THE AESTHETICS OF CARE?

The artistic, social and scientific implications of the use of biological/medical technologies for artistic purposes.

Presented by SymbioticA: The Art and Science Collaborative Research Laboratory
& The Institute of Advanced Studies, University of Western Australia

Perth Institute of Contemporary Arts 5 August 2002.

The Aesthetics of Care? Symposium is part of the Biennale of Electronic Arts Perth (BEAP) 2002.

Supported by

ISBN: 1 74052 080 7

Cover Design

Edited by Oron Catts

The Aesthetics of Care? is published by SymbioticA, School of Anatomy and Human Biology, University of Western Australia, 35 Crawley Avenue, Nedlands 6009. Western Australia. August 2002.
www.symbiotica.uwa.edu.au

9 –9.15	Oron Catts – Welcome
9.15 – 10	Professor Lori Andrews
Morning Session	
10 – 10.20	KDThornton: **The Aesthetics of Cruelty vs. the Aesthetics of Empathy**
10.20 – 10.40	Stuart Bunt: **A complicated balancing act? How can we assess the use of animals in art and science?**
10.40 – 11.00	Laura Fantone: **Cute Robots/Ugly Human Parts (A post-human aesthetics of care)**
11.00 – 11.10	Questions
11.10 –11.25	Morning Tea
11.25 – 11.45	George Gessert: **Breeding for Wildness** (presented by Adam Zaretsky)
11.45 – 12.05	André Brodyk: **Recombinant Aesthetics (adventures in paradise)**
12.05 – 12.25	Peta Clancy: **Gene Packs**
12.25 – 12.35	Questions
12.35-1.30	Lunch
Feeding Session of the semi-living objects	
1.30-1.50	Julia Reodica: **Test Tube Gods and Microscopic Monsters**
1.50- 2.10	Redmond Bridgeman: **The Ethics of Looking**
2.10- 2.30	Marta de Menezes: **The Laboratory as an Art Studio**
2.30 – 3.00	Guy Ben-Ary/Thomas DeMarse: **Meart (AKA Fish and Chips)**
3.00 – 3.20	Ionat Zurr: **An Emergence of the Semi-Living**
3.20 - 3.30	Questions
3.30 – 3.45	Afternoon Tea
3.45 – 4.05	Amy Youngs: **Creating, Culling and Caring**
4.05-4.25	Grant Taylor: **The obscured ideologies of Artificial Life and William Latham's Mutant Monsters**
4.25– 4.50	Steve Baker video: **Kac and Derrida: Philosophy in the Wild?**
4.50– 5.10	Adam Zaretsky: **The Workhorse Zoo Bioethics Quiz**
5.20-5.30	Questions
5.30 – 5.55	Break
6 – 8pm	**PANEL DISCUSSION** Professor Andrew Brennan, Chair in Philosophy, UWA Professor Stuart Bunt, SymbioticA Director Oron Catts, SymbioticA Artistic Director and BioFeel Curator Sue Lewis, Research Ethics and Animal Care Manager, UWA Heidi Nore, Animal Rights activist Adam Zaretsky, Vivoartist and Educator

Oron Catts

I would like to welcome you all to The Aesthetics of Care? - the first of an ongoing series of SymbioticA symposiums.

Since SymbioticA's inception in 2000 we have had artists working in our art and science collaborative research laboratory, utilising the knowledge and facilities available in the School of Anatomy and Human Biology at The University of Western Australia. One of SymbioticA's main premises is to act as a porous membrane in which art and bio-medical sciences and technologies could mingle. Artists are encouraged to employ biological techniques as part of their practice and undertake research in a co-operative and collaborative, rather than competitive manner. The cross fertilisation of ideas, skills and knowledge between different artists and scientists is key to our existence.

We now receive on average three requests per week from local and international artists wanting to be artist-in-residence at the lab. In accepting proposals we have had to find a medium between the merit of the work being proposed and the ethical implications of the research to be undertaken. Our innate curiosity and wish to experiment is tempered by social, ethical and epistemological issues.

The level of manipulation of living systems that biotechnology is starting to provide is unprecedented in evolutionary terms. The way in which humans choose to exercise these technologies on the world around them hints at the ways they will be used on each other. In The Aesthetics of Care? we will explore how artists are utilising this new knowledge and the skills that will be acquired by artists venturing into this new realm of operation. How will the general public respond to living biological systems presented as art? In particular how do we deal with the ethical implications of using living systems in artworks?

We do not foresee any resolutions being reached at the end of today's proceedings. Rather, we hope to generate an ongoing dialogue on where we have come from and where we are going that moves beyond the human-centric discourse of bioethics. We see it as a continuation of SymbioticA's ongoing commitment to open discussion regarding its role in the realm of biological art expression. We are proud to have such an eclectic group of presenters from legal,

scientific, philosophic, academic and artistic backgrounds who will explore the complexities of the inspiring and alarming arena of biotechnology.

The Aesthetics of Care? is presented by SymbioticA and The Institute of Advanced Studies, The University of Western Australia.

Lori Andrews

Lori Andrews is distinguished professor of law at Chicago-Kent, United States of America: director of IIT's Institute for Science, Law and Technology; and senior scholar of the Center for Clinical Medical Ethics at the University of Chicago. She has been an adviser on genetic and reproductive technology in the United States to Congress, the World Health Organization, the National Institutes for Health, the Centers for Disease Control, the federal Department of Health and Human Services, the Institute of Medicine of the National Academy of Sciences, and several foreign nations including the emirate of Dubai and the French National Assembly. She served as chair of the federal Working Group on the Ethical, Legal and Social Implications of the Human Genome Project and recently served as a consultant to the science ministers of twelve countries on the issues of embryo stem cells, gene patents, and DNA banking. Andrews has also advised artists who want to use genetic engineering to become creators and invent new living species.

Professor Andrews is the author of nine books, including The Clone Age, published in 2000, in which she unmasks the bizarre motives and methods of a new breed of scientist, bringing to life the wrenching issues we all face as venture capital floods medical research, technology races ahead of legal and ethical ground rules and ordinary people struggle to maintain both human dignity and their own emotional balance.

KDThornton

The Aesthetics of Cruelty vs. the Aesthetics of Empathy

"It is not at all a matter of vicious cruelty, cruelty bursting with perverse appetites and expressing itself in bloody gestures, sickly excrescences upon an already contaminated flesh, but on the contrary, a pure and detached feeling, a veritable movement of the mind based on the gestures of life itself..."
Antonin Artaud, Theatre of Cruelty

Non-utilitarian animal use documents as far back as 4000 years ago in China, Egypt, Rome, and Greece.[1] Some forms of these ancient carnivals, circuses and agricultural fairs are still with us today, though their numbers and frequency are dwindling. Zoos and menageries are usually state institutions, but for the renegade freelance roadside attraction, or private zoo. Before art became institutionalized in museums and galleries, exhibitions at agricultural fairs were the primary form of art exposure for most North Americans.[2] Exhibitions involving live specimens are on the increase in recent years, in art, science, and nature museums. "A number of museums have discovered what zoos have always known: visitors are fascinated by live animals." [3] In keeping with that observation, I will focus upon live animal use in aesthetic practice, and will not address the use of corpses, techniques of preservation, such as formaldehyde, mummification, taxidermy, representations of animals,[4] or the genetically modified innovations of recent times.

Artists are incorporating live animals into their work with ever-increasing frequency. If one adopts the "artist as visionary" model, some of these artists may be preparing society for the greater changes ahead in the fields of biotechnology or further along, the dissolution of speciesism. More cynically, considering the static environment of the typical art institution, the inclusion of dynamic or controversial content may often operate as an attention-getting strategy in the (forgive me) dog-eat-dog world of contemporary art. Works using animals are tied to their precedents in popular culture, ranging from menageries, circuses, religious sacrifices, sadistic entertainment and some forms of harvest or collaborations with domesticated animals. Generally, animal-works fall into one of the four following categories:

Appears in Popular Culture as:	Represented in art as:
Zoos, Menageries	objects
Circuses, Animal Acts	performers[5]
Sacrifice: cock+dog-fighting, factory farms	victims
Cultured pearls, honeybees, free-range farms, etc.	co-creators

In art, one may find the earliest example[6] of animal use to be Philip Johnston's 1934 installation *America Can't Have Housing* at MOMA, a tenement slum re-creation that included cockroaches.[7] Another early work, Salvador Dali's *Rainy Taxi* at the International Exposition of Surrealism at the Galerie Beaux-Arts, Paris (1938), incorporated snails. Almost twenty years later, 1957 saw an exhibition of paintings and drawings created by chimpanzees at the Institute of Contemporary Arts, London, curated by Desmond Morris.[8] From its beginnings in 1958,[9] Hermann Nitsch commissioned the slaughter of animals in his *Orgien Mysterien Theatre*.[10] According to various reports, these domestic animals were either diseased (refused by the slaughterhouse), sedated, or already deceased before slaughtering. In his public statements he professes either a more humane death than the abattoir, or at worst no different than such, and his events are regularly protested by animal rights organizations.

Within the next fifteen years, two works incorporating live animals appeared in Rome: Richard Serra exhibited *Live Animal Habitat* in 1965-6, which displayed cages occupied by animals, both live and stuffed;[11] Jannis Kounellis, *Untitled (12 Horses)* in 1969, with twelve horses tethered within the gallery. In Canada, Glenn Lewis and Michael Morris exhibited *Did you ever milk a cow?* in the Realisms exhibition, Toronto and Montréal, 1970. The piece featured a live cow in a pen, surrounded by paintings of cows from various periods, gleaned from the host institution's collection.

Helen and Newton Harrison, now known for their environmental works, were the first to incorporate intentional death in North America, in *Portable Fish Farm* (1971). Public outcry against the electrocution of the fish forced the artists to change the piece, electrocuting the fish privately. These practices were not limited to gallery installations; performance artists were also working with concepts of death, cruelty and/or the species rift. In 1972, 1973, and 1974 respectively: Ana Mendieta in *Untitled (chicken)*, decapitated a chicken; Valie Export dripped hot wax on a bird in *Asemia: The Inability To Express Oneself through Body Language*; and Joseph Beuys shared gallery space with a coyote, in *I like America, America likes me*. In 1976, Kim Jones set fire to rats, a practice he'd learned while serving in Vietnam. Joe Coleman,

performing as Professor Momboozo, revived the tradition of the circus geek by biting the head off of a rat at The Kitchen, NYC in 1980,[12] sealing the decade consisting almost exclusively of death/cruelty works.

The 1980's appear to have passed with only exhibitions of the menagerie or collaborative categories. Most notably, Noel Harding exhibited five installations using, variously: chickens, rabbits, goldfish, finches and an elephant.[13] Remo Campopoanpo exhibited at least two pieces, one with rats in a Buddha-shaped cage, and another referencing the North American Indian medicine wheel with rats, ants, and fish.[14] For collaborations, Hubert Duprat began his long-time work with caddis flies, encouraging them to build their cocoons from gold and semi-precious stones; while Garnett Pruet developed sculptural pieces, which were placed in hives to be adorned with honeycomb by bees.

In the 1990's, the use of live animals in contemporary art has followed this exponential increase in all categories. In China, the number of artists working with animals exploded in 2000, for cultural identity and speculatively opportunistic reasons: ostensibly to attract the attention of foreign curators. Chinese expatriate Xu Bing created *Case Study of Transferenc*e (1994), with text-covered pigs fornicating in a performance space littered with books. Since that time Xu has exhibited a talking parrot, a sheep tethered by a leash composed of linked metal phrases and silkworms spinning on various objects. He conscientiously distances himself from any cruel practices, though his artistic success may be serving as an ill-advised example for his imitators.[15] The frequency of thoughtless and cruel works in China prompted historian of Chinese art, Britta Erickson, to send an open letter to Chinese Type Magazine:
If an artist uses the most precious materials on earth, living things, then the artist needs to show respect towards the material. [...] Encasing a live goose in a plaster cast up to its neck, so that it experiences terrible fear before meeting its death as a horrified member of the audience tries to free it - how is this art?[16]

Around this time, Gu Zhenqing strategically staged an exhibition with the "morally upright cause of animal protection as a goal"[17] featuring some twenty artists producing work addressing various animal issues. In 2001, China's Ministry of Culture outlined jail terms of up to three years for bloody, violent, or erotic art, and especially targets "the more extreme forms of contemporary art performances which involved live animals."[18]

In the same time period, controversy at the Minneapolis Institute of Arts caused the removal (by the artists, Mark Knierim and Robert Lawrence) of two chickens from a well-outfitted and comfortable installation to protect them from disgruntled activists.[19] Marco Evaristti's "goldfish in blenders" piece generated global news reports for his exhibition in Denmark, as well as a comment from noted animal ethicist Peter Singer "When you give people the option of turning the blender on, you raise the question of the power we do have over animals."[20]

When power is wielded over another with a total disregard for pain or psychological comfort, cruelty often ensues. Sometimes this cruelty takes the form of nature itself. In Huang Yongping's *Terminal*, and Adam Zaretsky's *Workhorse Zoo*, animals, insects, and reptiles are exposed to one another, and behave as they would in the wild –with sometimes lethal interactions. It is often forgotten that in nature, it's survival of the fiercest: eat or be eaten.

In 2001, two Toronto art students were charged with cruelty to animals, for skinning a live cat, and documenting the 17-minute process on videotape.[21] Ten months later, they were convicted. Toronto artist Cathy Gordon Marsh said she has no problem defining the boundaries of art, and noted that there is already a boundary for this kind of art – the law. "Like what? We're going to change the laws for artists just so they can abuse animals for the sake of a greater point? There are other ways of communicating a message about that topic that doesn't involve the direct torture of an animal."[22] In the United States, laws against depictions of cruelty also exist, but allow special dispensation for "educational and artistic works."[23]

In the scientific community, where there exists a longer and more sustained tradition of work with animals, responsible scientific practices include educating animal workers in appropriate procedures. Often the experimental goals blind the practitioner to the reality of the living creature(s) involved. A study by Psychologists for the Ethical Treatment of Animals has established that animal experiment workers often have complete disregard for the comfort of their animals, denying that their subjects feel pain even after highly invasive procedures.[24]

Repeated exposure to, or participation in, violence against animals has often led to more advanced forms of mistreatment and cruelty. Despite this observation, concepts of responsible treatment also developed, and often those required to work with animals are trained in these techniques. Behaviourist Konrad Lenz initiated many new methods of working with animals. In collaboration with Lenz, Karen Pryor developed a structured means of training, which ensures

that many scientists and science workers are attuned to reading animal responses, enabling them to work more communicatively with their research animals.[25] As communication reduces the objectification of the animal, the likelihood of cruel behaviour is reduced. These ideas of collaboration, and interspecies communication are present within the arts community as well.
Aganetha Dyck works with bees. Since 1991 she has placed various objects within beehives, and encouraged the bees to build honeycomb on the available surfaces. When she installed a leather object in the hive, the bees began buzzing, behaving as they do when threatened. She listens to what she thinks they're saying, and in this case she felt they were signalling extreme discomfort. Bees will attack mice, which often invade the hives. Since the bees are unable to remove the corpse, they cover the dead mouse with propylous (an amber-like substance), in order to mask the residual presence of the threat. Since that time, whenever placing something into the hive, she has asked herself, "Who are their enemies?" as she interprets the leather as a reminder of dangerous mammals. In discussing forms of communication, Dyck noted that "there are all kinds of ways of communicating with insects– stand still for instance. Buzzing signals a threat, and our breathing releases CO_2 – which is communicating... it is something they dislike."

She notes that the common practice of "harvesting honey is more cruel than the removal of the wax-objects." For professional exhibitions she requests the presence of a beekeeper for the comfort of the bees as well as an entomologist to answer questions regarding the bees as a respected authority, as she is often confronted by activists.[26] Currently, she is investigating the use of pheromones and magnetism to assist in her communication efforts with the bees.[27]

In my own work, the taxidermied *Layer series* (1993), I found myself unexpectedly the caretaker of a chicken who had survived two potentially lethal gassings at a research facility. These chickens were routinely "decommissioned" – usually by neck breaking, if their egg production was insufficient. Though slightly disoriented, within a short time the surviving chicken was able to perch and appeared to recover rapidly. After a few days, I discovered that Spunky,[28] as she came to be known, would jump on my lap if I patted my thigh: this was not training, nor was it innate behaviour. Surprisingly, she understood my "language" –the same signal as I used with my cats. Months later, she began laying eggs, and would cluck to me when she was ready to gain access to the living room sofa, her preferred place for nesting. Her eggs were later used in a series of static and interactive works, though I never ate even one. As I considered her "co-

author" of these works, she was to be present at an opening, until murmurs of activist dissent affected a change of plans.

In 1999, Kathy High produced *Animal Attraction*, a video about the work of animal psychic, Dawn Hayman. High enrolled in Hayman's animal communication workshop. During a training conversation with Sonya Pia, a feline resident of Spring Farm CARES, High inquired of Sonya Pia "how she spends her days, what does she like to do?" High experienced mental images of jumping around hay bales. She continued the questioning in more detail and found herself seeing a series of mental images, chasing mice in a barn from a cat's perspective. Though she doubted herself originally, it was difficult to explain the hay bales, as it seemed unlikely as a product of her imagination. Later, it was revealed that Sonya Pia spends much of her time as a barn cat. Through considering these experiences High found herself wanting to translate the visual information received in these conversations to a form that would communicate to others, with her "communicators" as directors. Some of these co-director experiments were more successful than others: The llama, Gulliver, was more of a philosopher than a visual thinker, able to transmit a feeling about grass but not an image, while Ernie (High's feline housemate) began very literally, almost "slapstick" in his editorial decisions and content, but has persevered and his latest work shows a more sophisticated sensibility.[29]

Given that the predominant religious beliefs of Western culture bestow upon humans a soul but do not extend this privilege to animals, perhaps it is time to call this endowment into question. Although many philosophers raise arguments that "animals have souls," what if instead, for centuries, the philosophical ethic that allows for differential treatment is flawed in its essential premise. We invented the concept of souls to separate ourselves from the other animals. Perhaps we, the humans, have no soul after all. At the very least, a paradigm shift in this direction would level the playing field.

Notes and References:

[1] Cirque Eloise: History of the Circus, http://cpinfo.berkeley.edu/information/education/pdf_files/cirque_eloize_part3.pdf

2 Robert McKaskell on the history and installation of "Did you ever milk a cow?" at the Art Gallery of Windsor in 2000. Among the artist's directions for the piece: "Be nice to the cow" Interview: 5/10/02

3 Bedno, Jane and Ed: Museum Exhibitions: Past Imperfect, Future Tense, Museum News, September/October 1999

4 Even when as collaborative as William Wegman and his weimaraners.

5 Arguably, any live creature is "performing" if an audience is present, but whether they are behaving naturally, or interacting with either the artist, an environment or prop designed for their use, may distinguish any blurring between those two categories.

6 Database of animal use in art, http://www.rpi.edu/~thornk/animals

7 Staniszewski, Mary Anne: The Power of Display, MIT Press, 1998, p199. NB: the cockroaches were removed after complaints regarding the insulting assumption that poverty entails filth/infestation

8 Also see paintings by Washoe (the ASL chimp) and the more recent elephant paintings by Komar+Melamid – which are sold to ensure preservation of the species.

