new form for artistic expression to focus attention and challenge perceptions regarding the fact that these technologies exist, are being utilized, and will have a major effect on the future.

What is Tissue Engineering:

Tissue engineering is the creation (fabrication) of human made tissues or organs, known as neo-organs [1]. It is about producing body spare parts. Tissue engineering usually involves the construction of artificial degradable biopolymer scaffolding in the desired shape, which is then seeded with the appropriate cells and immersed in a solution rich with nutrients and growth factors in conditions that try to emulate the body (37°C, 5% CO_2). The system that provides these conditions is referred to as a bioreactor. With the advances in stem (embryonic) cell technology, it is in essence an artificial womb, which is being used to grow us new organs/extensions/additions.

Tissue engineering can offer an option of producing what we refer to as Semi-Living Objects. A tissue is a collection of cells of an individual organism that specialize in performing a specific task. When we combine this specialty with other tissue (not necessarily from the same organism) and artificially constructed support mechanisms, we will be able to 'grow' task specific or general use tools. The TC&A Project is interested in using tissue engineering and artificial wombs to grow sculptures.

These sculptures are still in the realm of a symbolic gesture representing a new class of object/being. These objects are partly artificially constructed and partly grown/born. They


TELL THE DOLLS
YOUR WORRIES

Doll A

Doll B

Doll A = stands for the worry from Absolute truths, and of the people who think they hold them.

Doll B = represents the worry of Biotechnology, and the forces that drive it. (see doll C)

Doll C = stands for Capitalism, Corporations

Doll D = stands for Demagogy, and possible Destruction.

Doll E = stands for Eugenics and the people who think that they are superior enough to practice it.

Doll F = is the fear of Fear itself.

G= is not a doll as the Genes are present in all semi-living dolls.

Doll H = symbolizes our fear of Hope

Doll C

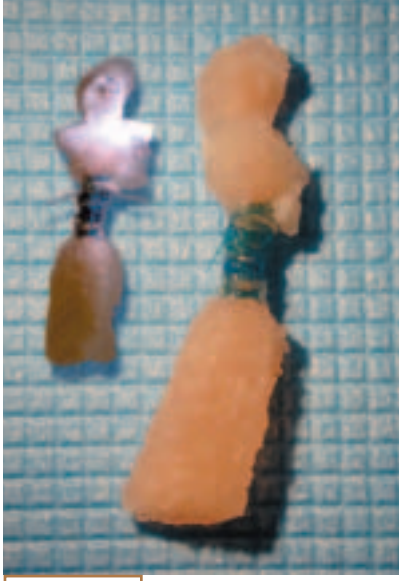
consist of both synthetic materials and living biological matter from complex organisms. These entities (sculptures) blur the boundaries between what is born/manufactured, animate/inanimate and further challenge our perceptions and our relations toward our bodies and constructed environment.

The concept of using Semi-Living Objects can be seen as a way to minimize the risks associated with new technologies as well as a way to eliminate some of the problems regarding the existing technologies and culture of consumerism. Changing the culture of production from manufacturing to growing could reduce the environmental problems associated with the process of manufacturing. The relationships that consumers will form with these semi-living objects will be different from the relationships they have with inanimate objects. Tissue engineering offers a possibility to change our own design as well as create a new breed of 'things': Presently, scientists are trying to mimic nature. However, how will we look when we decide to improve nature? Are we going to see fashion driven neo-organs? Are we going to completely objectify living matter?

We feel that not enough attention is directed at proposing, examining and questioning the possible futures where this new technology can take us.

Doll D

Doll E



Doll F

The Worry Dolls:

We chose to grow modern versions of the legendary Guatemalan Worry Dolls in the artificial womb.

> "The Guatemalan Indians teach their children an old story. When you have worries you tell them to your dolls. At bedtime children are told to take one doll from the box for each worry & share their worry with that doll. Overnight, the doll will solve their worries. Remember, since there are only six dolls per box, you are only allowed six worries per day." [2]

We decided to give birth to seven dolls, as we are not kids anymore. We may not be allowed to have more than six worries but we surely have. The genderless child like dolls represent the current stage of cultural limbo: a stage, that is characterized by child like innocence, and a mixture of wonder and fear when we create the new sex – hence, a new era.
We gave them alphabetical names as we think that we can find a worry for each letter of the language that made us what we are now. While working on the Tissue Culture & Art Project, people expressed to us their anxieties. These dolls represent some of them. You are welcome to find new worries and new names... You will be able to whisper your worries (not just in terms of biotechnology) to these dolls and hope that they will take these worries away.

Doll H

Doll A = stands for the worry from Absolute truths, and of the people who think they hold them.

Doll B = represents the worry of Biotechnology, and the forces that drive it. (see doll C)

Doll C = stands for Capitalism, Corporations

Doll D = stands for Demagogy, and possible Destruction.

Doll E = stands for Eugenics and the people who think that they are superior enough to practice it.

Doll F = is the fear of Fear itself.

G= is not a doll as the Genes are present in all semi-living dolls.

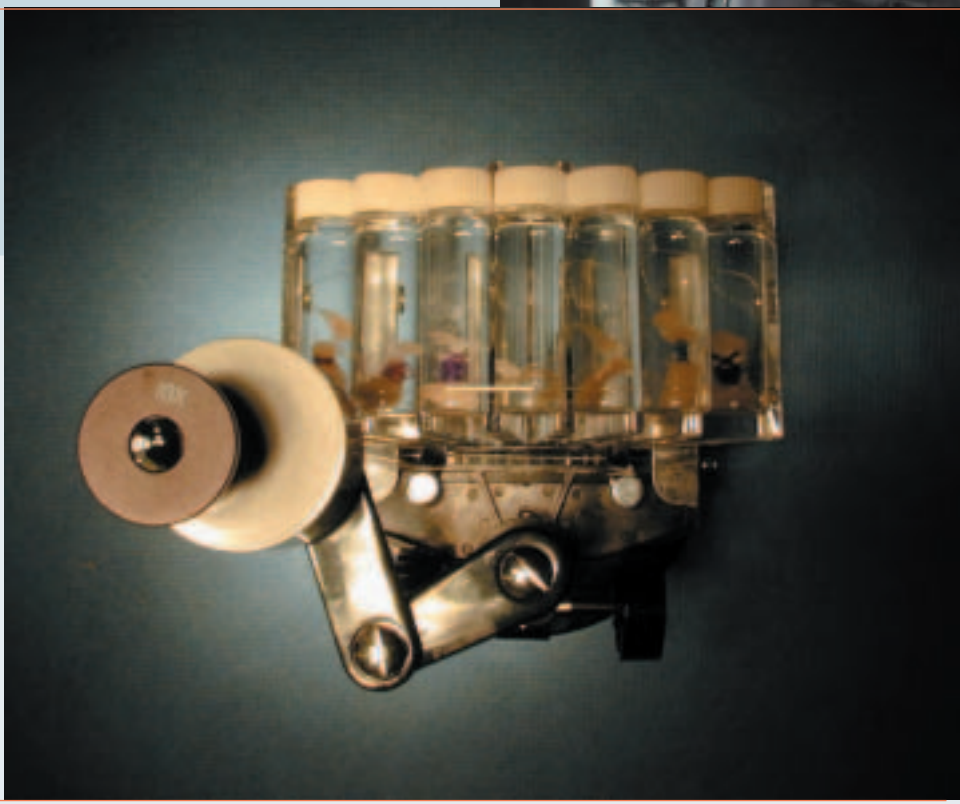
Doll H = symbolizes our fear of Hope...