9 Crichton, Fenella: Blood and soil, Art Monthly no220 (Oct. 1998) p. 7-10

10 which recently celebrated its 100th performative event

11 Krauss, Rosalind E.: Richard Serra/Sculpture, The Museum of Modern Art, New York, 1986

12 later filmed in Mondo New York, 1987. Unfortunately, TV personality and animal rights activist Bob Barker saw the film and pressed charges against Coleman for cruelty to animals. Although the artist fought (and won) this case, a second charge, for possession of an ' infernal machine', was brought following an explosive slaughterhouse of a Momboozo show in Boston, 1989 from Bizarre Magazine http://www.bizarremag.com/lives/coleman.html

13 The Centre for Contemporary Canadian Art, The Canadian Art Database– http://www.ccca.ca/artists/harding.html

14 Chen, Sande: Intriguing multi-media exhibit from Remo Campopoanpo, The Tech, Vol. 109, #49, November 7, 1989, p9

15 Xu Bing: http://xubing.com/aboutMe/bibliography17.htm

16 Chinese Type Magazine: http://www.chinese-art.com/Contemporary/volume3issuef/editorial.htm

17 Chinese Type Magazine: http://chinese-art.com/animal.htm

18 The Straits Times, 05/11/01, quoted in http://www.asiamedia.ucla.edu/Weekly2001/05.08.2001/China11.htm

19 Abbe, Mary: Chickens exit museum but show goes on, Star Tribune, November 10, 2000

20 Boxer, Sarah: Metaphors Run Wild, but Sometimes a Cow Is Just a Cow, New York Times, Late Edition, June 24, 2000

21 Smith, Foster: Between Art and Snuff, National Post, July 19, 2001

22 Honey, Kim: But is it art? The Globe and Mail, Print Edition, Page R1, July 21, 2001

23 Wong, Edward: Cruelty cases shed light on violent animal "crush" videos, San Francisco Chronicle, February 09, 2000

24 Phillips, Mary T.: Savages, Drunks, and Lab Animals: The Researcher's Perception of Pain, Society & Animals, Vol. 1 No. 1, 1993

25 See Pryor, Karen: Don't Shoot the Dog, often used as a basic training guide for zookeepers and marine mammal trainers

26 Interview with the artist, 4/20/02

27 Ringer, Janet: Bee art strategy smells promising, http://www.cbc.ca/artsCanada/stories/bees310502
–magnetism reference: interview with the artist, 06/10/02

28 http://www.rpi.edu/~thornk/old/spunky.html

29 Interview with the artist, 05/13/02

Stuart Bunt

A complicated balancing act? How can we assess the use of animals in art and science?

Biological researchers involved with the use of animals have long been used to regulation and control of their activities. (The British animal welfare act was first passed by parliament in 1865). However such examination and regulation has, so far, been absent from artistic endeavour in spite of the death of millions of sable and squirrels for paintbrushes. The major reason for this has been the vivisection involved with some scientific research while, in the past, most artistic endeavour used only dead animals. This has left society ill prepared for the challenge of artists that work with living organisms whose work may involve vivisection.

All scientists in the developed countries have to go through a rigorous vetting procedure before they can operate on any animal. The institution has to be certified, the area where any operations are to be carried out must be certified and the individual to carry out the work must also have a vivisection license. The license is only issued to those with appropriate training. Even after this process an animal ethics panel (with representatives from animal welfare groups, veterinarians, scientists, religious representatives and ethicists) assesses each individual experiment.

The assessment of the scientific endeavour is carried out on a basis of a combination of scientific "quality" and the outcome, the benefits to society of the knowledge to be obtained. However, some would suggest that only "scientific quality" can be assessed as a number of studies have shown that the most important medical discoveries of this century were not predicted by the scientists who carried out the original research leading to the breakthroughs. In each case the potential "benefit" is balanced against the harm caused to the animal, this in turn is related to the age and sophistication of the animal's nervous system.

Of course "it is of no concern to (a) mouse whether it is being used to test a new cure for cancer or a new cosmetic. or..is the subject of a patent application. The welfare of a mouse will be defined by whether... it experiences any physical or mental distress on a day-to-day basis and by what happens to it when it becomes involved in an experiment." (Webster 1995) It is

for this reason that scientists are committed to the "three Rs" - reduction, refinement and replacement wherever possible (Bulger, 1987). As Webster confirms we should as concerned scientists commit to support the "five freedoms" - freedom from thirst hunger and malnutrition, freedom from discomfort, freedom from pain, injury and disease, freedom from limits on expression of normal behaviour and freedom from fear and distress. It is also why some philosophers argue that animals do not have any moral rights, they are do not have the ability to enter into a moral contract, because they are not rational, so they cannot be provided any special protection under the human moral code (Carruthers 1992)

However anthropomorphism leads to many anomalies. Before hatching the regulation on chick embryos are much laxer than those that apply seconds later to the hatched chick. In many regulations animals are arbitrarily assigned to various treatment classes based on "domesticity" such that horses cats and dogs are in a separate category. Other animals lose their zoological status; a famous British legal ruling dictated that prawns can be fried alive because they are "insects" (they are crustaceans). Dogs are well protected while similarly intelligent octopi have less protection. Ugliness is definitely a handicap!

How are such principles to be applied to artistic endeavour? How do we apply utilitarian principles? Make value judgements about the importance of the artwork? Should we make such judgements? Animal ethics panels set up to judge scientific works are not qualified (if anyone is) to assess artistic merit or the even more obscure "value to society". The philosophy of the "end justifies the means" has long been discredited. Should we therefore make our own criteria separate to the utilitarian criteria applied to scientific research? Who should be on panels that make these decisions?

The use of animals in art is not a new phenomenon, biological materials from egg white to hogs bristle, elephant tusk to eagle feather have been used since antiquity to make works of art. Yet there is something qualitatively different about the use of biological material in more recent bio-art. This difference is that some of the material may, by many definitions, be alive. Either living cells taken from living organisms or the actual animal itself, alive for at least some part of the performance or existence of the art piece. Art has made the transition from post-mortem display to "vivo-art", in some cases, vivisected art.

For some the very word vivisection calls up Mephistophelean images of wild haired scientists carrying out sadistic experiments in dark satanic laboratories. This imagery follows as a logical proposition if you accept the common ("reliance on animal tests puts human health in jeopardy because the physiology of animals is so different from our own " Struthers, 2002), but clearly wrong (in a BMA survey of doctors, only 2.3% did not support the statement that "animal experimentations have made an important contribution to many of the advances in medicine"), propaganda promulgated by many antivivisection groups that no animal experiments ever lead to a medical advance. If this were the case why would anyone experiment on a living animal unless it was out of a perverted sadism? What then to think of an artist who does the same? How can we say if the art is "good" or "useful"? Do such adjectives have any agreed meaning when applied to art? If the art has no worth does that then mean, to use the scientific analogy, that the artist must be carrying out the "evil deed" out of pure malice?

This approach to the ethics or social acceptability of vivisection, for art or science, is based on a utilitarian principle. "The end justifies the means". However this very statement is a tautology for it in itself invokes a further utilitarian comparison, which does most harm, the means or not reaching the end required? Many a scoundrel has used this argument for an ultimately evil balance, from Auschwitz to present anti-terrorism legislation. In art and perhaps more surprisingly, in science, it is very hard, at the time of decision, to find any way of measuring the worth of the activity which led from the "evil" means. Even harder then to balance the value of the two; the cost of the means and the advantage of the "end".
The difficulty is that the value of the work, be it scientific or artistic, is often not known until long after the event. The final worth of the scientific work may be easier to quantify but even then it may remain open to interpretation for centuries, long after the animals have suffered and died. Peter Medawar, a famous post war scientist studied published, peer reviewed, scientific papers that lead ultimately to ten of the greatest medical breakthroughs this century. Not one of them foresaw the final positive result of their discoveries. Even some discovery as obviously "good" as a cure for cancer may bring long term difficulties to a society unable to feed or clothe its existing population.

The assessment of art is often by criticism or reviews, measured by its impact upon the art world. This "peer review" is as incestuous and value laden as any scientific editorial panel. It may be years or never before a consensus is reached on its "value". Art criticism is a highly social event, loaded with political, historical and anthropological bias. Fashions came and go as

"taste" changes, as society changes. Much Victorian art is now seen as high Kitsch, although even there, there are signs of a revival. We may congratulate ourselves about how awful a Maxwell Parish is but must also realise that the modern trend to consider any such art, which does not challenge, criticise or make us "think" about or reassess our view of human nature is based itself on a largely discredited Marxist philosophy. As Bryan Magee says, "this may be the last bastion of Marxism to fall".

I do not wish to pretend for a second that the valuation of science is any less a function of its time and place in society. However even that pillar of "social science" Thomas Kuhn could see from a study of the history of science that, in science, and perhaps unlike in art, the very weight of facts will always eventually overcome any resistance to a new paradigm, even after decades of a "dialogue of the deaf" as two rival camps fail even to understand what the other is saying. Does it make a difference that scientific facts will always be found one day but a Beethoven symphony may never occur if Beethoven is stopped from playing? Science can wait, but can art? To quote the arch rationalist Lewis Wolpert "Science makes progress, we build on the work of our current and earlier colleagues. To talk about progress in art makes no sense, there is change but not progress. Art is not constrained by reality. It cannot be shown to be wrong".

If we cannot judge the ultimate value of art or science at the time it is carried out, can we use the utilitarian argument to support or deny the use of animals in artistic or scientific endeavour? Can we instead ascribe some form or present "quality" to the work? Any such value judgement will obviously be based on present mores and social norms but ethics should be a reflection of those present norms. Ethical behaviour is not an absolute in spite of Kant's Categorical Imperative, his fundamental rule of morality that one should "act only according to maxims which you can will also to be universal laws". History shows that, through the fourth dimension of time, even universal laws of morality may change.

How then do we measure the "quality" of present work, be it scientific or artistic? Some scientists would state that there is a universally agreed set of rules that science operates under and that "good" science should meet these standards. This is almost certainly wrong. Actual studies of the way scientists operate show repeatedly that even the "best" scientists" do not necessarily always follow their own self-professed rules. Take for example repeatability. The mantra states, "All good scientific work should be repeatable". Scientific papers are, in theory,

written in their odd stilted, third person style to ensure that there is no ambiguity; that another scientist could directly repeat the work to confirm or deny its validity. Of course this is almost never done. There is no kudos to be had from merely repeating another's work, no professorships lost or found on the back or repeated work. In fact the PhD regulations state that for this venerable degree "the work must be original". Practically the only times I have come across when one scientist has deliberately repeated the work of another is when they are pretty certain they will get a new and different result. Often clashes of personalities and reputations are involved.

Even if the work is defined as technically "good" is it worth doing? Does this matter? If an experiment sets out to measure the grains of sand on a beach, wonderfully, precisely and reproducibly by any measure – is it still worth doing? Is it worth any animal's life?
In all this discussion I have been discussing the "value" of the art or science, but what of the other side of the balance, what is the "value" or "worth" of an animal? How do we judge this? Present animal protection laws make some attempt to put differing values on different species. There is an odd logic to it, ugliness places you low on the scale, and "intelligence" raises you higher. A recent evolutionary history seems to help, as does domesticity, and if you look like a human, a baby human even better – well you are practically invulnerable to the vivisectionist's scalpel! There are many anomalies; the intelligent, but invertebrate and ancient octopus has scant protection while the slow-witted possum, with furry skin and baby eyes is well protected.

Ability to feel pain is another apparent criterion, perhaps vaguely linked to intelligence (Petherick, 1995). It is sometimes stated that the "value" or the research is balanced against the stress and pain "felt" by the animal. But how can this be measured? Pain is an evolutionary construct, a measure of the value of the damaged item to our survival. It is not a special thing, separate from nerves. If one was to measure the nerve impulses going up the spinal cord from someone stroking your hand or amputating it, the flow of sodium and potassium in and out of the fibres would be the same, the nerve fibres look the same. The difference is purely in our interpretation of what that means. How would we explain the difference between a pinprick and a stroke to a robot? Why is one "unpleasant" one not?

If you apply an electric shock to a flatworm it will withdraw as fast as a greyhound, why then can we squash one and not the other without qualms? They both are responsive to pain, both "feel" pain. I would suggest the difference lies entirely in the ability to appreciate that pain

and relate it to other events. I think consciousness is the clue. When we are anaesthetised with halothane, blood pressure still rises when the stomach is cut. The body is reacting, but we do not think of this as cruel. Why? Because we are not "conscious" of that pain, not aware of it. What has happened to cause out loss of consciousness? Halothane acts on the cerebral cortex; it stops cerebral cortical neurones from firing, is this significant?

The phenomenon of "blind sight" has a lot to tell us about this. In rare cases individuals who have received a heavy blow to the back of the skull destroying the visual cortex, become blind. However, their eyes are still working and their optic nerves are connected to the brain. Careful testing, forcing the subject to "guess" where objects are for example, can show that they can in fact "see" in a technical sense, however, because they are no longer "conscious" of this visual input, it is useless to them. They bump into objects, cannot cross the road unaided, and are to all intents and purposes "blind". What then are we to think of animals like goldfish that have no visual cortex, have never evolved one? Do they "see" as we do, or are they like individuals with blind sight, able to react to light, orient towards food, but are in fact totally lacking in any "awareness" or "consciousness" of the sight. If this is the case, can we extrapolate this to pain; are they like some humans, born with cortical damage that are unaware of pain, or a patient on the operating theatre table, their cortex knocked out by the halothane? If such animals are "unaware" of pain (do not confuse this with unable to react to pain – remember the reactions of the anaesthetised patient on the operating table) can we "use" them as we wish, in art or science?

If "consciousness" of pain is crucial to our view of "cruelty" then where do we draw the line? Evolution is a gradual process leading to the gradual emergence of new traits. It would be impossible to draw a line in the animal kingdom and say this is when "consciousness" evolved. Some fish have a very large olfactory cortex and this may well subsume some of the roles of our own cortex, reptiles have the start of a cortex, birds and mammals a definite cerebral cortex, albeit one that varies enormously in size and complexity from platypuses to primates.

This raises yet another "balancing" paradox. Ethical committees often balance the pain and stress caused against the "value" (scientific or to society) of the procedure. How tenuous does this process become when one adds the further complication of how much does the animal "feel" or how much pain is it "aware" of. Absurd though it may seem, such comparisons have to be attempted in science. An experiment has to be extremely important for any painful

procedure to be allowed on a primate, but want to carry out some trivial work on a cockroach? Well – go ahead! How much harder still to make such comparisons to the "value" of a work of art when there is no accepted standard to compare its "worth" against!

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Laura Fantone

Please Note: The story I tell is not linear, and it moves between the different realms of images, robots, bodies, medicine, care and theory of science.
I apologize for the lack of intelligibility, which is the result of many translations among media, languages, disciplines and texts. I hope this text can be intuited and will not be taken too literally, or even too seriously, by human beings, whose understanding of each other is always based on approximations.

Cute Robots/Ugly Human Parts
(A post-human aesthetics of care)

I am interested in investigating some cultural and ontological effects of the ongoing technologization of the human body, and the parallel humanization of machines. I will look at these processes from contemporary feminist and science studies, which increasingly considered the biological and technological to be intertwined material-semiotic entities (e.g. Haraway 1997, Knorr Cetina 1999, Leigh Star 1999, Rapp 1999).

There seems to be an affinity between the parallel developments of biotechnology and digital technologies: both offer escape from our bodily limitations, both open up virtually infinite possibilities of assemblages, and both rely heavily on processing, visualizing and arranging pieces of information. Most interestingly, both seem to displace the concept of the human and the finitude of the body, and to expand or reduce to different scales the places where power lies (Deleuze, Foucault). For example, an individual's creativity and knowledge is attributed not

to the "fictional unit of the self", but is instead distributed between the unconscious, education, machines, institutions and collective entities. The "mother" is another example of how reproduction and value now seem to be located below the unit of the person, and are now thought to be found at the level of the genetic material she carries. These shifts are already reshaping our identities and demand a fundamental rearrangement of the social imaginary with regard to the locations of life and value. It is particularly intriguing to pay attention to the re-emergence, disguised as openness to different scales and mixings, of "old" discourses of hierarchy and control over nature. This "re-organizing" character of digital and bio- technology has ethical consequences for, among other things, race, and gender and species power relations.

I am interested in the impact of scientific discourses on social relations, and in the social forms that technology takes. Consequently, the story I will tell about digital and bio-technologies is complicated because it moves between the material artifacts which have entered the contemporary social world (such as gene chips, computers, cyber pets and images), and the ideas related to them (such as conceptions of knowledge, life, affection, care and aesthetics). The relationships I observe between these material artifacts and conceptions is based on some assumptions, which are still other complicated stories that I will attempt to summarize here in order to make visible their historical and subjective specificity.

Science and society

The social sciences, disciplines "born" during the enlightenment and the industrial revolution, rely largely on the development and acceptance of technoscience[1]. During the last century, many social and scientific changes (Heisenberg's principle of indetermination, relativity theory, the end of colonialism, psychoanalysis, the Nazi genocide, television, cybernetics, DNA, information technology, the Cold War, nuclearism and transnational capitalism) all contributed to profound changes in science, and in the relationship between the "scientist" and the studied object. Increasingly, positivism in science became subject to social and political criticism, and critical ethnography posed the question of "who is speaking for whom". *Here is where the question of ethics emerges*, in the form of questioning of the act of knowing in its potential destructive relationship with the world or the "object of knowledge". With the "advent" of deconstruction and the linguistic/post-modern turn, epistemology becomes a crucial socio-political question. Since we can not separate ourselves and our object of knowledge, this shift goes beyond the epistemological level into ontology. We are-in-the-world. The scientist, his or

her methodology, the detection devices and the "studied subject" are dynamic and mutually constitutive of each other. These general epistemological/social/cultural shifts impact all beings (including animals and plants). *These are the reasons why we care for "our" scientific objects, creations, artifacts, and extensions.*

Redefinitions of life

While in the realm of hard sciences high energy physics dominated the show, in biology, in the same period, the focus shifted from species and organisms (characterized by intelligible and relatively simple functions) to DNA, "the code of the codes", and into molecular biology (Cetina) [2]. It is crucial to recognize the influence of cybernetics on all sciences, war, and social relations since the 40s. Cybernetics developed system theories of control and response, flows of information. This paradigm became the model for developments in artificial intelligence. Ultimately, as the DNA model tells us, life is information (Haraway 1997). Science has the potential –or the pretense- to control life and death, by controlling and organizing the flows of information. Sociology, in the same years, was dominated by the structural functionalist model. This was also the time in which the consumer society was hegemonic in the Western world, and this was deeply connected to science and technology. As Gosden says: "The market gave significance to science and technology by integrating their discoveries into popular culture through the circulation of products. Science and technology gave authority to cultural and social forms by creating the illusion of moving toward a higher stage"(1995). One example of this is the refunctioning of sonar technology from military to medical purposes, with the diagnostic use of ultrasound to produce images of internal organs and foetuses[3](Petchesky).

Life and Embodiment

The most interesting implication of the aforementioned points is that technology; science, production and life are mutually constructed and always changing. The most crucial location of these dynamic interactions is in "the body" and what we call "life". What happens to the body if life is seen as energy, intensity, movement of information? If we think in terms of disembodied life, not only can life be found everywhere, but, in a sense, it has now been redefined as a matter of presence, image, or information rather than biological being (Haraway). The body is seen as multiple, not unitary - it is "distributed", assembled and disassembled constantly in its parts/organs by the flows of information/desire (See bodies w/out organs[4]).