Our worry dolls were hand crafted out of degradable polymers (PGA and P4HB) and surgical sutures. The dolls were sterilized and seeded with endothelial, muscle, and osteoblasts cells (skin, muscle and bone tissue) that are grown over/into the polymers. The polymers degrade as the tissue grows. As a result the dolls become partially alive!
Will they take our worries away?

The process, in which the natural (tissue) takes over the constructed (polymers), is not a "precise" one. New shapes and forms are created in each instance, depending on many variants such as the type of cells, the rhythm of the polymer degradation and the environment inside the artificial womb (bioreactor). It means that each doll transformation cannot be fully predicted and it is unique to itself. We are still in the realm of a dialogue with nature rather than a complete control over it. Our dolls are not clones but rather unique.

Notes:

1. *Tissue Engineering: The Challenges Ahead*, by Robert S. Langer and Joseph P. Vacanti, Scientific American, April 1999, pp. 62-65.
2. Taken from the written note attached to the Worry Doll package.
   Worry Dolls were purchased from a comic shop in Boston, USA.



Semi-Living Worry Dolls fixed in Formalin, 2000.

Oron Catts, Ionat Zurr and Guy Ben Ary

PIG WINGS

This project was developed as part of our residency at the Tissue Engineering and Organ Fabrication Laboratory, Massachusetts General Hospital, Harvard Medical School USA, and further developed in SymbioticA – The Art & Science Collaborative Research Laboratory, School of Anatomy & Human Biology, University of Western Australia.

Advances in bio-medical technologies such as tissue engineering, xenotransplantation, and genomics promise to render the living body as a malleable mass. The rhetoric used by private and public developers as well as the media have created public anticipation for less than realistic outcomes. The full effects of these powerful technologies on the body and society have, in most cases, only superficially discussed. Deciphering the human genetic code, and the creation of genetically modified pigs for the purpose of transplanting their organs into humans (xenotransplantation) opens up a space for the creation of ambiguous chimeras. The Pig Wings project was set to explore this space. Winged bodies (both animal and human) have been used in most cultures and throughout history. Usually, the kind of wings represented the creature (chimeras) as either good/angelic (bird-wing) or evil/satanic (bat-wing). There is yet another solution to flight in vertebrates which seems to be mostly free of cultural values - that of the Pterosaurs. We have used tissue engineering and stem cell technologies in order to grow pig bone tissue in the shape of these three sets of wings. The Pig Wings installation presents the first ever wing shaped objects grown using living pig tissue, alongside the environment in which such endeavour can take place. We will attempt to present living tissue engineered pig wings that will be animated using living muscles. This absurd work presents some serious ethical questions regarding a near future where semi-living objects (objects which are partly alive and partly constructed) exists and animal organs will be transplanted into humans. What kind of relationships will we form with such objects? How are we going to treat animals with human DNA? How will we treat humans with animal parts? What will happen when these technologies are used for purposes other then strictly saving life?


SYNTHECON, INC
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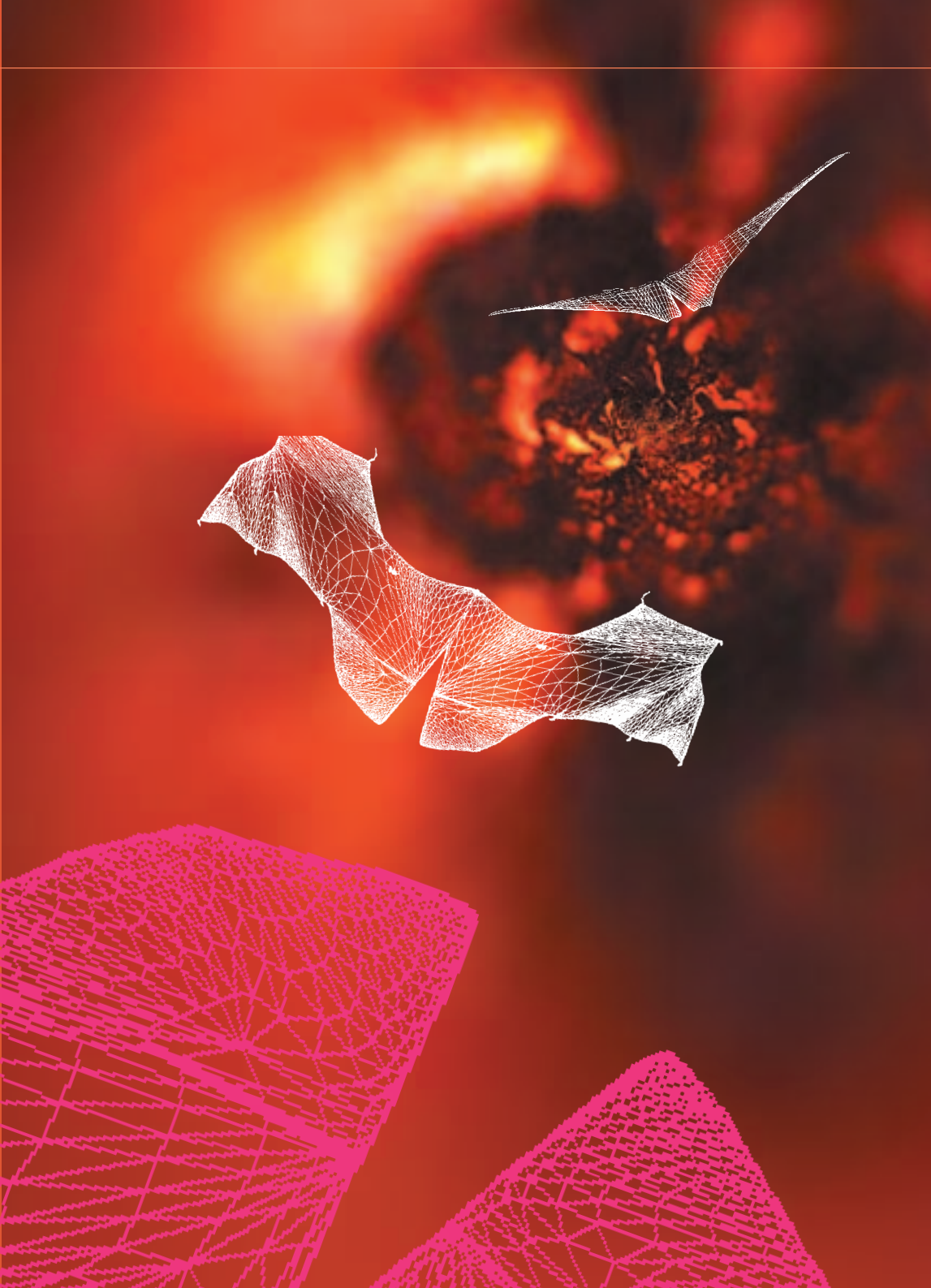
The Aesthetics of Parts

By Ionat Zurr & Oron Catts

It was her 16th birthday and she knew that from today she would finally be able to get a legal implant (most of her friends had one already). She had been planning that for a while. A Few months ago she went to the Implants Farm and checked the catalogue and the displays. She knew immediately what she wanted: a pair of decorative wings. Just like those of hamster-bat she got for Christmas when she was ten. The farm's practitioner took a biopsy from her inner-thigh and then showed the scaffold design. "Would I fly?" she asked. He laughed, " Ho no, that will require a complete redesign of your body and even then you will only be able to glide. These wings are designed to go with the current fashion of backless dresses." "What about these feathered wings?" she inquired. "I don't think your parents have the budget" he replied " and, beside, they will not grow with you, they are for adults only." It was a regular procedure and the risk of contamination was reduced to less than 3%. The farmer took her behind the office, to the implants growth factory. She looked through the glass window to the sterile farm, where pigs with different body parts seamlessly attached to them lay in pools of clear liquids. He showed her to "her pig". She immediately liked "her pig". It was smooth and its skin colour was just like hers. The farmer explained that the pig carried human genes to increase human-pig compatibility. She trusted the pig to carry and grow her wings till they would be grafted back to her

(A story of an upper class girl, 2028).