Undoubtedly, there are many risks to a conception of life totally abstracted from embodiment. One of the risks is that the body is reduced to a more and more alienated condition of control, surveillance, and commodification of its parts. For example, some of the latest research in anatomy has come about from digital cameras applied to sliced bodies of executed prisoners. In a similar vein, genetic research extracts and compares "strings of letters representing proteins, genes, chromosomes" from laboratory animals - their genes are modified and added to others, as in the case of the oncomouse™, or the famous rat with a human ear on his back. In both cases, the individual's *whol*e body is redundant; it's preferable to have organs without bodies. Simultaneous to the increasing selection and valorization of the specific components of *som*e bodies, the biomedical sciences have no use for millions of humans who are considered to be unwanted, redundant obstacles to accumulation, and who are consequently left to die (in wars, migrations, famines, toxic poisoning or epidemics[5]).

Value, affection and technology

It is starting from this view of life and bodies. I approach the parallel processes of technologization of the human body and the humanization of machines[6]. It is clear that these are not two separate phenomena, but rather specular reflections of a general shift in values. The human body and its life are no longer the units where we invest our resources, energies, emotions and affection. Economic and scientific interests are found in genes (chromosomes, proteins, etc.) while, at the same time, affection, desire and emotions can be experienced in relationship with machines or disembodied entities (such as computer "friends" or chat rooms). In order to understand how these post-human ideas and material entities work and what kind of knowledge and social relationships emerge, I looked at three examples of technoscientific representations of life and the body: the Visible Human Project, the visualization of DNA through digital technologies, and cyberpets, as social artifacts and non-organic embodiments. The underlying questions are: What kinds of bodies does science look at? Where are life, affection and care? How do these technoscience constructs shape life?

The visible female (human) project

The Visible Human Project® was developed by the national library of Medicine. "It is the creation of complete, anatomically detailed, three-dimensional representations of the *normal* male and female human bodies. Acquisition of transverse CT, MR and cryosection images of representative male and female cadavers has been completed. The male was sectioned at one-millimetre intervals, the female at one-third of a millimetre intervals. (...)

The Visible Human Project data sets are designed to serve as a common reference point for the study of human anatomy, as a set of common *public domain data for testing medical imaging algorithms, and as a test bed and model for the construction of image libraries that can be accessed through networks*. The data sets are being applied to a wide range of educational, diagnostic, treatment planning, virtual reality, artistic, mathematical and industrial uses by over 1,400 licensees in 42 countries. The long-term goal of the Visible Human Project® is to produce a system of knowledge structures that will *transparently* link visual knowledge forms to symbolic knowledge formats such as *the names of body parts."*
Such is the official description on the VHP webpage.

When we look at the images, there is nothing that reminds us of humans, or even "our" organs, because the "slices" are so detailed and large in scale that they show something else. In a sense, the initial images are so "below" the unit of the organ, so much below the unit of the body, so difficult to think of as human, that they inevitably have to be recomposed to a larger scale. These images of the body do not fit the imaginary of the modern science of anatomy, in which to each organ corresponds to a function: they have an excess of information and no unitary function. This may be the reason why digital scanning and photography (already obsolete) are just the first steps towards the construction of three- dimensional models of organs, to be studied by thousands of doctors and researchers as the "most extensive" source of anatomical knowledge ever. Rarely can one find any mention of the humans who inhabited these digitalized images - all the specificities have been removed, together with the social origins of these bodies (as mentioned earlier, the first laser-sliced body was an executed prisoners). Their lives and stories are not valued, in contrast to their symbolic universality as information.

The extreme care involved with the processes of obtaining the slices and producing the images does not have anything to do with care for the life of a human. The object of care is not the person, but the *transparency* and flow of *information*. The digitalization of the human is beyond life, the body is technologized even in death. The result is an incredibly ugly assemblage of human parts.

Another fascinating aspect of the visible human is the development of ad hoc software to navigate and interact online with slices - the so called " visible human browser". Clearly, technoscience has moved beyond the limitations of ultrasound visualizations. Digital technologies are not only cameras but also powerful epistemological tools. The idea of the

browser is so familiar to anyone who owns a computer that it is by now a basic way to organize time and space (back -forward -reload click-select- delete). The only specific new element to the "visible human viewer" is the zooming interface. Not surprisingly, the same organization of a browser capable of navigating space/time and scales may be found in the representation of genetic files.

The (junk) DNA

I discovered with slight disappointment that the entire sequencing of the human genome is downloadable in 5 zipped files. It is also possible to navigate through segments of the genetic sequences, and to zoom to different scales and visualizations. Here again it is practically impossible to separate the role of digital technology from the genetic material[7]. The "gene" is so full of information and so redundant (after all, 99% of it is today considered to be junk DNA) that it has to be "cleaned". It is so invisible and metaphorical that it must be symbolized by letters and colorful bars, transferred into a silicon chip and processed. The exploration of a mouse's gene is only possible by many navigations, where inscriptions and infinite re-readings are possible.

Surprisingly, immensely valuable genes are relatively simple to buy, to extract from lab animals and to compare. The files are accessible. It is the interface and processing that is the expensive part. In genetic maps and representations it is not even necessary to *take care* of the preservation of the body from which the information/life came from (the information is in genechips). The body is the production site; the animal, whether a lab mouse, a fruit- fly, or a zebra fish, is too literal to be visible. In contrast, genetic software and hardware are so abstract and beautifully complex that their visibility is considered to be important both aesthetically and economically. In this case, humans care immensely for the genetic material, as long as it is divorced from its origins. It is valuable due to its implications for the future of pharmaceutics. In other words, genetic technologies are valuable to the extent that they can re-enter the circuit of social v and economic value, in the form of possible cures.

If it is clear that life and machines are being constructed as more and more inter-related and indistinguishable, it is also true that machines are not only part of the process of knowledge, but that they are also material artifacts increasingly "rendered" alive. The most interesting example of this phenomenon is the popularity of cyber pets: programmed, embodied, living machines that enter into social relationships.

Cyberpets and the politics of cuteness

The most readily apparent characteristic of these artificial beings is that they are cute. They enter social life through the appeal of their innocuous and helpless "pet" features. They are part of a cultural politics that values the qualities of smart, small, cheap, funny, colorful and infantile, as opposed to rugged, gendered, threatening or merely "functional". They are intelligent machines (real masterpieces of AI research and design as exemplified by Sony's AIBO) with degrees of autonomy and personality. Japanese culture is increasingly characterized by the social acceptance of these artificial beings, which increasingly share everyday life activities with humans (playing, socializing learning...with "us"). Although they resemble animal forms of life, these cyber pets are preferable to biological life forms because they are docile bodies. This is so because the autonomy of cyber pets is controlled by humans, who can restart and reprogram them[8]. The kinds of animals that such machines resemble are quite unpredictable: they range from puppies, kittens and chick to insects, pterodactyls and even transgenic creatures. In short, these machines are "alive", but not too close to humans in their qualities. They are appreciated by humans for their infantile, emotional needs for affection, attention and daily care. They are customized to please our imagination and expectations.

The example of these non-human, embodied, artificial life-forms, known as cyber pets, is crucial to understanding the meaning of care[9] in the contemporary technosocial world. Based on the previous examples, I consider the current changes in care to be fundamental cultural and ontological effects of the technologization of the body and the humanization of machines. Care is now no longer human centered, it is post-human (Hayles). Our knowledge advances by the care taking of sub-individual entities, such as the genes and slices mentioned earlier. Our technoscience is interested in taking care of information, images and art. At the same time, our social relationships are characterized by care for artificial life forms, as opposed to other (human?) beings, despite the fact that we still need humans to care for other humans (especially bodies) at times[10]. In this process the conceptions of life, body, machine and care are redefined in terms that leave the human and his /her body no longer central to the relationships of care.

Art as the cultural logic of molecular biology

Biotechnology has had a notoriously difficult time in finding acceptability in the realms of politics, society and ethics. Perhaps, in response to this widespread aversion, the cultural logic

of biotechnology now seems to be shifting to aesthetics. It is fascinating to realize how genetics and biotechnologies have been recently addressed and explored through art![11] Is art a rhetorical strategy to make genetics understandable, visible and even popular? Indeed, art and genetics have something in common. Interestingly, they both function through a similar logic of the elaboration of symbols and the freedom to assemble them. They both of deal with the re-arrangements of vast amounts of rich information.

The politics of biotechnology for a PowerPoint presentation

- domination of nature by human technology- the example of Monsanto's terminator gene
- negation of the processes of destruction of life (reduction of patented varieties) and production in science
- selective research on genes and supposed universality of the discovery
- location and extraction of the matter from the margins for the knowledge of the centers (basmati rice re-engineered and copyrighted by Monsanto)
- expansion beyond the given limitations and control and reproduction of life at a molecular biological
- determinism that reduces the role of the environment to inertia

Let's consider how these points could be undermined by art. I would like to think that there are possibilities for using art and artifacts as ways to resist and transform the biotechnological paradigm of extraction/ destruction of organs and other human material. But I intend to go beyond the simple criticism of the scientific discourse and point at the possibilities of art for rethinking the logic of biotechnologies.

One possibility is that the production of artifacts could be conceptualized as a "restitutive act", aimed at designing new tools for recreating life in dead or endangered environments (See the work of Brandon Ballengée to selectively breed aquatic frogs originating from Congo). The idea is to give back biological metaphors and "living machines" outside of the established hierarchies of classificatory science. In art information can be subverted and reassembled to create life without a specific function or value. Such conceptions could be useful for the way artists in which artists choose to relate to technologies developed for scientific purposes. For example:
Art should make evident the inconsistencies and contingent nature of databases and classifications, even at the bio-molecular level. As a hypothetical example, perhaps the speed-up involved in the race to crack the genetic code in recent years, runs the risk of killing the

living "objects" of classification (Leigh Star). Art can remind us that every database has errors and that every digital image has a border where the "broken" pixels are visible.

Art should develop a sensibility for machines, an aesthetic of non-human care and a recognition of non-human elements and intelligence. Art should recognize computers and networks as living systems, albeit ones that are not inhabited by humans.

Art should assist humans in shifting to a sensibility in which aesthetic pleasure is experienced through watching machinic processes beyond human control (Broeckmann).

Art should increase solidarity and empathy among beings. These relationships should not be ordered according to marketable qualities or anthropocentric evolutionary hierarchies. Art should value symbiosis. How shall we imagine a symbiosis between oncomouse©, paramecium, robot, fruit fly, fish, human, and networks?

Notes and References:

1 The use of the word technoscience is the result of a long debate, developed between feminist epistemology and critical science studies (Fox Keller, Harding, Latour, and Haraway). It draws attention to the fact that this separation of science and technology is not consistent. Modern science is based on the experimental method, and even the most basic experiments rely on the technology of tools and measuring instruments. (Kirkup, Woodward and Bennett).
In Haraway's words, "technoscience indicates a time-space modality that is extravagant, that overshoots passages through naked or unmarked history. Technoscience extravagantly exceeds the distinction between science and technology as well as those between nature and society, subjects and objects, and the natural and the artefactual that structured the imaginary time called modernity. I use technoscience to signify a mutation in historical narrative, similar to the mutations that mark the difference between the sense of time in European medieval chronicles and the secular, cumulative salvation histories of modernity". (Haraway, 1997:4)

2 The relationship between biology and physics is extremely interesting- For example, Schrödinger, one of the most important physicists in the atomic physics debates, Nobel Prize in 1933, wrote a book called "What is life?" which showed many similarities with the Watson and Crick's assumptions about the DNA. "'What is Life?' summarized the emerging atomistic foundation of the biological sciences in the 1930s and '40s. Schrödinger proposed a correlation of the physical properties of DNA as an aperiodic 'crystal' with its function of storing the genetic information of every living organism. A few years later in 1953, Francis Crick and James Watson solved the high resolution structure of DNA confirming Schrödinger's theoretical considerations, while themselves proposing a mechanism of DNA replication based on the structure of this molecule. A decade after Watson and Crick's discovery of DNA, the genetic code, had been determined, and the biological, chemical, and physical pieces quickly fell into place establishing a picture of molecular biology which matured into a scientific fact establishing the foundation of the tremendously successful biotechnology"(excerpt from: The physico-chemical basis of life, http://www.whatislife.com)

3 The possibility of resistance suggested by some feminist research approaches is the appropriation of scientific military paradigms (cyborg, diffraction), and the subversive use of them for purposes of denouncing inequality. These approaches underline the importance of embodiment in knowledge and experience (especially in the case of non-heteronormative bodies).

However, these critical approaches to science are still problematic because the possibility of critique and resistance lies only in a derivative relation to science. How can we engage with biotechnologies in an challenging, not derivate way?

[4] The history of anatomy tells us that the discovery of organs brought about the idea of a specific organization of functions associated with specific parts. This idea of an internal order was reflected in modern models of society. The statically conservative implications of these models were heavily criticized by Deleuze, who developed the notion of body without organs to emphasize the freedom of flows; the body is not organized by hierarchical functions, but it can be a surface constantly reconstituted and yet distinguished from its surroundings. The risk to the idea of the body without organs is that its freedom can be "sterile". In other words, it may end up lacking "life"!

5 The best example is in the work of Sebastiao Selgado, whose photographs deal with suffering bodies in zones of death and strife.

6 I use the term machine in a loose sense, borrowing from Deleuze and Guattari, for whom machines can be social bodies, industrial complexes, psychological or cultural formations (...) aggregations which transform forces into a continuous state of becoming (Broeckmann).

7 The speed at which bioinformatics is developed is impressive, and it clearly shows how the "scientific discoveries" are intrinsically constituted by the technologies used. In this closed system there is very little room to develop scientific conceptions of life that avoid statistical reductionism. In other words, these models are limited by the fact that they completely ignore unpredictable external factors such as the environment.

8 It is interesting to note that some degree of freedom in the cyber pet is appreciated by humans. The latest versions of Sony's Aibos, emphasize their moody , unpredictable, even annoying behaviors. These qualities makes cyberpets closer to life precisely by adding slightly negative - never threatening- characteristics.

9 I discuss care here mainly referring to Heidegger's notion of care. In Being and Time, he discussed care as the fundamental characteristic of Dasein, (being) in its relationship with everydayness and the world. Care is critical to our temporality as beings. in Heidegger's view, care takes two forms: Fursorge, to care for others, living beings (presumably humans) and Besorge, to take care of things (for example some uses of tools).

10 On this topic, sociological studies on labor and migration has demonstrated how the services related to care are more and more needed and performed by immigrant, poorly paid human beings, and especially women. (See Sassen, Chang, Eisenstein).

11 See the work of Benjamin Fry, Eduardo Kac, Mark Dion, Helen Chadwick, Nicolas Rule. There have been many art exhibitions dedicate to genetics recently: Santa Barbara Art Museum, UC Santa Cruz, geneart.com, gene-sis.net exhibitions and the various Art and Science events related to human genome conferences.

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Thanks to Eddie Yuen, Iain Boal, Karen Wendy Gilbert, Joan Greenbaum, Jeff Bussolini Lisa J Moore, Ching Ning Wang, Patricia Clough and the CUNY New MediaLab, Andrea Vasquez in particular, for their help and encouragement, especially appreciated when I was unable to express myself in a linear fashion. They are all part of this project.

George Gessert

Breeding for Wildness

For the last twenty years I have bred ornamental plants. I select for forms, colors, and patterns that fascinate me. Everything else is secondary. However, when the medium is alive, is a purely aesthetic approach to art desirable or even possible?

Aestheticism

Traditional aestheticism has two poles. One is allied with the sacred, the other with cartoons. Many Americans encountered the dark, cartoonish side of aestheticism in the aftermath of September 11, when television endlessly replayed clips of planes smashing into the World Trade Center. These videos and other images of the disaster, often described as ³beyond Hollywood², penetrated so deeply into the heart of American culture that they seemed demoniacally inspired. Karlheinz Stockhausen paid homage to this when he said that September 11 ³is the greatest work of art for the whole cosmos.² His remark, which some people found offensive and he quickly retracted, evokes art as a rival to nature in scale, power, and Indifference to suffering. It recalls the poet Martinetti, who, at the time of the Italian invasion of Ethiopia, wrote, ³War is beautiful because it establishes man¹s dominion over the subjugated machinery by means of gas masks, terrifying megaphones, flame throwers, and small tanks. War is beautiful because it initiates the dreamt-of metalization of the human body.³

Marinetti separated language and the dazzling aesthetic effects of war from the rest of experience. He identifies with victors and metalization, with escape from suffering into mechanized immortality. However, there is more to art for art¹s sake than gameplaying and fascist posturing. Ad Reinhardt¹s paintings are examples of aestheticism as a sanctuary from the horrors of the world, yet not a sanctuary that denies those horrors. He eliminated almost everything from his paintings, but the little that remains is so beatific, like a patch of inexplicable light in darkness, that experiencing it makes all things momentarily seem possible again - the past healed (but not forgotten), and everything that is broken and misshapen redeemed. The price of experiencing his painting is to return to the world more keenly aware, more open to wonder and anguish.

Not that Reinhardt justified his work on utilitarian grounds. He was emphatic that the best art is useless and about nothing. He was a socialist who did not avoid the battles of his time. By engaging life on many different levels he freed himself to exclude imagery from his art along with conventional morality and politics. Reinhardt¹s greatest works embody intelligence, faith and clarity that transcend political consciousness. To me his painting is a model for plant breeding.

Kinship

Aestheticism begins with attention to materials. Breeding involves living things. This means that the artist and his materials have common ancestors, along with genetic codes written in the same molecular alphabet, and numerous shared life processes. Our kinship with mammals is obvious, but we are also related to plants, which we resemble on the subcellular level.

To recognize another as kin is to see oneself in the other. What is it like to be a plant? Plants have no nervous systems and to the best of our knowledge cannot think or feel. Their interactions with the world take place entirely without consciousness, but this does not make them absolutely different from us. Far from it: we contain within ourselves something of their way of being. What we share, I believe, is not an experience of life, but rather nonexperience. The extent to which we do not and cannot experience life is something that I only began to appreciate after the first time I had surgery. I was 22, and had a dislocated ankle. Sodium pentathol eliminated not only every trace of pain, but dreams and perception of time. The instant I went under, I awoke - six hours later. In that interlude all dualities had vanished, yet I had continued to breathe and metabolize. My blood had circulated. Perhaps some of my cells had divided. And yet the surgeon drilled through my bones, adding wires and screws to my ankle, without causing me the least discomfort.

The nonexperience of total anaesthesia is a reminder that human life is not synonymous with consciousness. What is the experience of a pancreas? A mitochondrium? Most of us are quite happy never to know. We drift on a sea of eternal unconsciousness far deeper than anything that Freud or the surrealists charted. I doubt that even the most shadowy dreams or images ever materialize in the depths of that ocean. And yet, although permanently unaware, it is a realm of intricate structures and processes that comprise the support system of consciousness. When we distance ourselves from genuine unconsciousness, we ignore our connections to the larger community of living beings, most of which, over immense spans of time, have lived and

died without once awakening. For me work with plants is a reminder of forgotten selves, and of beings that sustain us.

Sentience

As art materials, organisms can be divided into two broad categories: sentient, and not sentient. To the best of our knowledge, sentience, which is the capacity for feeling or consciousness, including awareness of pleasure and pain, occurs only in creatures with nervous systems, animals. To ignore the suffering of animals, or to explain it away, as Descartes did when he dismissed the cries of animals as grinding gears, is not an option for artists today, except perhaps for those few who absolutely reject science as a source of knowledge. There is no scientific evidence that we fundamentally differ from other animals.

In 1930 Olaf Stapledon foresaw grave dangers in breeding animals as art. He imagined a future society in which artists deliberately bred monsters to express cruelty and hatred of life. However, we do not have to look to the future for disturbing possibilities. Ozzy Osbourne bit off the heads of animals during rock performances. Some of art¹s roots lie in animal sacrifice. To insist that no artist under any circumstance should cause any animal to suffer or die would all but guarantee that someone would deliberately do it, and far more compellingly than Ozzy Osbourne. I can only hope that artists will voluntarily avoid causing animals pain, and that cultural conditions never require that that realm be explored.

Form, color, and pattern are what most interest me in art. Plants are good to work with not because they are more wonderfully colored or structured than animals, but simply because they cannot suffer. In this they are similar to bacteria, fungi, and animal cells or tissues grown in vitro. As art materials, plants present few ethical barriers to aesthetic considerations, as long as these are not reduced to cartoons.

Interaction Between Species

Plant breeding is a biological transaction. Through association with me, irises produce new varieties, and sometimes find new places to grow. In turn, I have the pleasure of their company. In a Darwinian sense, irises undoubtedly benefit most. Although many die on my compost heap, they are evolved to produce far more progeny than can survive, and for those that enchant me I will be a protector and a bumblebee. I tell myself that I bring consciousness to evolution, but I can¹t be sure that conscious evolution will lead anywhere that I really want to go. I gamble on

a specifically human kind of awareness that guarantees nothing, except that it will always be incomplete. Meanwhile irises live their lives.

Form and Ethics

When I choose which irises to pollinate and which to compost, I cannot distinguish ethics from aesthetics. Take form, for example. Irises have a distinctive tripartite structure evolved in response to pollinators and weather. I choose not only among wild types, with clean flower forms, but among garden-evolved flowers with elaborately ruffled parts. Ruffling can obscure overall structure so much that certain irises look less like their ancestors than like other highly bred but unrelated flowers – informal double roses, say, or fluffy petunias. One reason that many people like ruffles is that they offer generic prettiness.

But ruffles express more than prettiness. Slightly ruffled irises have existed for at least 400 years, but heavily ruffled ones were unknown before the middle of the twentieth century. Heavy ruffles reflect advanced consumer society, which exerts powerful evolutionary pressure on garden flowers to present themselves simultaneously as stand-ins for nature, and as emblems of nature¹s subservience to human whim. Poised between crumpled candy wrappers and Scarlett O¹Hara¹s flounces, ruffled irises pose as entertainments, to be bought, enjoyed, and discarded. Like many other commodities, ruffled irises appear to increase choice, but actually diminish it because their successful adaptation to the demands of markets has eliminated alternatives. Today few nurseries or glossy commercial catalogues offer bearded irises that are not ruffled. Tall bearded irises with clean forms have been relegated to old gardens, cemeteries, and specialists¹ collections.

Plant breeding is still a primitive art and a poor vehicle for sarcasm or irony, so I do not select for ruffles. As primitive art, what plants express best is the strangeness and beauty of living things, along with the human touch in evolution, for better and for worse. I love irises with clean forms because they represent nothing except themselves. Or rather, they represent a supremely elegant reproductive strategy within the ecological systems in which they evolved. They represent wildness.

Breeding for Wildness

We associate wildness with untamed nature, but wildness is also an aspect of domestication. Fields and flocks, gardens and pets benefit us, or rather, some of us, but organisms do not

become domesticated for our good, they evolve into domestication because it benefits them. More than a few take advantage of us. For example, tobacco, which was once endemic to a small area of South America, now grows on six continents, exploiting millions of people through the wonders of chemistry. Domestication is not artifice and outside of nature, but a set of survival strategies and manifestations of nature. There is nothing paradoxical about breeding for wildness.

How, exactly, can we do that? I begin with form, color, pattern, and materials. Flowers that are dazzling in the wild may be inconspicuous in gardens because of visual competition from domesticated ornamentals, many of which are large, colorful, and extravagantly formed. However, the visual qualities of wildness can often be strengthened through breeding. In the case of bearded irises the aesthetic qualities that I associate with wildness include integrity of form, fineness of color, and conspicuous vein patterns, especially on the falls. I select for these, and for the visual strength appropriate to plants in gardens. Such strength comes from large flowers, tall bloomstalks, strong patterns, clean form, and uncommon colors, such as blue.

We can take breeding for wildness a step farther by selecting for plants that grow with minimal care, without herbicides, fungicides, pesticides, or unsustainable use of water. Occasionally domesticated plants may even leave gardens for untended spaces beyond, but we should not attempt to breed such plants without carefully considering potential impacts on ecosystems.

It is safest to work with plants descended from local natives, because these cannot become invasive. To breed for wildness points toward an art that is ecosystem-specific.

André Brodyk

Recombinant Aesthetics (Adventures in Paradise)

This paper discusses the sourcing and encryption (ie. coding) of extra biological material specifically derived from inanimate sources for incorporation within living entities in the creation of new media living art works. Art practices based on such a proposition can be seen to engender considerable creative potential. I will briefly discuss the creation of synthetic DNA molecules developed by several art based encryption systems. Such systems have the potential

to enable the conversion of any material including extra biological material, into coded genetic sequences of purine and pyrimidine DNA bases. Converted into this biologically compatible medium, synthetic DNA can be incorporated into the genomes of living organisms using recombinant DNA processes.

Recombinant technologies make possible the transference and recombination of genetic material both on an intra species as well as an inter-species level in living organisms. This paper is based on *artists'* interpretations of these processes of genetic manipulation and the potential for "trait" transference specifically from encryptions of *inanimate* sources. Living entities comprised of encrypted extra biological material can serve as a new medium of in vivo expression as art. Prior to discussing an example of my use of encryption and extra biological material, I will demonstrate artistic precedent in the work of Chicago based artist Eduardo Kac and Cambridge (USA) based artist Joe Davis. Their work provides associations between living and non-living.

In 1998/99 Eduardo Kac created what he describes as a "Transgenic " artwork.[1] This work was entitled "Genesis" and was first exhibited at Ars Electronica in 1999.[2] "Genesis" was concerned with transgenic bacterial communication and the notion that biological processes can be seen to be programmable. "Genesis" involved the use of extra biological material, which resulted from Kac's use of his specifically developed encryption process. The key element of this "Transgenic" artwork was a synthetic gene which Kac referred to as an "Artist's gene".[3] This synthetic gene was created using extra biological material derived from a text-based source, the book of Genesis. The encryption process used by Kac was essentially a two-stage process. This process involved the translation of the following sentence from Genesis into a (synthetic) DNA molecule.

"Let man have domination over the fish of the sea, and over the fowl of the air, and over every living thing that moves upon the earth".

This encryption process firstly involved conversion of the text into Morse code. The Morse code was then converted into the first alphabetical character representative of each of the four nucleotide bases in DNA as follows.

t = dash c = dot a = a word space g = a letter space.

The result was a new sequence of DNA bases, which formed the "artist gene". This DNA was chemically synthesised and inserted into plasmids for transport into e-coli bacteria where it undergoes replication. This gene codes for a new protein molecule, which results from the extra biological material within the altered e-coli genome. This modified organism formed the basis of the interactive installation "Genesis", to become a living artwork. "Genesis" was one manifestation of the potential for using extra biological material specifically from an inanimate source to create unique new media living art. In this case a text based source.

Joe Davis has not only explored the use of text based extra biological material and encryption (ie. "Riddle of Life DNA" in 1993)[4], but also the use of extra biological material from visual based sources. These have been from graphic (linear) as well as digital image sources. Davis first explored the use of extra biological material in 1986 by the creation of a synthetic DNA molecule comprised of coded information derived from a graphic database. He utilized a graphic image of an ancient Germanic symbol known as a Rune, which was used to represent life. The living artwork, which resulted and named "Microvenus"[5] comprised of a genetically modified e-coli organism. The encryption process Davis used to create "Microvenus" was based on the work of Carl Sagan and Frank Drake who created a binary coded message based on a graphic image for transmission as a radio signal into outer space. Images can be coded in digital form using binary coded organization of information and realised as picture files jpeg, gif, tif or as alphanumerical text. This binary capability can facilitate the potential for any information to be encoded as binary operations within computer files including extra biological material.

Davis' encryption systems used a binary code as an intermediary for the conversion of his image into sequence of DNA bases. Essentially the "Microvenus" graphic was converted into a 5 x 7 binary bit map. This comprised of a grid whereby each part of the graphic (the positive) registered as a "1" & each part of the negative space within the grid registered as a "0". The resulting binary sequence contained 35 bits.

10101011100010000100001000010000100

Davis' understanding of computer compression technologies led him to explore the compression thus reduction of the number of binary and ultimately, genetic integers needed to be used, making it more biologically compatible.

With "Microvenus" this involved conversion to phase change values based on the frequency of re- occurrences of either a binary 0 or a 1 in the above sequence as follows;

c= 1 occurrence, t= 2 consecutive occurrences, a= 3 consecutive occurrences and g = 4 consecutive occurrences. The result = ccccccaacgcgcgcgct

This DNA was chemically synthesised and inserted into plasmids and transferred into a strain of e –coli bacteria. Joe Davis has subsequently explored the construction of synthetic DNA in other more complex encryption systems including the coding of an infrared image of the Milky Way. ("Romance, Supercodes, and the Milky Way DNA)[6]. Both Kac's and Davis' encryption systems are based on a comprehensive understanding of micro biological operations at a genetic level as well as computer information technology operations. Both identify and utilise the knowledge of the analogous ways in which computers and DNA functions as assemblers and sequencers of information memory. Both artists developed a medium compatible with the organisational conventions of computer data storage and processing while also being biochemically compatible for use in living organisms.

My encryption system also uses a binary code as an intermediary for the conversion of a visual image into sequenced DNA bases. It therefore relies on the retrieval of information in the form of binary data, reduced digital translation of an image, but as I discuss below it originates elsewhere.

Firstly, my encryptions are based on conversion of only segments of an image. With his Milky Way image Davis retrieved the binary data as a digital image translation of the entire (visible) image. The difference might be akin to obtaining extra biological material from a whole organism, or encryption of a whole genome versus an encryption of a gene, a segment of extra biological material. Secondly, the extra biological materials I encrypt are derived from multiple sources, for incorporation within a living organism. Davis' and Kac's encryptions retain scientific plausibility and remain more truth full to scientific fact.

My applications are based on interpretive qualitative principles of the operations of biology and biotechnology. They are not initially intended to be translated into significant proteins or impact on the phenotype of the organism.

I employ a variable encryption method. This is based on my interpretation of certain natural genetic operations of the processes of translation and recombination. In nature twenty available amino acids are assembled one at a time in the ribosomes and read out as triplets or three bases at a time. These triplets (codons) can produce identical proteins even though there are numerous combinations (64 triplets) possible from the four bases, which code the 20 amino acids. There are therefore (44) more codons than are necessary to make the 20 amino acids. In nature this means more than one codon can code for the same amino acid. This allows for considerable flexibility in the composition of DNA codes to direct the construction of the same specific proteins. These processes involve sequences of DNA bases being restated in different ways in the assembly of Amino acids within the ribosomes. This natural ability of restatement results in the reproduction of specific proteins. This means that there are various scenarios possible to achieve a particular outcome.

Davis also based his complex asymmetrical Milky Way super code on this process of restatement. Unlike Davis however my variable encryption is not dependent on alternative sequences of DNA resulting in the production of quantifiable outcomes. It is the interpretation of variable encryption and recombination of DNA sequences, which interests me, but not the production of quantifiable outcomes.

My variable encryption process utilises various interpretations therefore various sources. This assists in realising outcomes, which are different rather than the same. (The Milky Way image is after all an infra-red interpretation, not the Milky Way per say).

The extra biological material, which I initially used for encryption into synthetic DNA, is sourced from the biotech industry based in the USA. ie. Biotech Company warehouses. This inanimate material however, is not derived from a fixed photograph of a whole warehouse. It originates as a reconstruction of a mental image of a small part of this structure based on my *memory* of it. Any representation of an organisational entity ie. image, can take any number of manifestations when summoned from a computer *memory* and then discernible as either an

image file or a text file for example. This quality similarly allows for flexibility in the composition of encryptions to describe material, which has a variety of scenarios.
Any number of alternative conceptual constructs of the same image (facility) therefore might code for synthetic DNA. This assures the variability of any sequence.

My conceptual image (a partial recollection) materialises by taking a "still" of a developing photograph of a small part of the warehouse. This occurs just at the closest moment of proximity to the mental image, using a digital camera. The reduced mental image now in digital form can undergo binary translation into sequences of zeros and ones. I am not concerned to translate entire databases (like the Milky Way image), or the whole biotech site, which produces huge sequences of binary numbers. My interest is with small parts of this structure as summoned from a memory-based recollection. Reconstructed conceptual images are never complete and therefore provide a limited database of material to code from thereby yielding smaller sequences. This obviates the need for complex compression strategies. The DNA translation is based on my knowledge of the structure and varying molecular sizes of the purine and pyrimidine bases, for conversion from two binary numbers into four DNA integers.
Essentially, pyrimidine bases (c and t) contain one ring structure and purine bases (a and g) contain two ring structures. Since one is less than two pyrimidine bases c and t are expressed as smaller numbers than the purines a and g. c is also smaller than t in terms of its molecular size so it is the smallest of the four bases.

Therefore, these numbers expressed as multiples of ten are c = o units or 00 and t is = one unit or 01. Since purine a is smaller than g this is expressed as ten units or 10 and g as twenty units which is expressed as 11.

The amount of synthetic DNA, which results may be insignificant or may not even be acted upon by the process of transcription and translation when inserted into living organisms. Therefore like so called "junk" DNA, not necessarily be translated into significant "traits". Also, naturally occurring variable DNA sequences code for specific proteins. This suggests that any arbitrary encrypted DNA derived from extra biological material is unlikely to manifest significant "traits" in an organism. Extra biological material does not have to be manifest in a significant phenotype however, to be able to demonstrate the concept of permeability of taxonomical demarcations and the interconnectivity of all things at a genetic level. Including inanimate things. After synthesis into DNA and vectoring into fluorescent e- coli bacteria this

extra biological medium comprised of synthetic warehouse DNA is ready for use as a drawing medium.

Irrespective of the ultimate destination by duplicating this process and recombination with other source material, this process reveals these to be sites of osmotic inter-relationships. Under ultra violet light the drawn images appear as living renditions of biotech warehouse fragments. Permeable self-images. Appreciation as well as apprehension of such permeable inter-relationships is made fecund by experiences provided by these new art media practices.

These recombinant cryptograms lend themselves to unlimited creative potential as new art practices. From this locus, such a recombinant aesthetic constitutes adventures.

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Peta Clancy

Gene Packs

"No aspect of human existence will remain unaffected by discoveries in human genetics - irrespective of the new science's predictive accuracy or therapeutic efficacy. In their increasing claims on our attention and our resources, the new technologies will shape the way nearly everyone thinks." [1]

As an artist and individual I am interested in and concerned by particular issues raised by recent developments in the field of biotechnology. In this paper, I have written about some of my

ideas and concerns with regards to recent developments in the field of genetic engineering and review how these ideas feed into my art practice.

My approach is to explore the scientific processes that are currently being utilised in the field of genetic engineering. As part of my research I have had my own chromosomes imaged. When I initially decided to go about this I approached professionals in Melbourne to request their assistance with my research. This raised moral and ethical issues for them arising from the fact that blood is required to produce a karyotype and they could not justify taking blood from a healthy person and then using their resources for artistic purposes. Their decision was also influenced by an absence of precedents of this nature at their laboratory. As an alternative they offered the use of existing images for my research.

I then undertook a short residency at SymbioticA (Art and Science Collaborative Research Laboratory) where they are actively involved and interested in creating awareness through artistic exploration of wet biological processes. As part of my artistic process it was important for me to experience the scientific procedures used to image chromosomes. The protocol used to image chromosomes takes time to develop and perfect; my attempts were not successful at this time.

In further pursuit, with assistance from SymbioticA, I then had my chromosomes imaged by an interested and willing medical doctor. To do this I was required to give blood, my cells were then cultured for about 72 hours, they were then treated with two particular drug types; one initially to make the cells divide more rapidly than they would naturally and then another to stop the cells from dividing. At this point the cells were gently exploded and my chromosomes were imaged using light microscopy. Through this experience I learnt a great deal about the scientific processes involved with imaging chromosomes. This was also the first time that I had experienced working in a scientific laboratory as an artist.

The body and the way in which we perceive it are central to our conception of the self. This conception is fluid and evolves with the integration of new ideas and perspectives. Developments in medical technology, such as the decoding of the human genome, have produced huge volumes of data from which we are developing a new understanding of ourselves. At this time, in many areas of our lives, huge importance is placed on our genetic

material, we are lead to believe that our DNA contains the definitive instructions that makes us who and what we are.

I considered my own DNA contained within my chromosomes and I was overwhelmed with thoughts that here in front of my eyes was the genetic instructions containing the possibilities for my very being. However through further consideration I have become to understand that even though our physical and psychological make-up may be determined by genetic instructions the expression of our genes is profoundly influenced by our environment.

"There is probably not a single condition, physiological or pathological change that doesn't result in profound changes in cell or gene expression…immediately upon putting it in tissue culture and trying to grow it in tissue culture the gene expression pattern changes profoundly." [2]

I have since spent time at the Murdoch Children's Research Institute in Melbourne where extensive genetic research is being undertaken. There I have been generously given the opportunity to engage in conversations with research scientists and to take photographs within the facility. Through my contact with scientists at the research institute I have become aware of research being done in developing artificial chromosomes to be used for gene therapies in the future.

"…Whole manufactured chromosomes will be gently injected into embryonic nuclei. These artificial chromosomes will be constructed with components that ensure their faithful duplication and passage into the pair of cells that forms with every cell division in the developing embryo and foetus. A critical advantage of artificial chromosomes is that they provide a means of adding not just one gene to an embryo, but a 'gene-pack' containing hundreds, even thousands, of new genes with many different properties."[3]

The procedure for altering the genetic make-up of an individual would require inserting an artificial chromosome into a patient's body. Artificial chromosomes would be adapted from a patient's chromosome. The chromosome would have been treated the following way: all the genetic information would be removed except for the centromere and specific selected genes would have been added. Gene therapies could cause unforseen problems; for example the intention may be only to change somatic cells, however if accidental changes occur in germ

cells in reproductive organs then future generations may become affected as well. An important issue to address as a society is how we deal with the issue of altering the genetic make-up of embryos.