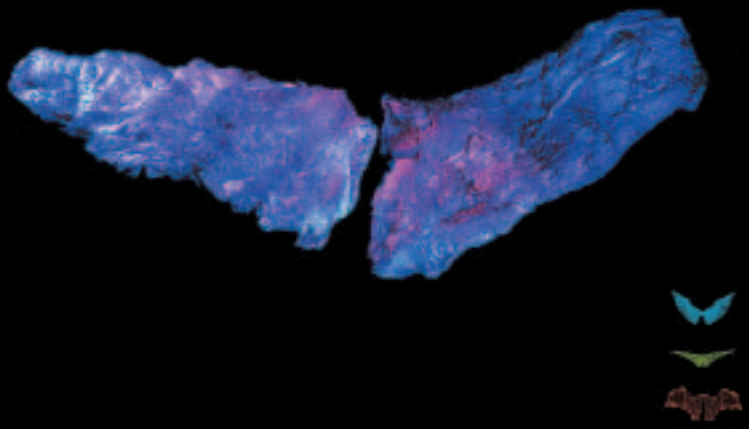


Deleuze and Guattari metaphor of 'becoming animal' till there is no longer man or animal' is becoming real with the advance in xenotransplantation, genetics, tissue technologies and stem cells research. Artists dealing with hands on wet biology art practice are exploring the tangibility of such abstraction. As artists working for the last six years with living tissues, we have come to realize the reality of a fragmented body and 'self'. We have grown and sustained alive for long periods (up to six months) communities of cells independently from their original host. We have grown them externally to a body as part of our ongoing research into growing semi-living sculptures . The above biological technologies open up an array of body treatment, enhancement and modification. It

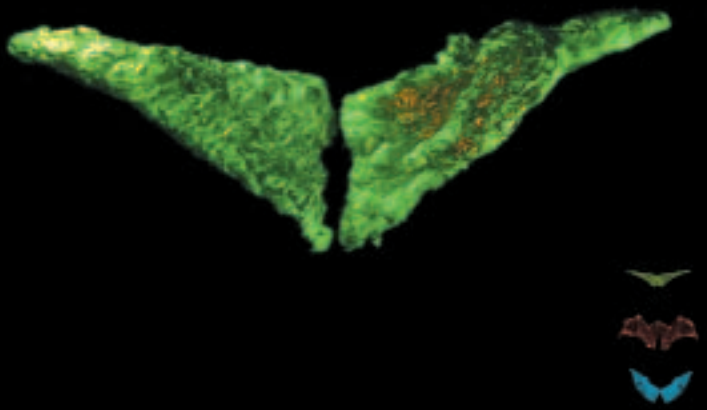
suggests contestable futures of cross-species and mergers that will profoundly question current held moral and belief systems. Organ transplantation is now a common procedure practiced in the biomedical field. Organs are being harvested from either living or dead donors in order to extend lives. This practice of 'extended bodies', like any other practice, operates within the socio-economic fabric, enabling the well off to receive more and better-conditioned organs, such as young healthy livers for affluent alcoholics. Organ trade and organ theft are widely practiced around the world. Organs become commodities that can extend life as well as be used for body enhancement and modifications. The first case of a hand transplant demonstrated the use of organ transplant techniques for proposes beyond strictly saving life. The media reported that the recipient requested that the 'new' hand be removed from him as 'He said it was like a dead man's hand with no feeling in it'

and 'he felt "mentally detached" from it , focused attention to the complex relations between the self and the introduced extension. Different aspects of art expression have been dealing with the mix/fusion of identities, genders and classes between the "selves" of the donor's organ and its recipient: A murderer's heart implanted in its victim's body and so forth. One human is becoming a hybrid of two humans. The shortage in human organs has encouraged a research into xenotransplantation. Xenotransplantation is the transplantation of cells, tissues or organs from non-humans. This procedure crosses a species barrier that has evolved over millions of years. Furthermore, the procedure involves genetic manipulation and insertion of human genes into the animal (mainly pig) genome

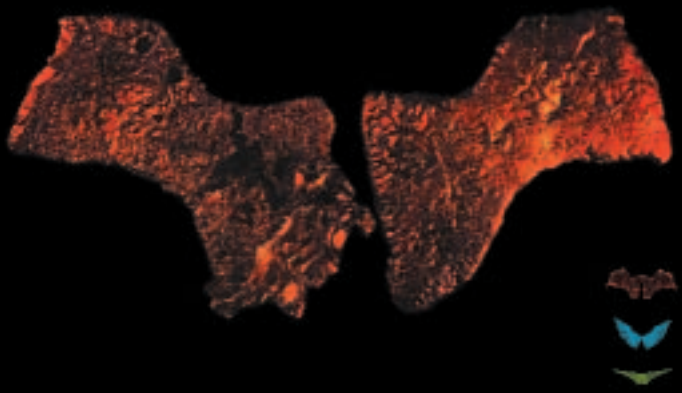
for better compatibility. The human-animal cross, from a biomedical perspective, presents new procedures and new risks that can only be assessed in a perspective of a time scale of more than one-generation. 'Tricking' the evolutionary mechanism by surgical and chemical means to suppress the immune system in the organ recipient and introducing pathogens and viruses from another species may result in unrecognized and new virus infections and other clinical syndromes. Also, the cross infections among humans (and their offspring) is unknown. Bach (1998) in his call for a moratorium on all human xenotransplantations, titles his commentary as "individual benefit versus collective risk". Nevertheless, insertion of pig cells into humans is being done, such as insertion of pig's Porcine cells into brains of patients with neurological diseases. The human-animal physical cross is still facing biological and ethical hurdles. Though its potential in terms of 'the becoming animal' offers