"...the effects of the implanted DNA would be wreaked on our descendants to the remotest time."[4]

The expression of specific genes varies from individual to individual. Researchers are trying to find the gene or genes that cause mania and depression, otherwise called Mood Genes, if found sufferers could be helped by dramatically improved treatments. There is strong evidence to suggest that the genes for depression and mania are hereditary. The expression of these genes vary between individuals, some who possess the genes that cause this condition may suffer from blinding mania however for others the condition may be quite mild. The latter individual may suffer from short bouts of depression followed by energetic times where creative, sexual and social energy is high. If the definitive gene or combinations of genes are discovered for mania and depression then gene therapy treatments could become problematic because it would be impossible to predict how the genes would be expressed in different individuals. If an embryo is diagnosed with the particular genes that cause depression or mania should the parents change the genetic make-up of their unborn child? Should we make decisions on behalf of undeveloped individuals?

"I have often asked myself whether, given the choice, I would choose to have manic-depressive illness. If lithium were not available to me, the answer would be a simple no - and it would be an answer laced with terror. But lithium does work for me, and therefore I suppose I can afford to pose the question. Strangely enough I think I would choose it....Because I honestly believe that as a result of it I have felt things, more deeply; had more experiences, more intensely....And I think much of this is related to my illness – the intensity it gives to things and the perspective it forces on me..."[5]

My interest now lies in the discovery of 'mood genes', the development process of artificial chromosomes as a gene delivery method and the profound ethical issues raised by the implications of germ line therapies should they develop in the future.

gene discovery - body__manufacture™

I am part of an artist group called body__manufacture™ which was initiated in 2000 by Sylvia Kranawetvogl, Erik Hable, myself and later joined by James Cecil. Founded out of the idea to come together to explore and research biotechnology in response to recent developments. The individuals in the group felt compelled to consider consequences, possibilities and the affect these advances have on the present and will have on the future. They believe now to be an important time to address the issues that arise from the discoveries in genetics. The aim was to exhibit research material and art works in an exhibition titled gene discovery in 2002.

For gene discovery the group collaborated on an inflated architectural structure which was based on the current representation of the chromosome form. We chose a chromosome form as this is a genetic structure that most people could recognise, using this as an entry point into the subject matter being addressed. The audience could enter the chromosome and in doing so they transformed their immediate environment.

Each of the artists also contributed different aspects to the exhibition. James Cecil created a sound work; this was placed inside and attached onto the chromosome structure via speakers and wires. James used the sounds of the body as well as medical processes and equipment to listen to the human body in hyper-detail to create an impression of 'micro listening'. Still within the structure, an animation by Erik Hable titled NX-tools could be interacted with, proposing fictitious prototypes for highly advanced genetic engineering tools. The NX-tools were modelled on electron microscopy images of molecular structures of the human body giving the viewer the sensation of being in a world within a world within a world. Sylvia Kranawetvogl contributed computer-generated digital prints that combined fashion photography with images from highly advanced biotech imagery. Sylvia is interested in how genetic products will change advertising and the market place in the future.

My contribution included a video projection work created from the raw material of my Karyotype. I re-interpreted visual material (ordinarily used for diagnostic purposes) created from my body. Gene patenting was an issue I considered during the process of working with my Karyotype. Throughout the world biotech companies are competing to patent genes. I, symbolically, reclaimed my own genetic material.

"It's likely that within less than ten years, all one hundred thousand or so genes that comprise the genetic legacy of our species will be patented, making them the exclusive intellectual property of global pharmaceutical, chemical, agribusiness, and biotech companies."[6]

For gene discovery I photographed vessels containing human tissue cultures taken inside a tissue culture laboratory and used for genetic research purposes. I produced images of light microscopy photographs of my own dividing cells to show what tissue cultures actually look like. For research purposes genetic departments purchase bodily materials such as tissue cultures and proteins obtained from specific genes. Ethical issues are raised as to where this material originates from and if the donor gave permission for their bodily material to be used for research purposes. It is astounding that as individuals we don't actually own our own bodily material. This fact was established formally in 1990 when the California Supreme Court made a ruling that an individual has no property right over their body tissue.

When considering the work of the other artists in body__manufacture^{TM} Erik Hable's work is of particular interest to me. In developing his fictitious NX tools Erik drew from scientific theories and engaged in advanced genetic engineering research to consider issues that may arise as genetic technologies develop in the future. As well as exploring issues raised by genetic technologies Erik is interested in the mechanisms at work in developing and producing products for release onto western markets. Bio-tool is based on cells that exist in the human body called macrophages. Macrophages freely wander the body patrolling and cleaning up cellular debris, engulfing and ingesting micro-organisms, other cells and foreign matter including bacteria. Bio-tool would be inserted into an individuals body (already containing a copy of their DNA) where it would travel around the body to check for unwanted alterations and weaknesses. If changes were detected the Bio-tool would manufacture a new copy of DNA and insert this into the affected cell but only working on somatic cells. Bio-tool would exist in the body as an independent organism where it would regulate and replicate itself depending upon the needs of the body. Bio-tool would constantly regulate all the cells in the body replacing mutated DNA and maintaining the body in an immortal state. The release of Bio-tool on to the market will be in suspension until the human genome project is finished and the function of every single gene and their relationship to each other is known.

"The new genetics has already opened a vast arena for contests of power over what it means to be human, who has the power to define what is normal, who has access to what resources and

when. Who will control the knowledge of our bodies after the human genome project has been mapped and sequenced all human genes? How can we ensure that this will not be another project for enforcing narrow norms of 'human nature' as Donna Haraway has put it, for legislating 'genetic destiny?'. How can we respect the diversity and difference that the Human Genome Project also establishes as 'normal'?"[7]

Nano-mech is another fictitious product proposed to monitor the development of an embryo by detecting and fixing abnormalities in the genetic make-up during pregnancy. Nano-mech would ensure that all babies born would be 'normal'. Currently certain illnesses and conditions can be detected in an unborn foetus; these genetic conditions have profound affects on the developing individual. In the future how far will western medicine go in deciding what is normal and how much variation will be allowed to exist between individuals? Nano-mech is the silent worker inside the mothers' body, pre-programmed as a surveillance instrument monitoring the development of the future of the human race.

The four artists of body__manufacture™ have richly different approaches to their work and ideas, which are inspired by the issues that, move them as human beings. It is fascinating to consider how each of the individuals has manifested their ideas.

Public opinion and support for developments in the field of genetic engineering is influenced by many sources including the market place, committees of experts, medicine, sociology, theology, the media and artists. It is very important for all sorts of people to be aware of and involved in the issues raised by genetic engineering because it raises so many ethical questions that the law, science and medicine can not fully answer.

"In democratic countries...public opinion may be the final arbiter for accepting the new eugenic techniques."[8]

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Julia Reodica

Test Tube Gods and Microscopic Monsters

Art as Inquiry

By utilizing living systems in artwork, the artist and viewer can raise ethical questions about the field of biotechnology, medicine and even the integrity of using the living organisms. Varied organisms used in my installations such as the Workhorse Zoo (Salina, KS) and numerous Life Science Exhibits at the Exploratorium (San Francisco, CA) are important living lenses for conveying information: how traditional science uses animals and plant life as "tools"; introducing the general public to philosophical history and current scientific issues. In the Workhorse Zoo especially, there were responses from the audience in appreciation of placing the living examples of traditional science in a manner approachable by lay people. We made it easier for spectators to familiarize themselves with model organisms.

In ancient societies, mystic leaders attempted to understand natural phenomena through the developing religions of animism, totemism and shamanism, linking the supernatural to the material world. Depending on the religious discipline, animals have been regarded as gods, guides or spirits with special powers or presence that aid the devout. Nowadays, hospitals and research centers create and house the modern priests, shamans and magicians. How do we process the real issues that underlie the love-hate relationships between public perception, concepts/issues of life sciences practitioners and biomedical technology? More importantly, how do we make sense of our evolving relationship to science and the natural world?

At the Exploratorium, we encourage the visitors to practice freedom of experimentation/expression during their visit. That way the public's education is based on their own understandings, curiosities, preconceptions and principles. Visitor evaluations have concluded that in a hands-on museum environment, people who handle specimens not only spend more time observing and asking questions about them but also learn more. I have observed persons of different levels of education to be highly receptive and able to discuss

their findings after their interaction with the exhibits. By de-mystifying the aura around the lab equipment and organisms, the concepts become less overwhelming and monstrous.

Under the Lens

Working as an artist in a science and art museum setting, I have the challenge to create and maintain pieces that are engaging for patrons of all ages and levels of education. What is most difficult is ensuring that the environment fosters both learning and recreation. In a formal educational setting, there is a set agenda and a predetermined result that is expected from classroom exercises and activities. However, when you are encouraging the learning process in a museum, you grant the visiting explorer more freedom to raise further questions based on science, moral philosophy and personal experience. As for recreation, the visitor arrives at a facility in a casual attitude, not in a total escapist mindset (the approach to entertainment), but ready to receive information under informal conditions. All exhibits are designed with a hands-on component to engage intimate interactivity with conceptual models. An exhibit developer must be able to differentiate learning from education in the acquisition of knowledge and wisdom as well as consider the overall aesthetic design.

In particular, biology-related exhibits may seem ominous upon approach. The shape, sounds and smells emanating from them may deviate from familiar gallery pieces made of paint, wood or other crafted materials. But what happens when art can stare back at you? Or is aware of your presence? Living organisms can be unpredictable and the work must yield to the habitat that may or may not be totally influenced by the artist. The piece becomes an on-going conversation between the living, the dead and the inanimate.

From observations of model organisms such as developing chicken embryos to frantic dynamics of drosophila fruit fly colonies, we see the beauty and horrors of life. Life cycles are maintained and destroyed. Looking down the microscope or into the mouth of an unfamiliar organism is like arriving at opening night in a museum. On a minuscule level, the architecture of symbiotic relationships unlocks clues to cell organization and fate. Art takes on a new life as living organisms inhabit it and display their own "works in progress" in an unconventional environment.

Life and Death: Methodology, practice, ritual

In the realm of biology and life sciences, the role of the artist is split between being a craftsman and a garage scientist. The chance-interplay between the artist's motivation and scientific traditions results in an unusual collaboration of techniques established in both the laboratory and the studio. During the development of a new environment, there is the opportunity to learn by trial and error, conduct scientific investigation and create physical/psychological bonds with the living medium(s). Before incorporating a living system into a piece, there is usually a crucial period of time for study and observation of the organisms and compliance to respected protocols of handling.

The continuity of maintaining museum exhibits as learning tools is also an issue for me. There are museum exhibits that require regularly scheduled dissection or removal of organs in which I have come to terms with. I believe that the "sacrifice" that is made in efforts of communicating information through the use of "live science," is necessary and currently the best way to understand biological principles.

"Live science" includes the altered state of being outside the conventional body. For example, when dissecting a live crayfish to extract the nerve cord, its life continues in a different physical state. The San Francisco Exploratorium has an interactive exhibit that illustrates nerve cord reaction to outside stimuli controlled by the operator (museum patron). In my daily preparation of this exhibit, I ensure a "quick death" to the physical body with minimal pain. We conduct the dissection according to certain protocols agreed upon as humane and practiced by the lab staff.

Many of the exhibits I have worked on and maintained required careful and timely attention to life and death cycles. In the laboratory, there may be elaborate colonies of organisms occupying petri dishes or tubes. The nests of smaller animals are cared for and studied. Under hot lights and heavy handedness by museum patrons, it is especially important to attend to a living system's requirements for survival and quality living conditions. Nourishment, housing and environmental concerns are addressed through protocols about handling the specimens and proper disposal of potentially bio/hazardous materials. At the same time, the learning experience for the visitor must be optimal. This includes the display and discussion of the dreaded issue of death.

Much of the viewing public isn't used to seeing real death in a museum setting. Death is present everywhere: movies, television, etc. Depicted negatively in these medias, society has been conditioned to view death as evil, violent or painful. But death is a natural part of a "living system" that is often overlooked and purposely forgotten. From death, energy is generated. A crop of bacteria can flourish from a festering pile of dead flesh. A colony of zebrafish may eat its eggs and young as population control. Termites practice cannibalism by eating their dead to avoid overcrowding in a snug living space. Seeing death in progress seems distressing or graphic at first. In actuality, it's a beautiful process of recycling materials and a display of survival behaviors by predators, parasites, symbionts and scavengers. As an artist and human being, my views about death and life (natural or altered) are integral to the dignity of the organisms and artwork.

The process of life and death go beyond the actual exhibition of the art piece. My relationship with the organisms before and after exhibition is quite personal, traumatic and rewarding all at the same time. I do not believe in the frivolous use of organisms or excessive waste in the creation and display of exhibitions. At this point of my personal artistic growth, I operate on a hierarchy of live/semi-living organism use, ranging from cell lines to small vertebrates like mice and invertebrates such as crayfish. In slightly larger vertebrates like chickens, I will only work with early embryo development with the intention of euthanizing the embryos in a timely matter. This helps avoid the further trauma of bacterial infection and the unnatural state of the embryo living outside of the safety of its shell. For larger vertebrates, I do not believe in live vivisection of any kind but am able to consider medium-sized animals in a performative art capacity keeping in mind their well being and representation.

Looking Within

The intimacies established between myself and all the organisms I have ever used are valued on spiritual and utilitarian levels. I am aware of the mortality that I am personally responsible for. However, I still struggle with the fact that I do take a superior position on the food chain and that we are able to use/control other organisms for our own intellectual evolution. Where do artists and scientists draw the line? I am still trying to figure that out. In my role as an artist, I feel that the knowledge I gain is useful to research and regulatory efforts. By making scientific principles accessible outside the laboratory, I hope my work can help another person construct their own opinions and conclusions through this unconventional forum.

Roundworms emboss agar plates with trails that document their travels. Zebrafish work quickly at creating their next heirs for the watery estate. Xenopus frogs rule the underwater world as albino mice build castles aboveground. The behaviors and life cycles of model organisms such as these become artistic inspiration for the laboratory canvas. What I look for is the uniqueness of behavior and habitation patterns that are critical to maintain in order to ensure quality of life for them. As soon as artistic mediums, unusual and unfamiliar in form, are introduced to the organisms, there is a tremendous responsibility to see that their entire life cycle can be completed with minimal pain and discomfort.

A life force in art creates an intimate relationship between the artist, medium and audience. In addition to an exhibit's impact upon visitor's learning capabilities, I also consider my emotional/intellectual navigation that guides me in the use of exhibited living systems. I have created my own organism hierarchy; my own ethic based on personal beliefs and experiences. In an effort to convey information/artistic expression useful to the general public I feel my work with animals is valid.

In respect to the organism, and without getting too "new agey" or silly, I have my own set of private rituals on death and dying. I express gratitude towards the life forces that have helped realize this and other exhibits. To me, magic and science have much in common. In the pursuit of knowledge and wisdom it is important to acknowledge the "tools" that assist the curious and the relationships/consequences that are created. This is my own way of being conscious of the social/ethical implications and importance of public information that is generated from my work.

Finding Significance

BioArt is a genre that enables much needed discussion and interaction between art, science and the viewing public. The artistic use of living organisms in my pieces have aided in my own comprehension of life, death, and an independent sense of improving global conditions. The identification/discovery of the symbiotic relationships both planned and unexpected, reveal our strengths and shortcomings that can be wonderful, dangerous and compelling.

By employing biological mediums as creative vehicles of expression, we open many doors for conversation, discussion and interactivity between the artist, audience and scientific community. In particular, the incorporation of living systems into artistic exhibits or

installations assists in public understanding. In living art exhibitions organic relations and reactions to man-made constructs are often re-simulated in a way that encapsulates emerging biotechnologies and their ensuing debates.

From protest to sympathy, the audience is invited to react. As one walks away from an exhibit, the experience doesn't always end at the exit. The artist can act as a megaphone for the general public or can be put under scrutiny by the viewing audience and/or the scientific community. Ultimately, we process the messages that arise from the cultural interpretations of living organisms and social mores, both inside and out. For instance, in terms of emerging biotechnology, we understand how the threat of eugenics, exploitation, and medical advancements can have adverse social implications. If misused they can proliferate disagency, exploitation and the distorted distribution of medical privileges. By valuing the public's opinions and reactions to certain practices/research, the scientific community should consider the concerns in the development of medical technology and responsible administration of care.

As you can see, art is a valuable tool for investigation, inquiry and evaluation of scientific and medical practices. While the general population does not wield scalpels and microscopes to probe and ponder the innards of the latest medical wonders, artists have gained a newfound responsibility of sorts to enrich the relationship between scientists and non-scientists. The artistic ability to recognize the bio-semiotic roots of the rift comes from some artist's critical focus on deconstructing behavior paradigms. That may be because we can offer an environmental/social organization from a viewpoint that is intentionally inclusive of the imperfect mishmash that is our "world."

Performance: Every eye has its blind spot.

Through the ages, incomplete visions have prompted mystics, philosophers and scientists to probe through the viscous liquid. What has been revealed are truths and lies about the super/natural world. The power of the eye and gaze, still not fully understood, continues to be a source of inspiration and fear. The live performance explores the physical structure and cultural symbolism of the mysterious eye.

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Redmond Bridgeman

The Ethics of Looking

This paper will consider the types of looking that an aesthetic of care would entail. The art historian Martin Jay draws a distinction between two visual modes: the assertoric gaze and the aletheic gaze. The first is "abstracted, monocular, inflexible, unmoving, rigid, ego-logical and exclusionary."; whilst the latter,"is multiple aware of its context, inclusionary, horizontal and caring". Both kinds of looking illustrate how what one sees depends on how one looks; whether with a gaze that Medusa like turns all that it regards to stone, or with a glance that looks with circumspect concern.

From this it can be seen, that the kind of looking involved in the interaction between artists, audiences, and living biological systems, is a key ethical question. This question will be investigated with reference to the work of robo-bioligist Mark Tilden and artist Mark Dion. Tilden's Alife creations, built according to BEAM principles, (biology, electronics, aesthetics, mechanics), offer an important perspective. Tilden's entities operate according to autopoetic principles whereby they recursively interact with the world in order to generate the conditions for their continued existence. In this way, these 'creatures' illustrate how visualisation technologies can provide insight into complex biological systems.

For over a decade Dion has immersed himself in the relationship between art and science and how it has mediated our relationship with the world of living things. A recurrent theme of his work is the role visual analogy and metaphor play as a means of visually constituting nature. His installations, public performances, and writing often mirror issues within biological science, for example his installations Frankenstein in the Age of Biotechnology (1991) and The Delirium of Alfred Russel Wallace (1994). Both Dion's and Tilden's creations bring into focus the type of considerations that are appropriate for the development of an aesthetics of care. It will be argued such an aesthetic would involve an interplay between visualisation technologies, with their capacity to expand and organize our experience of the world, and visual art's investigation of the limits and nature of visual experience.

The full paper presented at The Aesthetics of Care? can be found at
http://www.imago.com.au/photonics

Marta de Menezes

The Laboratory as an Art Studio

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. 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 incurable diseases, but at the same time the public fears misuse of this powerful technology. As society becomes aware of biotechnology, with all its hopes and fears, artists have started to include references to biotechnology in their works. Furthermore, modern biology and biotechnology offer 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, using laboratories as art studios.