Pig Wings
- the Aves Version
2001-2002



Pig Wings
- the Pterosaurs Version
2001-2002



Pig Wings
- the Chiropteran Version
2001-2002

a new dimension; a physical human-animal hybrid. Tissue engineering technologies have been offered as another solution to deal with the shortage in body parts. Tissue engineering is a technique that offers the construction and growths of an organ in-vitro (outside of the body) using the patient's own cells, and the re-implementation of the organ back to the recipient. It is intriguing that the image of the subject/object who brought tissue engineering into the public psyche was the mouse with the ear on its back. A nude mouse (a mouse with suppressed immune system) was used as a bioreactor, hence as a 'vessel' for the growth of an organ. The scaffold of the ear was constructed out of special biodegradable polymers and seeded, in vitro, with cartilage and skin cells from the earless patient. As the cells grew over/into the scaffold it degraded. In an early stage during this process the construct was attached to the mouse, which acted as a nutrient supplier and temperature regulator. The walking sniffing chimera 'scarred' each human who were exposed to it. One may suggest, that it has become one of the most important icons of the late 20th century. A living icon of our unlimited sculpting and designing abilities to create the creatures/monsters of our imaginations and the possibility to sculpt and design ourselves in these shapes. Stem cells are the current 'holy grail' in the biomedical field. Embryonic stem cells are cells before differentiation. Hence, these cells have the ability to divide to any type of tissue, when they are given the right conditions and appropriate growth factors. The general idea behind this promise is the ability to clone an identical twin with identical DNA. This twin should not necessarily develop into a whole human being. It can become A 'Bag of organs' with no central nervous system that will be there in case you need or desire an organ. "My twin is a liver" can become not only a figure of speech. The combination of stem cells and tissue engineering technologies can be appropriated not only for saving/extending life and/or the growth and construction of organs in the 'original design'. These technologies open up a gate to the treatment of a living body as a malleable entity. One will be able to attach a tail, a horn or any fashion driven shape of tissue to 'its' own limited and less than perfect body. In the socio-economic climate in which these technologies operate, we can speculate on the large divide between the well off and the less advantaged, as well as between the human species and the rest of the animal kingdom. We can also speak about the playfulness and decision making based purely on aesthetics and/or fashion driven taste. As all of these technologies will become more available in different forms and different prices, the idea of Organ Farms (for replacement, modification and enhancement) might become a reality. Body parts made out of different animals tissues might become objects of desire. The traditional view of a body as one autonomous unchangeable self will go through a radical change. Body parts are designed, exchanged, replaced and sustained in a semi-living state as part of the environment. Animals are being used as a bioreactor for the growth of other parts. Naturally, as we suffer from speciesm, non-humans animals such as pigs will become the "vessels" for the growth of ears, noses and other body decorations. Stem cells technologies for the rich, pig farms for the poor and the adventurous. Actualizing Deleuze and Guattari's 'becoming an animal' to physical actuality will severely challenge current belief systems, which are unable to account for developments in biological technologies. Are you willing to take this day trip to the farm?

Adam Zaretsky in collaboration with
the Tissue Culture & Art Project

Between 1999-2001, Adam Zaretsky was exploring the effects of music on bacterial fermentation as an Artist and Research Affiliate in Arnold Demain's Laboratory for Microbiology and Industrial Fermentation at Massachusetts Institute of Technology. During that time, Oron Catts and Ionat Zurr were also in Boston. They were in the process of growing their Pig Wings as as Research Fellows in Dr. Vacanti's Tissue Engineering and Organ Fabrication Laboratory at Massachusetts General Hospital's Harvard Medical School. That we were in the same town living with similar day-to-day tactics was pure happenstance. As some of the few artists who use biological laboratories as their studios, we decided to collaborate by playing Pig Music to Pig Wings.

To this end, we downloaded all the pig related MP3s from the soon to be illegal Napster. By typing in PIG as the keyword, our search

DYNAMIC SEEDING MUSICAL BIOREACTOR

http://www.emutagen.com

revealed a cross section of the etymological nuance symbolically connected to this family of animal. A few examples: *War Pigs* by Black Sabbath, *Fascist Pig* by Suicidal Tendencies, *Da Killing of Da Pigs* by Da Yoopers, *Chokin this Pig* by Eminem, *Squeal Like a Pig* by The Reverend Horton Heat, *Filth Pig* by Ministry, *American Pigs* by The Angry Samoans, *British Pigs- The Price of Royalty* by *One Life Choir*, *PigInCheez* By Aphex Twin, *Blue Christmas* by Porky Pig and of course, *Pigs on the Wing* by Pink Floyd.

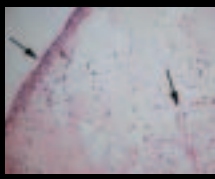
Once a week, over the next three weeks, we played Pig Music to Pig Wings at Mass General Hospital. This allowed us time during the week to relax and listen to music with the steadily differentiating bone precursor cells. We started with what we referred to as a Dynamic Seeding Musical Bioreactor. Getting cells deep into constructs is common quest for many in the tissue engineering field. The constructs are very porous and it was hypothesized that the irregular vibrations of the music might assist in the distribution and physical embedding of the cells into the construct. The Vibro Transducers, generously donated by Acouve Laboratories, were intalled in a 37 degree Celsius incubator. The Synthecon Bioreactor vessels were then stuck to these vibrating plate speakers. Inside the vessels were the wing shaped polymer constructs (about 4mm thick) and a rich sample of Mesenchenal stem cells (each cell
~ 15 thousandths of a millimeter in diameter.) Pirate MP3s were played. Scientists, artists and stem cells took moments of repose together.

Alteration of Sculptural Morphology was noticed early on as the wing shaped biopolymers curled up like fried corn chips after the first few songs. Not surprisingly, the wings visibly 'danced' to the music both during the early seeding of the biopolymers and on their following weekly exercise regiments. Bouncing and twisting, stretching and jumping, the Pig Wings took flight. After the incubation period had finished, some of the Musically Entertained Pig Wings were sent to histology to be compared to the Pig Wings whom had been Musically Deprived. Considerable differences in cells count, tissue morphology and distribution throughout the construct were ascertained. Although our application of music to growing tissue cultures was informal and non-repeatable, our observations and the results of the histological comparison lead us to postulate that Pig Music may have a curious effect when applied to Pig Tissue in Vitro.

Scientific Perspective

By Kylie M Sandy

In the Pig Wings project, mesenchymal cells (bone marrow cells) from pigs are grown over bioabsorbable poylmers. The scientific aspect of the project is engaging an artisitic medium, to investigate both the movement of bone cells within the 3D scaffold of the polymer, and the occurrence of calcification within the polymer. Future research will include quantitative and qualitative accounts of the amount of calcification in the polymers, when they are subjected to sound waves. Findings have a potential application to orthopaedic science and tissue engineering.



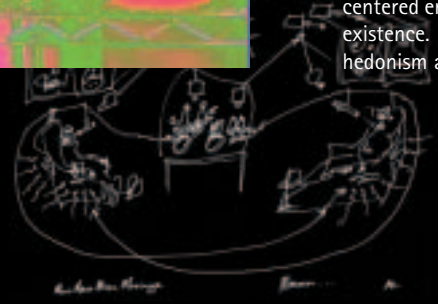
MMMM... Adam Zaretrsky

In MMMM...(Macro/Micro Music Massage), we, the public, are invited to join in the process of sonic performance for cells in culture. Please engage your living unfamiliar relatives. Here is your chance to massage various living tissues or organisms without getting your hands dirty. We, as fleshy flasks of living culture, are also invited to become part of the experiment by vocally vibrating each other's rear ends at the same time.

Two ButtVibe lounge recliners are placed facing each other on opposite sides of the room. The chairs massage according to sound output miked from the vocalizations of the person in the opposite chair. This can include voice and instruments/noisemakers. The same signals are sent to neighboring vibrating plate speakers applied to various lifeforms. The organisms will bounce, splash, stretch, bear down and/or jump to attention in response to the audio source. Please Feel Free to Sit Down and Talk to the Living Specimens!