The trekking towards wet biological art

In the recent, and not so recent, history, technical advances frequently resulted in opportunities for artistic exploration. Photography, video, or computers have all been successfully adapted by artists for use as art media. Biology will not be different, in spite of some particular hurdles that can still deter a wide artistic use. Unlike photography or video, biological equipment is not readily available outside research facilities. Artists willing to explore the use of biology as art medium still have to engage in collaborations with scientific laboratories. Equally, many biological material and equipment may raise bio-safety concerns: research laboratories have to comply with several safety guidelines, regarding for example the containment of live organisms according to their characteristics. Also scientists are trained in the use of laboratory equipment, and biological material, in order to protect themselves and the environment. As a consequence, it is likely artists will have to continue to use the laboratory as an art studio, rather than converting their studios into laboratories.

It is uncomon for artists to have a significant academic education in scientific subjects, including biology. Such deficiency in biology training may deter some artists from exploring the opportunities for creating biological art. Furthermore, many of the scientific communications are unintelligible to outsiders to the field. Unfortunately, this includes some books and events aimed at making science understandable to the general public. It is possible that an artist willing to use biology as an art medium, would have to make an effort in order to learn the basics about the experimental systems she is considering to use. Personally, I do not see such requirement as a major hurdle: several artistic techniques require extensive learning and training. The use of Information Technologies as a new art medium, for example, is only possible when the artist acquires significant skills in a field that is not by nature "artistic". Biology may not be very different from informatics, except for the different availability of computers when compared with biological equipment.

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

Beyond genes

Biology and biotechnology do not deal exclusively with genes. In spite of all the recent hype concerning the sequencing of the human genome, the development of transgenic organisms, or the use of powerful genetic screening methods, biological research is making important advances in other fields. It is clear that genetics offer immense possibilities for artists, but other biology areas have similar potential. Proteins, cells, supra-cellular systems and organisms can also be used as an art medium, as it has been demonstrated by several artists including myself.

It is likely that other fields of biological research will become more exposed to the public in the near future. For example, a significant effort is being made to characterise all the proteins produced by human cells – the proteome - a task more daunting than the sequencing of the genome. A recent meeting on proteomics was entitled "Human Proteome Project: 'Genes were easy'". Many biotechnology start-up companies have been constituted to explore the economic

possibilities of proteomics, and last December Oxford GlycoSciences alone filed patent applications for ~4,000 human proteins.

Concerning the opportunities proteins offer to artists, I would like to invite artists to explore any protein structure database. Certainly the three-dimensional shapes of proteins will not leave anyone indifferent. 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.

It is possible to take advantage of proteins as a medium for the creation of sculptures. In my project **Proteic Portrait** 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 amino-acids; each one can be represented by a letter (one-letter code). As a consequence, it is possible to use that convention to design a protein whose amino-acid 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:

MARTAISAVELRIVEIRDEMENESESDASILVAGRACA

Using computer databases it is possible to confirm that there is no known protein in Nature with such amino-acid sequence. In fact, it is even possible to identify the natural proteins most similar to marta protein~~s~~. Computer modelling also creates several possible conformations for marta, based on the structure of similar amino-acid 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 is uncovered.

Picturing the mind

For years artists have been attempting to portrait not only someone's appearance, but also who/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 is still an experimental technology that permits direct visualisation of the brain regions that are active in real time, while the subject is performing a given task.

I have been creating **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.
As a development of Functional Portraits, I am now planning 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 simply by thought.

Using DNA as an art medium

I have also been exploring the use of genes, DNA, and chromosomes as a new art medium. In spite of my previous assertion that biology is much more than genes and DNA, the importance of genetics in our present society is beyond doubt.

In **nucleArt** I have been using DNA labelled with fluorochromes to paint the nuclei of human cells, 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 one or many chromosomes are painted, with or without portions of them in other colours. The resulting artworks (the stained cells) require the use of a confocal laser scanning microscope in order to be visualised, and are displayed at a visible scale using computer projections in order to convey the three-dimensional structure of the human nucleus.

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 Dr. Ana Pombo's laboratory, where the project is being developed, is how different human chromosomes interact with each other. All the images I have been creating are analysed by scientists as they might provide clues for a better understanding on 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.

It is a central feature of my work, not only to take advantage of scientific techniques and adapting them to the production of artworks, but also to try to contribute to the scientific research of the lab. Although my work is not based in scientifically designed experiments, occasionally my artistic experiments give unexpected results. Such results are frequently a consequence of attempts to use the technology in a different way. Occasionally, results of "artistic experiments" reveal scientifically important issues that require follow up by the scientists.

The artificial – natural

In **nature?** I have created live butterflies with wing patterns never seen before in nature. This has been achieved by interfering with the normal developmental mechanisms of the butterflies. The butterflies are simultaneously natural (their wings are made of normal live cells, without artificial pigments or scars) but designed by an artist.

I have only modified the pattern of one wing of Bicyclus and Heliconius butterflies. As a consequence, all butterflies have simultaneously one wing with the natural design and another one with my design. Through this asymmetry, I have tried to emphasise the similarities and differences between the unmanipulated and manipulated, between the natural and the novel natural.

I have been trying to express concepts in the butterfly wings that deal with our perception of shapes. By adding, changing or deleting eyespots and colour patches it is possible for our imagination to identify shapes and rhythms familiar to our senses. Another approach includes highlighting particular aspects of the natural wing – for example, the removal of the outer rings of an eyespot to simply show the white centre of it. I never had the intention of enhancing in any way nature's design, nor did I intend to make something already beautiful even more beautiful. I simply wanted to explore the possibilities and constraints of the biological system, creating (within what is possible) different patterns that are not the result of an evolutionary process.

It has also been my intention to create unique butterflies. The changes are not at the genetic level, and the germline is left untouched. As a consequence, the induced modifications are not transmitted to the offspring. Each modified butterfly is different from any other. The new patterns are something never seen in nature before, and quickly disappear from nature not to be seen again. This form of art has a life span – the life span of a butterfly. It is a form of art that literally lives and dies. It is simultaneously art and life. Art and Biology.

Acknowledgements

Works mentioned in the text were created in laboratories at the University of Leiden, Netherlands (nature?); MRC – Clinical Sciences Centre, Imperial College, London and Vivid, Birmingham (nucleArt) and University of Oxford, UK (Functional Portraits, Proteic Portrait). The following scientists and artists have contributed to the development of the mentioned projects: P. Brakefield, A. Monteiro, R. Kooi, K. Koops, and M. Bax (nature?); A. Pombo, M. Higgbottom (nucleArt); P. Figueiredo, J. Waldmann, and M. Higgbottom (Functional Portraits); R. Alves (Proteic Portrait)

Guy Ben-Ary and Thomas DeMarse

Meart (AKA Fish and Chips)

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.

(The members of SymbioticA Research Group are: Guy Ben-Ary, Phil Gamblen, Dr. Stuart Bunt, Ian Sweetman, Oron Catts, Ionat Zurr, Gil Weinberg, Matt Richards)

"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 stimulating 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 won't be using fish neurons and silicon chips, rather neurons from embryonic rat cortex grown over Multi Electrode Array (MEA). In this stage we are collaborating with Steve M Potter, a neuroscientist from the Laboratory for Neuroengineering, Georgia Institute of Technology. Steve is developing a new paradigm for neurobiology research, that will bring together top-down (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. Further more 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 (Atlanta, Georgia). 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 will 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 occur, or trace any change in the pattern of behavior of the neurons that occurs as a result of the stimulations.

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. 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)", "neurons / digital components /robotic arms" 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 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 neural 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 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 pixels will initiate a stimulation to the correlating 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 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[4] 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 on the action potential 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 a single action potential signal 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, where 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 signalling 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 and References

[1] A substrates 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

Ionat Zurr and Oron Catts

An Emergence of the Semi-Living

"To think of objects not as instruments for our use, but as entities that are effectively linked and that need care--to think of objects as plants in our garden.... Think of objects that are beautiful and useful as trees in your own garden, objects that endure and have lives of their own, objects that perform services and require care.... I am thinking of criteria of quality that leads to a system of objects that have the variety, complexity, life and blend of beauty and utility of a garden but, at the same time, are a product of the real world, a world extensively and intensively artificial." Ezio Manzini[1]

A new concept is emerging in the continuum of life--that of the Semi-Living. A Semi-Living entity is a new, autonomous entity located on the fuzzy border between the living and the non-living, the organically grown and the constructed, and the object and the subject. While the Semi-Living relies on the vet and the mechanic, the farmer and the artist, the nurturer and the constructor to care for them, they are not human imitations nor do they attempt to replace humans. Rather, the Semi-Living is a new class of objects/beings that is at once similar and different from both human made objects and selectively bred domestic plants and animals (both pets and husbandry). The Semi-Living is yet another construct of a self centred species (homo-sapiens). The semi-living is a product of what can be defined as a human centric activity, but can not be classified as human made objects nor modified animals; the semi-living consists of parts from both. This paper raises--but does not resolve--some of the conceptual issues that emerge with developments in new biologically related technologies, drawing on examples of existing precursors for Semi-Living entities. As the emphasis of this paper is on life in its tangible physical form, we will only superficially address issues regarding artificial or virtual life and intelligence.

Modern biology enables us to objectify living systems and to create Semi-Living beings. As wet biology art practitioners who use tissue technologies to create Semi-Living Sculptures, we are acutely aware that the Semi-Living beings that we create are dependant on our care for survival and well-being. We try to formulate the broader questions to the extent to which we can morally manipulate and exploit living biological systems for human-centric activities. For

example, will the emergence of the Semi-Livings make our society a more caring one or will life become objectified even further?

The idea of using a plant's living tissue as a malleable material for human-centric purposes is widely used and accepted. Ivy growing over a wall could be understood as a pre-cursor for a Semi-Living entity. The constructed wall and the ivy—the living tissue--are combined together by the gardener who provides the human intervention. Beyond its aesthetic presence, the ivy/wall hybrid is also functional; it can be used as an insulator and as an air filter. Pruning, watering, and fertilising are used to sustain the ivy in most cases. (The ivy may "grow out" of our conceptual definition of the Semi-Living when unchecked. It outgrows its purpose, as perceived by humans, and becomes a weed). The idea of using plant's living tissues is widely used and mostly accepted. The most common example is that of plants' amputated sexual organs - flowers, arranged inside a vase. Here, the epitome of the human-centric presumption is exposed. The gratification of human needs for aesthetics allows for the mutilation of a fellow living being. In his insightful paper "Kitsch Ornamental Plants" (1997) George Gessert, an artist who breeds plants against the commercial grain, speculates that plants are not sentient and therefore, "plant breeders have expressive freedoms inappropriate to animal breeders…plants are our kin. We cannot converse with them, but we can interact in infinitely various ways, and we effect their evolution they become our mirrors…reflect our thoughts and dreams, and shape us in turn."[1] Gessert looks at plants as living materials through which we can express our curiosity, wonder, and love. Perceptions, ideologies, and values radically change as we move closer, in the scale of the life continuum, to our own species, but we are left confused when we project emotions onto Semi-Living entities as they are made out of reassembled parts of complex organisms.

Technology Imitates Life

AIBO dog, a Smart Toy produced by SONY, does not consist of any living materials, but it produces an illusion of life. It is an electronic machine embedded with artificial intelligence. '… Autonomous mode enables AIBO to act on its own. Curiosity and experience help AIBO grow. Interaction within its environment builds character. 16 degrees of motion give AIBO its freedom to move."[1] AIBO can be your companion pet as well as your guard dog. Besides, AIBO cannot die and if it breaks, it can be reassembled. AIBO dog is designed to look and behave as if it is alive and even semi-sentient. Sherry Turkle suggests that computers or smart toys are evocative objects that ignite human perceptions.[1] The psychological relationship that children

form with smart toys, says Turkle, forces them to engage with fundamental questions regarding what is alive and what is life. Semi-Living objects that contain living elements evoke epistemological and psychological questions about life from a different perspective--that of life in its physical sense. Evocative Semi-Living objects raise questions such as how much, and what kind of, living material is needed in order to make an object alive and/or sentient? Is plant tissue less sentient than a tissue from a more complex organism? Is there a difference between epidermal tissue or a muscle tissue, which has the ability to twitch in real time in vitro, or nerve cells that are commonly believed to aid in forming the notion of self? Is an AIBO dog covered with living fur more alive? What about an AIBO dog embedded with rat neurons over its circuit board?

A few years ago, we bought a Furbi toy hoping that would fill the gap left in our heart after we were forced to leave our beloved dog in Australia. Needless to say, a Furbi is not a living intelligent dog. We also must admit that the Furbi became an annoying toy after a while. It was demanding, noisy, and did not always go to sleep after we pressed what we believed to be the right button--the Furbi is packaged with an instruction booklet and a dictionary of Furbi's language. Due to the lack of care we provided, it eventually "became ill." It coughed and expressed dissatisfaction and discomfort, so we took it apart. First, we skinned its artificial fur and then we took out its circuit board to shut it up. How many living components are needed to make the act of dismantling a toy an act of killing? How much time and energy are we prepared to invest in taking care of something which is Semi-Living?

Living Components for Computational Tasks

Biological computing, the integration of neurons and electronics is still in its embryonic stages, but its future implications are infinite. Scientists have put forth the speculation that a Semi-Living "thinking" computer can solve problems intuitively and creatively. A computer, or more appropriately, a very basic calculator made of neurons taken from leeches has been described by its creators at the Georgia Institute of Technology as a device that "can 'think for itself' because the leech neurons are able to form their own connections from one to another. Normal silicon computers only make the connections they are told to by the programmer..."[1] An intuitive and creative computer is an intelligent and unpredictable being. It may be created by us and for us, but as it will be creative and unpredictable it might not necessarily stay the way it was originally made for. Fish & Chips, an artistic project we were involved with, explores notions of sentience and creativity. We recorded signals from fish neural activity (wetware) and

translated them by a computer algorithm (software) to movements of a robotic drawing arm (hardware). The same set of data (that of the fish neural activities) also manipulated a musical score. The outputs (both the drawings produced by the robotic arm and the music) determined the rate of the stimulation fed back to the neurons. We refer to the wetware/software/hardware hybrid we created as a Semi-Living artist[1]. The perceived creative outcomes, the drawings, the music, were still in the eye of the beholder, but the questions regarding the possibilities are real. What will happen when something else would start to express a uniquely human aptitude such as art?

The Use of Living Tissue Cultured Outside of the Body

The term tissue culture was coined by Alexis Carrel of the Rockefeller Institute and his assistant Montrose Burrows. In 1910 they began experimenting with growth of tissue in vitro using different kinds of tissues such as embryonic, adult, and cancerous. Carrel, who was a surgeon, was looking at tissue culture techniques, namely cells division and growth (and not merely cells survival) outside of the body, as a way to explore techniques to extend the life of the body. 'Central to this was the establishment of the possibility of "permanent life" for tissues in vitro, giving rise to the possibility of an immortal or continuous experimental subject abstracted from the perishable bodies of individual animals and humans' suggests Hannah Landecker (2000)[1]. Landecker goes on to quote one of Carrel's assistants Eduard Uhlenhuth; 'Through the discovery of tissue culture we have, so to speak, created a new type of body in which to grow a cell' (1916). For more then four decades Tissue Culture was a field of study of its own, the art of sustaining cells alive was an end and not the means, and great specialization was needed to practice tissue culture. During the 1950s tissue culture has started to become standardized and pre-mixed solutions and other tissue culture specific items have become more available. To borrow a term from the world of computer software, many tissue culture practitioners become users rather then developers and tissue culture becomes a research tool, and may no longer regarded as a research field.

The early 1990s seen another major conceptual shift- tissue engineering- the realization that cells can be grown in three dimensional and form a functional tissue (to be implanted into to the body to replace or support organs). Once it was proven that functional tissue can be engineered and sustained alive out side of the body, we can talk about the emergence of the Semi-Living.

Semi-Living Sculptures

In the last six years, we have grown tissue sculptures, "Semi-Living objects," by culturing cells on artificial scaffolds. The goal of these works is to culture and sustain tissue constructs of varying geometrical complexity and size for long periods, and by that process to create a new artistic palette to focus attention on and challenge perceptions regarding the utilization of new biological knowledge.

The Tissue Culture & Art Project (initiated in 1996) is an on-going research and development project examining the use of tissue technologies to create Semi-Living sculptures.[1] We are using constructed biodegradable/bio-absorbable polymers in a desired shape, and seeding them with living cells from complex organisms. We use technologies and procedures developed by tissue engineers. Tissue engineering deals with constructing artificial support systems (with the use of bio-materials) to direct and control the growth of tissue in a desired shape in order to replace or support the function of defective or injured body parts[1]. It is a multi-disciplinary field that involves biologists, chemists, engineers, medical practitioners and now, artists.

Our Semi-Living sculptures must be kept in sterile incubators and immersed in nutrient media. We see them as evocative objects which require care for survival. When presenting our sculptures alive in galleries, we have to construct a tissue culture laboratory in which we can feed the Semi-Livings on a daily basis. In our recent installation, 'Pig Wings', presented at the 2002 Adelaide Biennale of Australian Arts, we presented living-pig-bone-tissue-sculptures grown to the shape of three sets of wings. The wings were about five months old when they were brought to the gallery. We kept them alive in the gallery for another ten days. But as we had to go back to Perth, and there was no one in Adelaide to take care of them, so we killed them. We performed a "ritual of killing the Pig Wings." In this ritual, we asked the audience to touch and be touched by the Pig Wings. On exposure to Human touch, the Pig Wings became contaminated and their death was imminent. They were fatally infected by bacteria and fungi, which lives in the environment and on humans. The touching/killing rituals are our way of coercing people to face the problematic existence of Semi-Living entities. These evocative entities expose the gaps between our new knowledge, our ability to manipulate living systems, and our belief and value systems. These systems are not equipped to deal with the epistemological, ethical, and psychological implications raised by the emergence of the Semi-Living.

One of the issues limiting our abilities to confront the audience is that of scale and tactility. The main barrier to achieving a large-scale tissue-engineered sculpture is the lack of an internal plumbing system (blood vessels and capillaries) to deliver nutrients and other agents and to remove harmful waste. Diffusion alone cannot sustain thick formations of tissue. The development of a capillary system would also facilitate the creation of a living barrier---a skin---to protect the sculptures from harmful agents in the environment. This would enable us to take our sculptures out of containment and provide an element of tactile interaction.

Our Semi-Livings consist of constructed elements and living parts of one or more organisms assembled and sustained alive by humans. The entities we create might become our "natural-ish" companions, invading and replacing our constructed and manufactured environments with growing, moving, soft, moist, and care needing things. One area in which the Semi-living is seriously discussed is that of Architecture, in 1996 we suggested the creation of living walls as a way of making urban environments more hospitable. Ted Krueger suggests that, "Through the use of scaffolds, biologically-based components may be configured to architectural requirements."[1], and Geffrey Miles[1] describe a future in which genetically modified bacterial towers would dominate city skylines. This emergence of a new class of object/being may become increasingly visible as our abilities to manipulate life increase. As these creations will contain different degrees of life and sentience, new relationships will be formed with our environment, and with the concept of life itself. Parts of our own bodies can be sustained apart from us as independent autonomous entities (currently only small fragments such as skin cultures). What kind of relationships are we going to form with these entities? Will we care for them or abuse them? Where will Semi-Living objects be positioned in the continuum of life and how will this effect our value systems with regard to living systems including our own bodies human or otherwise?

Amy Youngs

Creating, Culling and Caring

ABSTRACT: An exploration of culling and the role it plays in the creation and care of unique beings. In traditional selective breeding, the living things that do not support the project are culled, or killed, so that resources may be put toward the specimens exhibiting the proper traits. This is regularly practiced by farmers, pet breeders, fanciers and hobbyists, but rarely by artists.