Video of reclining volunteers and their life-world mirrors dancing on biopolymers is projected above and behind the volunteers. This functions as a closed circuit and very local vibro-videophone for talking to various kinds of strangers. We have here a real time, multimedia, multi-species erotic continuum of sonic jostling. We also have the ability to record a certifiable non-repeatable effect through bioassay of public play. Please record any data you might have amassed during your research in the communal lab books provided.

Public Knowledge Purpose: My personal favorite artistic offering to public experience is the reinsertion of fun for fun's sake into the social. I know that sounds simple and naïve. It is. Vibrating chairs are titillating. The idea of helping strangers in public liven each other's bodily experience shamelessly in a temporary suspension of moral standards is my call to duty. It's something to do while waiting for the AIDS vaccine. At the same time, the conjoining of the microcosm and the human body, so often forgotten in the workaday world, is emphasized. Simple assays could show alterity of cells due to vibration, which can be an effective comparative aid in analyzing human facial response patterns to mechanical tickling and vibro-erotism in general. This sensual experience could abstract our importance as self-centered entities by focusing on bounce as a form of transient existence. In other words this is art and tech lite, public hedonism and unashamedly so. Sit Down and Extrapolate!

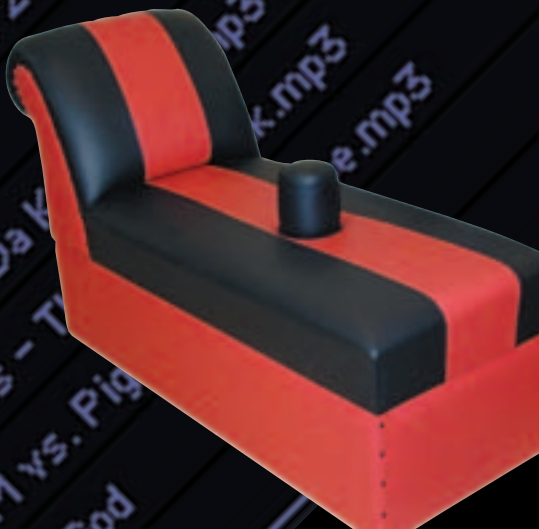


Philosophy of Science Purpose:

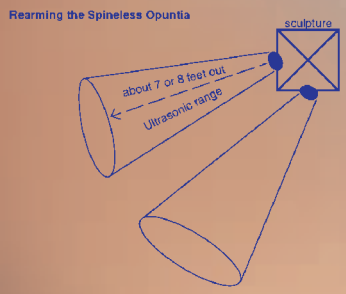
If our research into the effects of sonic spectrum vibrations are progressing so neatly, why then is the next stage of this project an interactive public event? MMMM... is an artistic experiment. No hard data is expected to arise. This in no way limits potential insights into the natural world that might stem from MMMM... Most artistic products, if shaken well, exude scientific data as a by-product. Unfortunately, there are often strong and contentious reactions to cross-disciplinary activities. It is almost as if breadth itself were a kind of blight on the stability of taxonomy. If labels and classifications are more than mythic, faith based logics of the day, then they shouldn't have such a phobic reaction the birth of hybrid concepts and complex admixtures. With a little grant money, this too can be reduced to its fundaments. Tame All Anomalies!

Artistic Purpose: I am a rather insular little maniac. I know how important it is that interactivity be interactive and not some uni-dimensional point/click act of avoidance. Dialogical artworks are important diffusers of the unsporting voyeurism of which both scientific objectivity and artistic appreciation are prone to. This bodily bi-directional communication is both remote and deeply interpersonal. It should remind us of our corporeal fleshiness and, by proxy, our relation to all the squiggly things that squiggle upon the earth. As a libertine in the days of deadly STDs, this is perhaps a reflection of the traumas of libidinal economizing for personal survival. The vibratory arts are highly underrated due to fears of lost productivity.

Viva Tactility!



Amy Youngs



AMY YOUNGS

http://www.accad.ohio-state.edu/~ayoungs

The plant inside this device is both interactive with people and protected from them. Its metal armor closes up when approached and opens when people move away from it. Through cloning and micropropagation technologies, humankind has engineered creations such as the Spineless Opuntia, a cactus that lacks its original defense mechanism against those who eat them. This sculpture embodies my impulse to protect this vulnerable, human-engineered creation. But it also reveals the folly of protection in its heavy reliance on technology.

Rearming the Spineless Opuntia – 1999 (60"x30"x30") Live Spineless Opuntia cactus, electronic components – including ultrasonic sensors and microprocessor - motor, copper, steel, aluminum and rubber.

Marta de Menezes

MARTA DE MENEZES

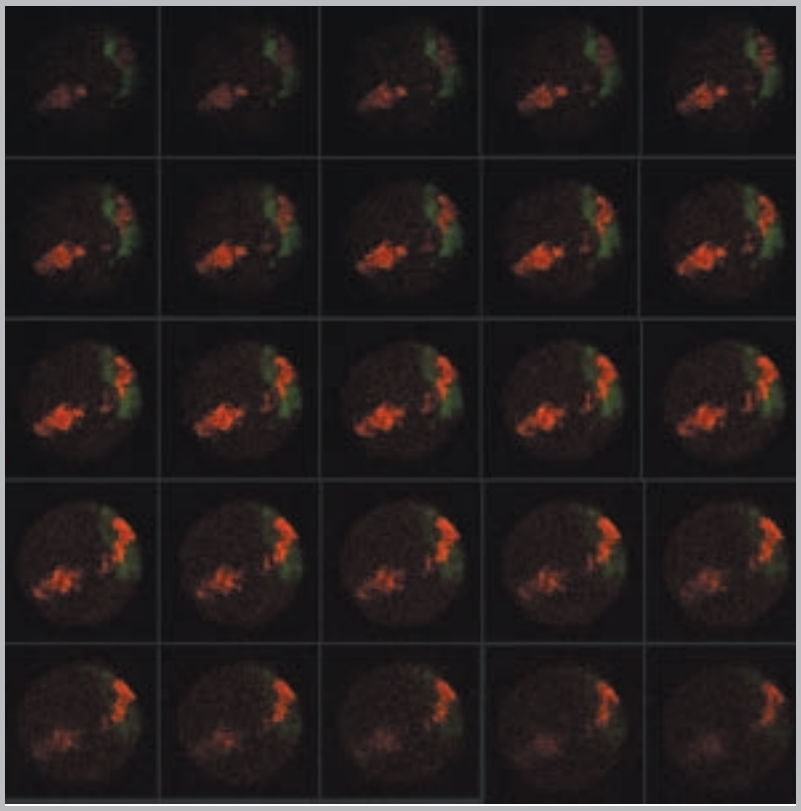
During the last thousands of years humankind has tried to manipulate Nature. Today's dogs, cats, horses, and crops are evidence of what has been achieved by artificial selection. It is remarkable that the understanding of hereditarity and evolution is so recent, when our ancestors were using it empirically for so long. In 1953 the molecular basis of hereditarity was disclosed as the structure of DNA was revealed by Watson and Crick. In the last 50 years significant scientific advances have been made, allowing the modification of life in an extremely controlled way. Biotechnology was born to explore these new tools for the benefit of humankind.

However, the remarkable tools of modern biology are seen with hope and fear, simultaneously. It is becoming possible to develop new therapies for uncurable diseases, but at the same time the public fears the misuse of this powerful technology. As a consequence, words like *transgenic*, *genome*, *clone* and *stem-cells* have spread from scientific publications into the mass media. As society becomes aware of biotechnology, with all its hopes and fears, artists have started to include references to biotechnology in their works.

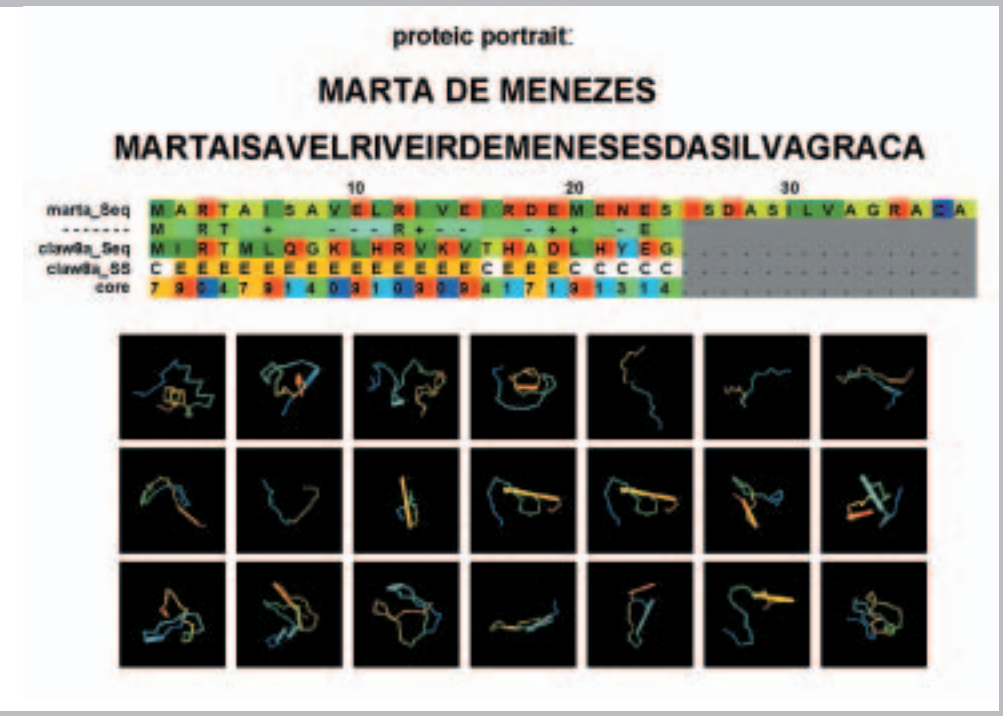
Furthermore, biotechnology offers the opportunity to create art using biology as new media. We are witnessing the birth of a new form of art: art created in test-tubes, inside laboratories.

My work has been focused on the possibilities that modern biology and genetic research offer to artists. I have been trying not only to portrait the recent advances of biological sciences, but to incorporate biological material as new media: DNA, proteins and cells offer an opportunity to explore novel ways of representation and communication. Consequently, my recent artistic activity has been conducted in research laboratories.

Being an artist, with no formal training in biological sciences, I always have to start by learning the jargon and techniques in use in the laboratory. With time I learn the possibilities and limitations of the experimental systems available. At that point I can start producing biological artwork.



NucleArt Two chromosomes inside a human cell. Stack of images.



Proteic Portrait Study showing similarities between marta and claw8a, as well as predicted structures of marta.

NucleArt

In NucleArt I am using DNA labelled with fluorochromes to paint the nuclei of live human cells. I want to explore the relationship between the object and the observer. The artworks are live human cells painted with DNA. However, in order to be adequately observed they have to be killed. Like in many scientific subjects, from the Eisenberg's principles to anthropological studies, frequently the observation disrupts what is being observed.

Chromosomes are made of DNA, a complementary double helix, and are localised in the nucleus of cells. Normal human cells have 46 chromosomes; females have 23 represented twice, including two X chromosomes, and males have 22 represented twice plus an X and a Y chromosome. The position of chromosomes in the cell nucleus is determined in part by certain rules. For example, some chromosomes tend to stay closer to the periphery of the nucleus while others are more commonly found towards the centre. With this information, it is already possible to predict, to a certain extent, where chromosomes should appear, and to paint them accordingly. However, there are still many uncertainties concerning the position of chromosomes in the cell nucleus. In fact, one of the topics being researched in Ana Pombo's laboratory, where the project is being developed, is how different human chromosomes interact with each other.

In the NucleArt project I explore new possibilities by adapting cell biology techniques to the production of art. I combine the knowledge of the relative position of the chromosomes with the capacity to use DNA to paint each one of the chromosomes specifically. The technique is known as Fuorescence In-Situ Hybridisation (or FISH) and can also be used to visualise segments of chromosomes or even single genes. Groups of chromosomes can equally be stained with the same colour. In this way, it is possible to create relatively controlled images where some or only one chromosome is painted with or without portions of it in other colours. The resulting artwork requires the use of a confocal laser scanning microscope in order to be visualised.

All the images I have been creating are analysed by scientists as they might provide clues for a better understanding of how the human nucleus is organised. In fact, one of the objectives of all my projects is the demonstration that artists can work in research laboratories alongside scientists in collaborations leading to advances in both art and science.

The artworks are exhibited using computer projections in order to convey the three-dimensional structure of the human nucleous.

Functional Portraits

For years artists have been attempting to portrait not only someone's appearance, but also how the person is. The personality of the model can be conveyed by elements of the pose, the setting and even the technique used by the artist.

Science has developed powerful tools to image the interior of the body. Since Roentgen's discovery of X-rays, one can easily see what is hidden behind the skin. Today, new imaging technology allows better visualisation of both biological morphology and function.

Functional Magnetic Resonance Imaging (fMRI) of the brain permits direct visualisation of the brain regions that are active in real time, while the subject is performing a given task.
In this project I have been attempting to create *Functional Portraits* by imaging the brain function of the model, while performing a task that characterises herself or himself. I have been using fMRI equipment more powerful than the ones used for medical diagnosis in order to achieve better images. The first portraits I have been producing are 'Patricia' with her brain activity while playing the piano and a self-portrait with my own brain function while drawing.

I am now planning, as a development of *Functional Portraits*, to paint the brain by manipulating its activity. With the knowledge of the brain regions that are activated by certain tasks or stimuli, it is possible to design a number of simultaneous tasks and stimuli that will achieve a complex brain activity pattern. In other words, by planning a defined set of tasks it is possible to "paint" a defined pattern of brain activity. Although the artwork has a short lifespan – as long as the subject is performing the tasks – it is possible to document it by means of fMRI. It is a case where it becomes possible to create art by simple thought.