However, artists are beginning to create unique living beings using biotechnological tools. Do these techniques bypass the unsavory process of culling? Alternative ways of creating artwork that engages living creatures - and examines the interconnectedness between humans and the non-human world - are explored.

The Reoccurring Dream:

I call this the rabbit dream even though it always starts out as a nightmare. In it I discover that I have neglected to feed and water hundreds of caged rabbits. Some are dead, but most are still alive; just barely hanging on and somehow I know that they have been waiting for me to come and care for them. I have not kept rabbits for over a decade, and even in my dream I am shocked to learn that I am responsible for these rabbits in this dire situation. I then realize that they are the progeny of the rabbits I had bred so many years ago. I don't know who their current owners are, but because I had a hand in bringing their ancestors into the world, I feel overwhelmingly guilty and responsible for them. I am rush around to each cage, trying to revive them. But even in this guilty frenzy I am playing favorites. Realizing that I cannot save every single one before it dies I am looking at each of them, judging them, choosing to first feed and water the most promising-looking specimens; those with the proper coloring, ear carriage, body type, etc. I begin to fluctuate between feeling horribly guilty and feeling hopeful that I will save the "best" rabbits and be able to continue the breeding project that I had stopped when I was twenty years old. Usually the horror of the deaths falls away to the background as I become captivated with a promising litter of eight-week-old rabbits or a pair whom I believe could create the next grand champion if bred together.

Upon awakening from the dream I find myself wishing that I really did have the progeny of the line of show rabbits that I had a hand in creating. During the entirety of my teen-age years, my passion was rabbit breeding – I raised, showed and sold purebred, pedigreed, French Lops, Mini Lops and American Fuzzy Lops. With the cooperation of the rabbits I was able to produce exceptional creatures, many of them even earned the official status of Grand Champion bestowed by American Rabbit Breeders Association. Still to this day, I find that a perfect rabbit is one of the most aesthetic experiences. Directing a selective breeding project that produced incredibly aesthetic beings was even more satisfying. The daily caring for the herd of thirty to one hundred rabbits I owned was part of the joy. The part that changes everything, however, is culling.

Culling is the secret:

Culling is the unsavory, unspoken secret of selective breeding because it often involves killing. A planned killing has different names, based on the species being referred to: putting-down, selective termination and euthanasia are some. It is also the secret formula to efficiently create new breeds or altered traits in a population of living things. It is true that not all culls are killed - they are also sold or given away as pets - but because it is not always possible or practical to find a home for the undesirable, unselected animals in a selective breeding project, breeders do kill.

As a breeder, and as someone who has known many other breeders, I can say that most breeder love and obsessively care for their population of animals. However, it is not an unconditional love for every individual in the population. For example, in the creation of a new breed, such as the American Fuzzy Lop, those who have the best woolly coats and lopped ears are the keepers. Those whose wool is too short or thin, or whose ears tend to stand up instead of down, are culled in the interest of the project. Limited time, energy and resources prevent the support of the failed experiments. In a breeding project, culling is a way to ensure that the population of living things under one's care does not exceed the available resources, as these will be needed to continue to care for the living things that have "made the cut". New varieties and breeds of animals and plants have been created this way for over ten thousand years. If culling could be eliminated from breeding, I would be whole-heartedly practicing the pursuit of new breeds of rabbits.

Perhaps bioengineering technologies provide a more humane way to create unique living beings? As a radical speeding up of selective breeding, it does not engage in the same trial and error process of selectively breeding and culling thousands of living things over hundreds of generations. Although bioengineering clearly has many ethical issues, it has been presented as a clean way to improve the economic efficiency, the disease-resistance and overall health of domestic plants and animals.

I began to imagine what I would create if I were a genetic engineer and in 1998 I made a series of sculptures that allowed me to explore the idea further. In Hyperdomestic Cacti aesthetic ideals of nature are projected onto live and fictitious cacti. Taking existing examples of engineered cacti, such as grafted cacti and genetically enhanced, spineless cacti, this body of work imagines the possible future permutations of these living forms. Perhaps the plants of the

future will be engineered in ways that enable them to show us their emotions or reflect ours back to us. Indeed, it is possible that our new creations could affect us in ways that bring about a greater appreciation for, and conservation of, the non-human world.

Engineered for Empathy is a cactus I endowed with a green, pulsating heartbeat-like glow. Inspired by the creation of transgenic tobacco plants that glow with the genes of fireflies, it is a speculation as to what might be possible to engineer into future plant species. Beyond mere visual aesthetics or economic motivation, I imagined a plant that responds to humans and conveys emotions in ways understandable by us. This cactus is engineered to elicit empathy from humans, so that we will be compelled to care for it. Its signal to us is a glowing heartbeat that speeds up as a person comes near it. If the cactus is touched, its pulsing behavior changes to a frenetic flashing. Though visually and mentally satisfying at first, this project took an ironic turn when the live cacti I altered suffered an untimely death, most likely due to the operation of embedding forty-eight LEDs into it.

The Warm and Fuzzy Glowing Bunny

I was excited to learn about the transgenic rabbit transformed into an artwork by Eduardo Kac. He calls it GFP Bunny, as it has a Green Fluorescent Protein in its genes, which causes it to glow under a special kind of light. It was made in a lab in France that had been creating a strain of GFP rabbits since 1998. So, while the technology is not brand new and the creation of the rabbit was not the work of the artist, the transformation of a transgenic lab rabbit into an artwork (and into a bunny named Alba) is quite interesting. It instigates dialogue about human/animal relationships and challenges notions of purity and naturalness. Kac's desire to bring the rabbit into a social sphere - to treat it as a pet living among his family - certainly focuses attention on how the rabbit is objectified by the scientific community it came from. It would not be given any special care, love or even a name in the lab. Kac has been attempting to persuade the lab that created the rabbit to allow him to bring it to his home in Chicago. It gives me a warm and fuzzy feeling to think that Kac might rescue this object rabbit and turn it into a social subject rabbit.

Nouvelle Culling:

In his writing about the GFP bunny project, Kac assures that the process of creating this kind of rabbit is safe and harmless. [1] The process used by the lab is called pronuclear microinjection and it starts with fertilized eggs from donor mother rabbits who have been injected with

hormones to make them superovulate. Harvesting the embryos involves killing the donor mother rabbits. [2] The eggs are microinjected with the foreign DNA and, in an invasive surgical procedure, they are implanted into the surrogate mother rabbits. Of the fifteen to twenty embryos implanted in each mother, an average of three babies are born, and among the number of live births, only around 3% are actually transgenic.[3] The rest are the failed, culled animals in the experiment. Kac's GFP bunny was one of the very few lucky rabbits (and rabbit embryos) that did not get harmed or killed in her creation.

Learning about this process has changed my mind about creating my own transgenic rabbits. Even if I were provided access to biotech specialists and a lab, or given enough money to hire them to create rabbits for me, my past experiences with culling and responsibility prevent me from being able to create in this manner. My reoccurring rabbit dream/nightmare is a reoccurring reminder of the responsibility I felt - and still feel - for the animals I created, culled and cared for.

Alternative Collaborative Creating:

The process of breeding and raising animals feels like a collaborative artwork with nature. The process of culling requires shifting attention away from the individuals and objectifying the group so that tough decisions can be made that will advance the project. Some human mothers-to-be, mainly those who have undergone fertility treatments, face a similar situation when they learn that they are pregnant with multiple live foetuses. Since the project of having one healthy baby is decreased in cases of multiple births, doctors often encourage parents to consider "selective termination", the culling of some of the smaller or less healthy embryos in order to increase the chances of survival for the one or two embryos left in the womb; a place of limited resources.

If the project is not working toward the health of a human or animal, and is instead an art project, it can be difficult to justify. In other essays I have argued in favour of the kind of artwork that interacts with living things, as I believe it is an ideal way to explore important concepts of ecology and interconnectedness between humans and the non-human world. [4] One artist whose work exemplifies this concept is George Gessert, who has been breeding and hybridizing unique flowers as a genetic artform since 1982. His work with flowers highlights one way in which humans have interacted with the natural world for thousands of years. Gessert's breeding project however, stands out from other horticultural endeavors, as he is not

breeding for traits that are considered economically valuable in the marketplace. He believes that "Genetic art is not simply a matter of inscribing individual human ideas and fictions into the DNA of other beings." And that, "On the deepest level, genetic art is about community, the community of living beings." [5]

My own desire to create artwork that interacts with the community of living things without hurting them has led me to design a sculpture to protect a spineless cactus. Rearming the Spineless Opuntia is a machine that protects a Spineless Opuntia, an actual cactus that has been altered by humans so that is lacks its spines. It is, therefore, easier to eat and to feed to cattle than its relative, commonly known as the Prickly Pear cactus. The metal armor built into the machine closes when people approach and opens up again when people move away from it. It signals a future in which humans will need to engineer increasingly elaborate remedies for ecological problems we are responsible for; much like the current creation of artificial reefs which are needed in populated costal areas to replace the natural reefs damaged by humans.

In current attempt to collaborate with living things, I am designing shells for hermit crabs. Prototypes for Hermit Crab Shells is a project that began with computer-designed, rapid-prototyped shells, which I gave to seven Land Hermit Crabs [6]. Since they cannot grow their own shells they rely upon marine snails to produce the shells they use to protect themselves. When they grow out of the old shell, or find another they prefer, they will move into a new one. So far, the crabs have rejected all of my designs. They have all elected to either stay in their own shell or to move into a natural shell. The crabs have essentially culled my designs. I am incredibly humbled by this experience, but at the same time I have been challenged to learn from my mistakes, to learn more about the crabs' needs and to try new designs. After the experiments with rabbit breeding, research into genetic engineering and the continued longing for other ways to engage and collaborate with non-human living creatures, I believe the feeling of humility is most appropriate.

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Prototypes for Hermit Crab Shells began as a collaborative project with Matt Derksen, and was exhibited at Archetype Gallery, Dayton, OH. Nov 16, 2001 - Jan 31, 2002 as part of Intersculpt:Ohio.

Steve Baker video

Kac and Derrida: Philosophy in the Wild?

Eduardo Kac has a very clear sense of the kind of art that he makes, and of the kind of art that he thinks worth making. "The artist is not a decorator," he insists. "The artist is a philosopher." More enigmatically, he asserts that "Art is philosophy in the wild." These views inform the complex and controversial manner in which Kac's recent transgenic art addresses the status of the living animal. The work is philosophical in the sense that it aims to challenge what Kac sees as the shortcomings of philosophy's engagement with the animal. He finds "the Western philosophical canon" to be "faulty in its construction of animality," which troubles him "because the idea of humanity in this philosophy is largely based on the difference between the animal and the human."

The idea that philosophy has managed to get both the non-human and the human animal wrong is also to be found in Jacques Derrida's work on the animal over the past decade, especially in his recent lecture "The animal that therefore I am." He finds "in every discourse concerning the animal, and notably in the Western philosophical discourse" a concern with "what is proper to man, his superiority over and subjugation of the animal, his very becoming-subject."

Neither for Kac nor for Derrida and Kac do human and animal constitute securely discrete forms of life or fields of knowledge. Kac states that he intends his transgenic art to be an "examination of the notions of normalcy, heterogeneity, purity, hybridity, and otherness." Derrida similarly attends "to the animal in itself, to the animal in me and the animal at unease with itself."

There is of course a crucial difference between the forms taken by these parallel investigations into human uneasiness with the animal. Derrida is concerned with how to do philosophy by

means of a prolonged and absolutely serious meditation on his relationship with the cat who shares his home: "cannot this cat also be, deep within her eyes, my primary mirror?" he asks. Kac's art-as-philosophy, on the other hand, is pursued through transgenic art, which he defines as "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." In the case of the GFP Bunny artwork, this involved the creation in a French laboratory of an albino rabbit whose entire body glows green under flourescent light. (Kac continues his campaign to get the lab to release the rabbit, named Alba, so that she can live with the artist and his family in Chicago, as he had intended.) In the case of his more recent project, The Eighth Day, it involved the creation through similar techniques of glowing fish and mice as elements in what he calls "a transgenic artwork that investigates the new ecology of flourescent creatures that is evolving worldwide."

The contrast is clear. Derrida's may be an unusual way of doing philosophy, but it appears to draw on a serious and entirely ethical relationship with his cat; whereas Kac, with similarly serious intentions, engages with the animal through techniques that strike many people as meddlesome, invasive and profoundly unethical. There are important reasons not to rush too quickly to such a conclusion.

Derrida's complaint about philosophers "from Aristotle to Heidegger" is that their discourses go on "as if they themselves had never been looked at ... by an animal that addressed them." They cannot envisage, as Derrida now begins to attempt to envisage, a philosophy written "from the vantage of the animal." And this is all prompted by his thinking at length about the experience of having been looked at, naked in his bathroom, by his cat: "The animal looks at us, and we are naked before it. Thinking perhaps begins there."

Both Kac and Derrida offer striking accounts of the centrality of the traditional philosophical concept of "responsibility" in their respective thinking about the animal. Whether or not viewers approve of the use and treatment of animals in Kac's transgenic art, his comments about the attitudes that inform that work – and in particular about his attitude to Alba the rabbit – are generally unambiguous. "Responsibility is key," he insists, and in contrast to the one-way relationship of power that is evident in "corporate genetic engineering," he argues that the artist's responsibility is "to conceptualize and experience other, more dignified relationships with our transgenic other." Of Alba herself he writes: "I will never forget the moment when I first held her in my arms ... She immediately awoke in me a strong and urgent

sense of responsibility for her well-being." But what exactly is the nature of that responsibility? What does it entail? What actions does it permit or prohibit?

The question of human responsibility to the nonhuman animal is explored in some detail in Derrida's interview entitled "'Eating well', or the calculation of the subject." In it, he attempts to outline a post-humanist conception of responsibility that extends it beyond the exclusively human subject recognized by "the whole canonized or hegemonic discourse of Western metaphysics." Like his later lecture's claim that the acknowledgment of being looked at by the animal is where alert or independent human thinking really begins, he talks here about responsibility as an exacting demand, open and endless, that prevents him subscribing even to the notion of a "provisional" morality. "Responsibility carries within it, and must do so, an essential excessiveness," he states. "A limited, measured, calculable, rationally distributed responsibility is already the becoming-right of morality," and as such serves only, and shamefully, "to give oneself a good conscience."

But how might this excessive responsibility to the animal actually operate in the world? It is instructive to see that the sense of responsibility shared by Kac and Derrida leads them in quite different directions. And this is perhaps where art and philosophy come apart, or where art – to borrow Kac's phrase – leads philosophy into "the wild."

Commenting on *The Eighth Day*, and on the fact that one of the goals of his art is to "heighten awareness" of some of the generally unnoticed social transformations that are already underway, Kac contends that "humans and other species are evolving in new ways," and that "a transgenic ecology is already in place": "Transgenic crops are cross-pollinated by insects that fly from one place to another," he writes. "Transgenic animals are found in farms worldwide. Transgenic fish have already been introduced into the ornamental fish market. ... The list goes on. We do not grasp the complexity of this cultural transformation when we drive by a corn field, when we put on a cotton shirt ... *The Eighth Day* dramatizes this condition." He believes that the interdisciplinary dialogues he wants his work to provoke will only come about if he and other responsible artists are prepared to "dramatize" those conditions by learning to work with the very technologies that brought them about. This, for him, is the artist's distinctive role: "If we leave technology behind in art, if we don't question how technology affects our lives, if we don't use these media to raise questions about contemporary life, who is going to do that?"

The use of these technologies has consequences, of course, as is evident from Kac's rather defensive remarks on the question of harm. In the transgenic projects that created Alba and the various animals of *The Eighth Day* he has worked with GFP, "which" – he writes – "is deemed harmless by every scientist who works with it." He does not comment on the views of those scientists who choose *not* to work with it, though his website does include a message in which his friend Adam Zaretsky takes him severely to task on this issue, concluding: "No art that uses the knife (even a knife for hire) should claim that it is harmless. That is a grotesque affront." The criticism is not that Alba has been harmed, or that she ever was in pain – the procedure precedes the animal's birth – but rather that Kac seems to overlook the larger picture.

That picture is presented uncompromisingly in Derrida's "The animal that therefore I am." In the middle of the lecture, he breaks from his philosophical speculations to protest at "the joint developments of zoological, ethological, biological and genetic *forms of knowledge* and the always inseparable *techniques* of intervention" that have transformed the experience of the living animal in the service of "the so-called human well-being of man."

This does have a bearing on Alba. Like all transgenic animals created in the laboratory, she emerges from what Derrida plainly calls the "hell" of "the imposition of genetic experimentation" that has condemned untold numbers of *other* laboratory animals to "an artificial, infernal, virtually interminable survival, in conditions that previous generations would have judged monstrous." Kac may judge the procedures he uses to be safe because, as he notes, "transgenic technology has been successfully and regularly employed in the creation of mice since 1980 and in rabbits since 1985," but that is precisely the technology that has shamefully led to an *increase* in the numbers of animals currently subjected to laboratory experiments. And this is Kac's chosen arena of operation, his space for invention and intervention.

Where else, though, could he responsibly have chosen to operate? The laboratory is arguably one of the spaces in which art *needs* to get involved. Derrida occupies the high ground of good conscience with his confident equation of "genetic *forms of knowledge*" and their "always inseparable *techniques* of intervention," but Kac has at least had a go at separating the two, critiquing the knowledge by means of the techniques.

In the case of *GFP Bunny*, of course, it could be said that Kac botched it, he got it wrong: at present, contrary to his intentions, Alba is still stuck in the French laboratory. But getting things wrong is one model of what art quite properly does. It calls for an experimental attitude that is evident in Kac's assertion that art's legitimacy lies in its ability to remain open "as a transformative field of possibilities." As an artwork, *GFP Bunny* remains open in almost every respect. The uncomfortable irony of this situation is obvious: had everything gone smoothly, Alba would presumably be living a more agreeable life in a Chicago household and the *GFP Bunny* project would be, quite simply, *of less interest*. There would have been less to learn from the work, and from how it slipped from the artist's control, and far less likelihood that he would have found unexpected support from a spokesperson for People for the Ethical Treatment of Animals, who commented that in highlighting the plight of such animals the controversy could be "helpful for laboratory animals everywhere." It is in its goings-wrong, therefore, that it remains for the present Kac's most compelling project.

Despite what some certainly regard as Kac's irresponsibility in embarking on the project in the first place, it may nevertheless say something useful about the idea of responsibility. If art in the broadest sense (the "poetic thinking" that Derrida distinguishes from "philosophical knowledge") is a space in which a post-humanist and excessive responsibility towards the animal might be explored, it seems likely to be through constant improvisation, invention and reinvention, getting things wrong, trying again. And this is one of the ways in which art is dangerous. The artist can't always control it, and can't always keep the animal on the "safe" side of it. This is the dilemma: "Responsibility is key," but it may be that only by *risking irresponsibility* do artists open themselves, often against the grain of prevailing thought, to the possibility of experiencing animals – as Deleuze and Guattari dauntingly put it – "as the only population before which they are responsible in principle." These are wilds into which much philosophy will be understandably, and perhaps wisely, reluctant to stray.