Proteic Portrait

Proteins are frequently as beautiful as contemporary sculptures. To explore a computer database of protein structures using software and hardware allowing three-dimensional visualisation is like exploring an art gallery.
I decided to take advantage of the visual opportunities offered by structural biology in order to create a self-portrait using proteins as art medium.
Proteins are made of 20 different aminoacids, each one can be represented by letter (one-letter code). As a consequence, it is possible to use that convention to design a protein whose aminoacid sequence corresponds to a name. However, interesting three-dimensional conformations are only seen when the protein is over a given length: very short peptides adopt linear structures relatively uninteresting. As a consequence, my professional name – Marta de Menezes – would be too short for an interesting conformation. However, as portuguese people tend to have very long family names I could design a protein with my full name, the *marta* protein:

MARTAISAVELRIVEIRDEMENESESDASILVA GRACA

Using computer databases it is possible to confirm that there is no known protein in Nature with such aminoacid sequence. In fact, it is even possible to identify the natural proteins most similar proteins to marta. Computer modelling also creates several possible conformations for marta, based on the structure of similar aminoacid sequences in known proteins. However, the exact conformation of marta, can only be determined experimentally by solving its structure using nuclear magnetic resonance (NMR) or crystallography.
The proteic portrait will only be finished when the true structure of *marta* will be uncovered.

Acknowledgements
NucleArt is a collaboration with scientist A. Pombo, and helpful advise from S. Xie and S. Martin at the MRC – Clinical Sciences Centre, Imperial College, London. Chip-Art has insights from C. Goodman and T. Magalhães at the University of California in Berkeley. Functional Portraits have been created with assistance from P. Figueiredo at the University of Oxford.

Darren Moore Drums and Lindsay Vickery Saxes

HEDKIKR:

We live in our heads too much – or at least we think we do. Post-Everything society asks us to disconnect with increasing frequency and we listen, obediently 'losing' ourselves in leisure, consumer and worker fantasies. At the fringes, radical movements like cyberpunk take up same call, transmuting it into a notion of identity as a kind of software and envisioning the society's literal disembodiment. New Age spirituality – seemingly an entirely opposed worldview – strongly continues the Gnostic desire to jettison the decay and inertia of material reality.

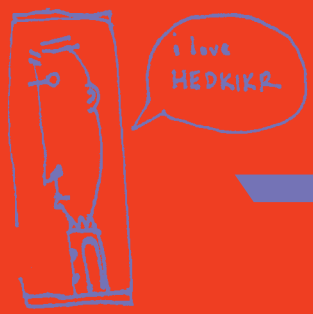
HEDKIKR is a free improvising duo. We make sound from an interaction that is heavily weighted toward the physical and the subconscious. It comes from the body, from under the mind – from outside. We like it out there.

Our work at SymbioticA has been literally to put the physicality of our performance under the microscope. The closer technology permits us to look at the world, the harder it is to escape the idea that the time scale of the human universe is too slow. Built on systems that are built on more systems – human perception is at the blunt end of the scale. From the scale's pointy other end, our most minute actions proliferate into a tidal wave of consequences. Our unification of experience is a fabrication constructed out of a vertiginous array of micro-universes.

Bacteria and viruses are where the action is.

We have developed a series of performances analogous to a laboratory culture – with certain environmental conditions and a prescribed duration. Each new performance retains some form of audio or visual residue from the last, creating its own micro-history.

It's Experimental music – we hope to justify the capital E.



This project is a joint project between SymbioticA and the School of Architecture and Fine Arts, UWA.
Adam Zaretsky & Oron Catts.

In first semester 2002 SymbioticA offered for the first time a hand on course in Art and Biology. Adam Zaretsky, a visiting research fellow in Symbiotic was the driving force behind this course, drawing on his experience in running art and biology courses and workshops in San- Francisco State University and The School of The Art Institute of Chicago. Dubbed VivoArt, this course was delivered by Adam Zaretsky and Oron Catts and involved both practical and theoretical sessions. Students received hands on experience in Molecular Biology (inserting a gene from a jellyfish (GFP) into bacteria), Tissue Culture, Developmental Biology, and more. The course also extensively covered issues related to the ethics of using living systems for human centric ends with invited speakers from the zoo, animal research ethics, scientists and artists. Some of the students' works is presented as part of BioFeel.
SymbioticA ,University of Western Australia

VIVOARTS

VivoArts student composition

Students: Donna Glasson, Margaret Heenan, Anisa Hirte, Barbara Kletnieks, Emily Green, Matt Marchment, Ruth Jeffery, Gill Phillips, Zoe Saleeba. Kelly Scurr, Kelli Sharp, Catherine Traicos, Lauw Sauw Ting, Cynthia Verspaget, Carla Webster
Unaffiliated Synchronous Collaborators: Poppy van Oorde-Grainger, Tanja Visosevic

DNART

André Brodyk

The installation 'DeoxyriboNucleicArt" is a work in progress. This work engages with the processes used in Recombinant DNA technologies as new art marking processes and the use of living material as new art media. Creative interpretations and applications of recombinant DNA processes enable the encryption of extra biological material derived from inanimate and aesthetic sources for use as synthetic DNA. The inanimate sources used in this installation are fragments derived from biotech industry company warehouses, laboratories and research facilities. When synthetic DNA is vectored into the genomes of living organisms such as Escherichia coli bacteria, it is incorporated into the genetic makeup of the organism. The loci of such genetic transformation can be seen as sites of permeable aesthetic exchange, between innate and living material. Living entities comprised of encrypted extra biological material embody a new medium of "in vivo" art expression. Appreciation as well as apprehension of such permeable interrelationships between all things at a genetic level is made fecund by the experiences provided by such new art media and processes.

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Dr. Hidetomi Terai, Dr. Didier Hannouche, Dr. Julie Fuchs and Alec Sevy, The Tissue Engineering & Organ Fabrication Laboratory, Massachusetts General Hospital, Harvard Medical School; Dr Frederic Gimenez, MIT Bioengineering Department;

Bec Dean, PICA

Julia Reodica, Artist & Laboratory Technician - Exploratorium San Francisco.

Peter Macintosh

Guy Ben Ary:
Born in USA (1967), lived in Israel and Australia. Currently living and working in WA. Manager of the Image Analysis and Acquisition Facility (IAAF), School of Anatomy and Human Biology, UWA. Specialising in light microscopy, biological and digital imaging. Member of the Tissue Culture & Art Project (joined in 1999). Joined SymbioticA – The Art & Science Collaborative Lab in April 2000. Trained in programming, web development & Law (LLB).

André Brodyk:
Bio artist born in Adelaide Australia
Currently PhD candidate at the College of Fine Arts University of New South Wales MFA from COFA UNSW Research interests centred on recombinant DNA technologies and processes and the use of living material as new art processes and new art media. Currently investigating the use of synthetic

BIOFEEL-BIOS

DNA via art based encryptions. Artist in residence at SymbioticA research laboratory UWA. Undertaken research in microbiology laboratory at University of Newcastle. Australia.

Dr. Stuart Bunt:
Co-founder of SymbioticA, the first art and biology lab situated in a science department. Have consulted and lectured on the nexus between Art/Science and Technology, exhibited in Ars Electronica and collaborated or helped produce a number of biotech art pieces revolving around emergent technologies in the biosciences. Background in science (developmental neuroscience lab, D Phil in Natural Philosophy, Oxford), and the arts (Director/co-founder SymbioticA). Senator at the University of Western Australia, chief executive biomedical software spin off company, Paradigm Diagnostics, and founder of the Image Acquisition and Analysis Facility, UWA.

Marcus Canning:
Marcus works and collaborates with many different people in many different ways. Most recently he has been busy bee as a designer for the 'Shishka-Car' spectacle at the Adelaide Festival 2002, and as creator of the video work and inflatable set used in Buzz Dance Theatre's 'Cave' production, which has just toured to Korea. He curated the 'Now You See It' window installation exhibition in Midland which is still running, and started in April as the Director of the Artrage Festival – which kicks off in October. Previously he was Creative Director of the Awesome Festival's regional programme. The first pneumatic soft sculptural work he undertook was a balloon snake created in collaboration with all the kids in Kalumburu – the most remote community in the Kimberley. He has an incessant and never-ending video opus which will one day crawl gasping into the light of day. It is called 'Dough-Boy'. It features a cosmic chef deity who floats through space and has a small white rat living in his mouth.

Oron Catts:
Tissue engineering artist. Born in Finland, lived in Israel and Australia. Co-Founder and Artistic Director of SymbioticA – The Art & Science Collaborative Research Laboratory at The School of Anatomy & Human Biology, University of Western Australia. Founder of the Tissue Culture and Art Project (1996). Research fellow at The Tissue Engineering & Organ Fabrication Laboratory, Massachusetts General Hospital, Harvard Medical School (2000-2001). Trained in product design, and specialized in the future interaction of design and biological derived technologies.

Phil Gamblen
Born in the UK in 1964. Migrated to Canada in 1966. Trained and worked as a gem cutter in the 1980's. Re-settled in WA in 1991 after two years of travel. Graduated from Claremont School of Art in1996 and Curtin University of Technology in 1998 with an Honours Degree in Fine Art, majoring in sculpture. Current artworks utilize motion and light to investigate technological aspects of today's culture, the overlap of art and science and the re-use of obsolete and discarded materials.

Sohan Hayes:
Sohan completed a degree in Fine Art at UWA, graduating 1997. His art practice spans a diverse array of mediums, some of them being kinetic sculptures, performance work, video, installation, sound and CG character animation for CD-ROM games . In recent years with the Awesome Children's Festival regional program Sohan has travelled to various communities around Western Australia, working with young people to create special events and artworks.

Tom DeMarse
Tom DeMarse is a postdoctoral researcher in the Biomedical Engineering Department at Georgia Tech. His primary research interests include the study learning and memory invitro and invivo. He has worked with Steve Potter for over two years on the Animat Project whose goal is to create a hybrid animal using mult-electrode array technology in which a biological brain that is cultured invitro is interfaced and controls a computer/robotic body.

Marta de Menezes
Marta de Menezes is a Portuguese artist (b. Lisbon, 1975) with a degree in Fine Arts by the University in Lisbon, and a MSt in History of Art and Visual Culture by the University of Oxford. In recent years, she has been exploring the interaction between Art and Biology, working in research laboratories demonstrating that new biological technologies can be used as new art medium, and proving that laboratories can be art studios. Besides researching into new ways to create art, Marta de Menezes is also an accomplished artist using

traditional media, with paintings frequently representing insights from scientific research.

Darren Moore
Percussionist and a composer, born in the UK in 1974. From 1981 lived in Perth after a family immigration. He studied music at the WA conservatorium graduating in 1997 with Bachelor of Music. Between 1998 - 2001, Darren lived & worked professionally as a musician in London. Currently Darren leads local avant guard jazz group - 'Open Source Project' as well as performing in Hedkiker with Lindsey Vickery.

Steve M. Potter
Steve M. Potter is the product of an artistic mother and a scientific father, who fostered both creativity and curiosity. As a result, he is perhaps more interested in the aesthetics and presentation of scientific data than most scientists, eager to make it interesting for the general public. He got his undergraduate degree in biochemistry at the Univ. of California, San Diego, and his PhD in neurobiology at the Univ. of California, Irvine. He worked as a postdoctoral scientist 8 years at the California Institute of Technology, developing tools to study living neuronal networks. He is now a professor of Biomedical Engineering at Georgia Institute of Technology in Atlanta. More info, http://www.neuro.gatech.edu/potter.php

Alexander C. Shkolnik
Alexander C. Shkolnik is an undergraduate at Emory University, Atlanta, GA, graduating with a B.S in neuroscience and behavioral biology and a joint B.S / M.S in computer science and mathematics. He is currently working on his masters thesis as a research fellow in Steve Potter's lab. Interested in merging the fields of neuroscience and computer science, Alexander hopes to continue his academic career in Artificial Intelligence.

Ian Sweetman
Through an eclectic and undistinguished career Ian Sweetman is uniquely unqualified in, but has at one time or another earned a living from; photography, bacteriology, pulmonary physiology, bass playing, record production, sound engineering, neurobiologly, forensic anthropology, maths, applied computer science, network administration,artificial intelligence, strange art projects involving fish and robots and, tentatively, haptics . He still does not know what he wants to do with his life, but if he ever gets paid what he thinks the world owes him, travelling around the world with a bicycle, a tent and a credit card is a strong possibility.

Lindsay Vickery
Composer/performer Lindsay Vickery's music includes works for acoustic and electronic instruments in interactive, improvised or fully notated settings, ranging from solo pieces to opera and interactive video. He has been commissioned by numerous groups and performed in Holland, Poland, Norway, Germany, England, the Phillipines, the USA and across Australia. Lindsay has been artist-in-residence at STEIM (NLD), HarvestWorks (NYC), LACMA (LA), the University of Illinois and the MATA festival (NY). Vickery is a lecturer at the WAAPA@ECU in Perth. He was a founder member of Magnetic Pig, GRIT, HEDKIKR and LA-based multimedia group Squint.
www.magneticpig.iinet.net.au/lv/lv.html

Amy Youngs
Amy M. Youngs exhibits mixed-media interactive sculptures nationally and internationally. Reviews of her work appear in the Chicago Reader and Artweek and her articles have been published in Leonardo and Nouvel Objet. She has lectured nationally, including, California State University, Long Beach and the Massachusetts Institute of Technology. She was awarded an Individual Artist Fellowship Grant from the Ohio Arts Council in 2002. She received a full Merit Scholarship to study at The School of the Art Institute of Chicago, where she completed her MFA in 1999. Youngs is currently an Assistant Professor of Art at The Ohio State University.

Adam Zaretsky
One of the world's foremost Microinjection Food Science Researchers, Zaretsky practices garage embryology, parasitology and glossolalia as a perpetually rotating academic at the International University of Pataphysics.
In 2002-2004 he will be teaching VivoArts in Neil Rolnick's Electronic Media, Arts, and Communication department at Rensselaer Polytechnic Institute. The class focuses on all of the living arts, including but not limited to: Environmental Art Installation, Radical Food Preparation, Performative Pet/Domestic Animal Relations, Science Fiction Enactment, Art and Science Co-Laboratory and Licentious Body Manipulation Arts.
Rumor has it that Zaretsky met with the illegitimate brother of US President George W. Bush, Osama bin Laden at a cultural summit in the Cayman Islands, whereupon Osama stated: "the axis of benevolence *is* soft parasitology."Contact: injector@emutagen.com

Ionat Zurr:
Wet Biology art practitioner. Born in England, lived in Israel and Australia. Artist in residence in SymbioticA – The Art & Science Collaborative Research Laboratory at The School of Anatomy & Human Biology, University of Western Australia. Co-Founder of the Tissue Culture and Art Project. Research fellow at The Tissue Engineering & Organ Fabrication Laboratory, Massachusetts General Hospital, Harvard Medical School(2000-2001) Studied photography and media studies, specializing in biological and digital imaging, as well as video production.