This is certainly not to conclude that all is necessarily well in the world of Eduardo Kac's transgenic art. His suggestion that the point of art is "to learn from it, to grow with it, to be transformed along the way" raises a vital question concerning his more recent transgenic project, *The Eighth Day*. What kind of a response is it to the *GFP Bunny* controversy? What has been learned, and what, if anything, has been transformed along the way?

A fuller version of this essay will appear in *Bioethics and Transgenic Art: The Work of Eduardo Kac*, edited by Dan Collins and Sheilah Britton, forthcoming.

Grant Taylor

The obscured ideologies of Artificial Life and William Latham's Mutant Monsters

A blind fate, a vast pitiless mechanism, seemed to cut and shape the fabric of existence, and I, Moreau, Montgomery, the Beast-People with their instincts and mental reservations, were torn and crushed, ruthlessly, inevitably, amid the infinite complexity of its incessant wheels.
The Island of Doctor Moreau, H.G Well [1]

The fear of humans exceeding nature through errant scientific intent exemplified through this evolutionary fable is once again articulating contemporary fears in popular scientific and cultural discourse. Current Biotechnologies allow humans to materialise both evolutionary and genetic suppositions in the form of grandiose schemes that re-engineer both life and limb. Subsequently ethical considerations have quickly materialised in reaction to the perceived threat from the Moreau's of science, whose demented rational method, devoid of any moral code promises only debasement and monstrosity.

Ethical debates have revolved mainly around physico-chemical process of life, with precedence being given to the creatures perceived as possessing a higher level of consciousness. The ethics of virtuality, however, is somewhat overlooked in critical discourse, finding itself mainly relegated to the realm of mere simulation. There is a propensity within the culture of technology and liberal philosophy to view the digital machine as a moral free zone, an apparatus with primarily utilitarian values. One consequence is that the construction and simulation of life through synthetic processes, epitomized by the new science of Artificial Life, is ethically undervalued. Much has being written about AL, its conjunction between biology and computational science, and the many niggling epistemological and ontological questions it has generated. Edward Shanken believes the critical analysis of artificial life research 'may reveal as much about epistemological and ontological biases of a particular cultural moment as the research.[1] The subject of this paper is the distinct biases and underlying ideologies evident in digital artwork engendered from AL. Examining the art-making system of William Latham I

demonstrate, how, dominated by models, metaphors and scientific tropes derived from Darwinian biology this art form possess the abhorrent spectre of Doctor Moreau.

Technological Narratives

The self-styled artistic process known as *Evolutionism* results from the union between artist William Latham and computer programmer Stephen Todd. Together they created the commercially available form generating programs,[1] which produced the distinctive digital art forms such as *Mutation Y1*. The evolutionary mechanism located in the genetic algorithms, and artificial selection procedures of the central program *Mutator* are biological analogues of mutation and natural selection. This system allows the artist to control parameters of the virtual world, and apply physical and biological rules to generate various forms. Taking a fusion of genetic and evolutionary theory and installing an experimental method Latham fashioned the artist as both alchemist and creationist: instilling life where there was previously none, and commanding ultimate control over its existence. Like Moreau the artist becomes an allegorical figure representing in part the process of evolution itself. The many commercially available programs and web sites devoted to this sort of 'creation sciences' or what Haraway calls 'secular creationism'[1] raises several important questions about simulation and the ethics of virtuality. What are the desires driving the quest for absolute emergence, endless excess or the need to create creation, variation, and otherness? [1] Is the unbounded symbolic potential of the digital medium a perfect sphere for the megalomania of Moreau, or is it just a novel way to create artistic form in a contemporary medium?

Pioneer of AL Christopher Langton outlined a bold manifesto in which the ultimate goal for this new science was to extract the 'logical form of living systems.'[1] This firmly establishes the essence of life as a rational entity when in previous periods it had a strong vitalist quality. Stephan Wolfram another AL pioneer believed that he was destined finally to identify the hidden laws that governed the universe and provide a 'general mathematical theory to describe the nature and generation of complexity.'[1] Clearly the pioneers of AL were following in the theoretical footsteps of Von Neumann, the father of modern computation, who maintained the belief that life was based on logic and that computation was capable of 'forcing organisms to surrender their secrets.'[1] Pervading all AL narratives is the reductive rationalist policy of abstracting life's mechanisms into mathematical principle. As Simon Penny writes 'the digital computer is constituted by the ideology of the discipline from which it arose. This ideology, which Penny calls the 'engineering worldview' is quintessentially 'reductive and deterministic.'[1]

For Simon's the use of the digital computer in art practice and art pedagogy now 'slams' these ideologies and narratives of technology into artistic methodologies.[1]

Evolutionary Ideologies

One of the most interesting features of Latham's work is how he weaves an evolutionary hypothesis and the logics of genetics into the fabric of his digital system. The artistic style is inextricable linked to narrative and philosophy of evolution, in which Latham's 'monsters' enact an evolutionary drama upon a 'virtual stage.'[1] Partly inspired by biology, Latham's artistic system, as he suggests, 'uses and abuses for artistic ends the current scientific theories of life, and can be viewed as a comment on later 20th century genetic engineering.'[1] The essential aspect of *evolutionism* is the generation of artworks from genetic codes, and the manipulation of these codes by the artist. But to what extent has this form of art been seduced by Darwin's 'dangerous ideas'?[1] For Penny the central concern is the particular 'flavour' of Darwinism that is enlisted in AL. On this point, Penny views 'the very simplistic, individualistic and mechanistic evolutionary narrative chosen has a decidedly nineteenth century ring to it, and implicitly supports social Darwinism.'[1] However to what extent is the artist who uses such a programme an ideologue or doctrinaire supporter of Darwinian ideology? One must make the distinction between Darwinian theory and the explicit ideological strains of Social Darwinism. Clearly Latham and Todd's algorithmic descriptive, and artificial selection methods carry many of the associative Neo-Darwin, Promethean, and ethnocentric connotations. Filtered through logical formulas and the substrate of virtual experimentation these ideologies are subtly engaged in the digital medium.

In the past evolutionary theory has been misappropriated to lend scientific respectability to immoral political and social doctrines. One problem that arises from this sort of thinking is that scientific taxonomies through which human variation has been constructed are perceived in essentialist terms of 'race' or 'sex'. Avtar Brah contends these categories become 'signifier of inherent and immutable 'difference'. Ultimately for Brah science can become an 'alibi for legitimising processes of inferiorization, exclusion, subordination and inequality…arbitrary relationships can be made to seem preordained, natural, always already given.'[1]

Beyond the evolutionary schema the artistic system centres on parodying genetic engineering through the process of selective breeding. Embodied in the principles of domestic breeding, the program encourages 'tinkering' with genetic codes to produce 'hopeful monsters.'[1] The system

is reminiscent of the diabolical pursuits of Nazi eugenics, in which the proposed improvement of the species is brought about by genetic characteristics being judged desirable. Unlike Moreau's surgical sculptures that are created by non-genetic means the artists mutates and evolve the form through manipulating the genetic information. The *Mutator* works on our desire to become the geneticist, who engaging in recombinant-DNA 'tinkering' can actualise the form of monsters or monstrosities. As with Latham's embryonic structures in *Standing Horns* the role of gestation in the creation of monstrosities is seminal in the mutation method.

Pursuing perfection through Design Space

Whenever human beings had been considered in the pre-Darwinian literature, for instance by Lamarck, their rise was always explained in terms of a trend towards 'ever-greater perfection' or 'Man as the highest step in the *scala naturae*.'[1] Darwin himself saw natural selection working 'solely by and for the good of each being [with] all corporeal and mental endowments,' tending to progress 'towards perfection.'[1] Likewise Latham and Todd view their method as essentially an optimisation technique,[1] in which the optimal creature is achieved through the genetic algorithm and artificial selection. Influenced by evolutionary biologist R. A. Fisher's mathematical theory of evolution,[1] John Holland first exposed the potential of evolution as an engine for adaptation.[1] Based on genetic and evolutionary principles the algorithm provided a powerful way to perform optimisation functions within the digital realm. Genetic evolution allowed Latham and Todd to explore 'Form Space,' which theoretically akin to Daniel Dennett 'Design Space'[1] offered great design potential. Form space has a regular underlying layout mathematically called a 'vector space'. This space defines all possible forms. Each of the vast numbers of structures has an associated vast number of forms, and all these existed in the full multidimensional space.[1] This space parallels what biologists referred to as 'genetic space,' a mathematical atlas that geographically located all possible life forms.[1] Here Dawkins' imagines the potentiality of this imagined space:

The actual animals that have ever lived on Earth are a tiny subset of the theoretical animals that could exist. These real animals are the products of a very small number of evolutionary trajectories through genetic space. The vast majority of theoretical trajectories through animal space give rise to impossible monsters. Real animals are dotted around here and there among the hypothetical monsters, each perched in its own unique place in genetic hyperspace.[1]

Simulating evolution, *Mutator* embodied a powerful mechanism, which allowed the artist to navigate form space.[1] As a precursor to *Mutator* Dawkins' *Biomorph Land* was the first to tap into the potential of evolutionary mechanisms. By using visual attractiveness as indicator of fitness, one could bypass the innumerable characterless *biomorphs* and get directly to the superior ones.[1]

The Power of Selection and Classification

As Coyne suggests the technologies that support AL imply a 'certain self exaltation or conceit on the part of humankind, a presumption that we can…play God, by simulating, mastering, redefining, manipulating, and controlling…life.'[1] Like Moreau the artist is a parody of the Old Testament Jehovah, in that he is both Creator and Lawgiver. Epitomised in this system is Moreau's passion for total control and rationality, and his will to discover the limits of plasticity in living form. Todd and Latham designed *Mutator* to help artists explore 'form space' by way of subjective judgment. This type of 'hyper-Darwinism,'[1] with generation of novel and appealing phenotypes, allowed the artist's to drive selection via the 'main mutator menu'. Characterised as 'steering' this feature makes searching form space a rapid process. The artist, like the 'gardener' is empowered to breed and destroy selected forms, replacing 'survival of the fittest' by 'survival of the most aesthetic.'[1] Darwin had used the term natural selection to stand as a counterpart to man's 'power of selection' manifested in the breeding of domestic animals.[1] 'Breeders,' he said, 'habitually speak of an animal's organization as something plastic, which they model almost as they please.' The 'great power of this principle of selection,' he went on to write, 'is the magician's wand, by …which he may summon into life whatever form and mould he pleases.

The other analogue between Darwinian methodology and Latham's art is the distinct schema of evolutionary classification. One essential aspect of Latham's system and art is the visualisation of an evolutionary history. In Latham's first experimental system for art generation *FormSynth* the evolutionary 'tree of life' appears as an ever evolving and increasing family of forms descending from a common form. The repeated application of simple form generating rule creates a tree of increasingly complex forms. Apparent are the diverging branches of a phylogenetic tree, showing the entire phyletic lineage from the ancestral forms. In Latham's *Large Mutator Evolutionary Tree* species or groups of forms are differentiated by visible morphological features. *Treefrac* pictures the taxonomy of Family through a set of forms derived from a single genotype. Also evident is reductionism and typological system, later

baptized 'essentialism' by Popper. It consisted of classifying the variation of nature into fixed types (classes), invariant and sharply demarcated against other such types. Revealed in the form definition of *FormGrow* these morphological types, with their particular zoomorphic biases, are characterised as horns, bends, and twists.

Simon Penny warns artists to be careful and not to 'unconsciously and unquestioningly endorse the value systems and narratives hidden in scientific discourses, here they often lie, hidden, disguised as axioms.'[1] It seems the virtual world is not beyond castigation where science doctrines and technologists mix. There is no doubt that Latham and Todd's artistic system was a new visual paradigm through creating a measurable spectacle of the evolutionary process. This establishes e*volutionism* as a particularly interesting style and process. However, the primary methodologies of AL, such as genetic algorithms and artificial selection embodied in this technology of 'art making' does require critical attention. It becomes clear that the formation of genetic algorithms, and the heuristically conceived process of synthetic selection can reveal a particular breed of value judgement akin to Moreau's vision. To what extent the artist is reminiscent of Moreau is conjecture. Inevitably both are a parody of the 'mad scientist' and God, both creates a totalitarian regime of sorts, and both carry the oppressive character of ethnocentric and anthropocentric biases.

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Adam Zaretsky

The Workhorse Zoo Bioethics Quiz

What follows is a four-part depth ethical foray into The Workhorse Zoo with accompanying quizzes. The Workhorse Zoo installation was enacted by Julia Reodica and Adam Zaretsky as a part of Unmediated Vision an exhibition curated by Stacy Switzer at the Salina Art Center in Salina, Kansas from Jan 26 to March 31, 2002. The project was funded by The Daniel Langlois Foundation for Art, Science and Technology.

Intro

By discussing the ethical edge-workings of the Workhorse Zoo, we are exasperating an already contentious arena. Various competing and ideologically inflexible concepts of animal cruelty and care are in a verbal and sometimes physical brawl for the moral high ground. There are many conceptions of what a properly functioning artist is. One way to measure the degree of artistic efficiency being expressed in any presentation would be to gauge how much of a royal 'fly in the ointment' their works are for everyone involved. We don't expect everyone to agree with all of our actions. Through our expressions of personal philosophy, we hope to cause contention and incongruity to the multiplicity of outdated and inhibitional humanenesses we live in. We function only as underscorers of the porous membrane between our 'human' cultures and the rest of the lifeworld.

Our pride and willingness to discuss important issues surrounding nature/culture issues and human/other relations implies a public invitation to intelligent debate. Conceptual novelties are expressed in the living arts, with or without the meddling of artists, scientists or ethicists. Life is alive and mutating, officially and unofficially. It is only within the situational ethics of pluralist integrities that an effective debate has a chance of flourishing. Life is not composed of pat answers and shallow assumptions. This is why this essay includes many more questions than answers.

The Workhorse Zoo was a display of nine of the most studied industrial organisms of Modern Molecular Biology living together in a 'glass house'.

The Organisms:

Bacteria - E. coli
Yeast - C. cerevisiae
Plants - A. Thaliana and Fresh Wheat
Worms - C. elegans
Flies - D. melanogaster
Fish - D. rerio
Frogs - X. laevis
Mice - M. musculus
Humans - H. sapiens

With the exception of the Zebrafish, the hybrid wheat and the mead-brewing Yeast, all of the organisms were pedigree, wild-type laboratory breeds. They were either donated or bought and all of them (with the exception of the local hybrid wheat) were shipped United Parcel Service to the Art Center from their respective vendors. The E. Coli, Worms and Flies came from Carolina.com. The Yeast came from Beerathome.com. The Plants were donated by Lehle Seeds (Arabidopsis.com) and The Land Institute, which is a local eco-minded wheat lab. The Fish came from Santa Fe Pets, a local pet store who ordered them from a tropical fish vendor in Florida. The albino Xenopus Frogs were donated by Enasco.com. The mice came from Charles River Laboratories, 1-800-LAB-RATS. One mouse order was shipped as newborn pups / lactating mum combination and the other was a timed pregnant mother expecting on or around the opening. We, the only voluntary, informed and consenting subjects in this installation, were the representatives of human organisms. We came in from San Francisco, California on commercial airline flights.

For the first week of the installation, all of the organisms lived together (or were housed) inside of an 8' X 8' cleanroom lent to us by Simplex Isolation Systems. All of the air in the enclosure was HEPA filtered, insuring that no airborne life larger than 3 microns was able to enter the enclosure. Of course all the organisms were released inside of this Aseptic Containment Facility, making the point moot. Worms were released into the soil and the water. Flies were released into the air. Overlapping microenvironments were sustained according to the needs of

the organisms in question. The Fish and the Frogs had water filters and aeration. The Mice, Plants and Worms had moist mulchy soil to burrow into. The humans were given a fridge and a hotplate as well as a porto-potti.

All of the organisms were allowed to interact with each other. In fact, multi-species interaction was encouraged. The Humans were given a cot and changes of costume were provided. The interior architecture reflected our desire to overlap our culture's generic definitions of kinds of interaction with 'other' life. This is why the interior of the cleanroom was designed to emulate the architecture of a kitchen, a water garden, a farm, a laboratory and a natural setting all in one. An experimental Earth/Air/Water Interface was put in place to help socialize these disparate varieties to each other. It was a rather successful attempt as the Frogs and the Mice were seen chatting along the perimeters of their respective interfaces.

The actual artists were only physically present during the first week of the installation, Jan 26th - Feb 3rd. During that time Adam did not leave the enclosure. Over the period of a week, Adam and Julia took on daily personas to reflect various devolutionary conceptions of what it means to be a part of pop culture in a multi-organismic world. We were particularly interested in the ways in which cultural conceptualizations of Food, Animal Experimentation, Pets, Wildlife and Entertainment can be blurred, transgressed, confuted and variously de-trenched for re-evaluation in one multifaceted display. We took on different relational personas over this weeklong odyssey and we tried to live through the eyes of these usurped identities as follows:

Day One - Biotech Workers Day
Day Two - Biotech Hobbyists Day (a sort of do it yourself Punk Biotech day)
Day Three - Bioterrorist Day, including references to both Al-Queda and
Jack in the Box food poisoning
Day Four - Medical Patient/Doctor Day
Day Five - Caveman/Anthropologist Day
Day Six - Wild Animal/Lion Tamer day
Day Seven - Infant/Mother Day

Within the first week of The Workhorse Zoo, the installation had become a part of the Global entertainment network, which meant that the Animals (including the humans) had become another in the long line of Real Television styled, ironic volunteers in the media war against

personal privacy. Like a multi-species Big Brother, The Real World and Survivor, we had voluntarily displayed ourselves spread eagle on a non-stop 24-hour web cam and through personal interaction with the hungry, voyeuristic eyes of Middle America. We had college level Art, Biology and Psychology classes, high school and elementary classes, church groups, lawyer's luncheons, art appreciation groups, goth-punk contingents and local farmers filtering through on a daily basis. There were also rewarding moments of public purview, mostly when the little children entered the Zoo and held or fed a lab mouse or a lab frog for the first time. Whether they would become future Biologists, Bioethicists or VivoArtists or all three was not up to us. It was a joy to facilitate the interactions.

Quiz 1:

We have our own way of seeing and commenting on the State of Naturality/Humanity in which we inhabit. Please feel free to be lucid, transparent and forthcoming. Though we may disagree on some of these points, the stimulus of debate should be a service to all sides and we value your opinions. Please, try to cover each of these important points and please try to describe why you hold these views:

What is your view on the Origin of these organisms, before domestication and now as mail-order commodities, particularly laboratory breeds. Where should they be if not where they are? Why is this your belief?

What is your view on the live Shipping of these organisms, especially pregnant and neonatal UPS shipments? Why is this your belief?

What is your view on the Housing of these organisms, in particular the ethics of multi-species housing? Should multiple organisms be allowed to live together under the jurisdiction of human compatriots? Why is this your belief?

What is your view on the variety of settings collaged upon each other inside this education/entertainment/agitprop environment? How is this different than a nature-ish setting at a zoo or the minimum requirements for keeping laboratory animals? Are any of these settings acceptable? Is there a way to determine what an acceptable or unacceptable environment may be? Why is this your belief?

We have been overt in our detailed intro. We are sincerely interested in the your personal eye view on these issues, in detail. As you can see, We are curious about both your beliefs and the philosophies that inform these beliefs.

Outro:

The most difficult panopticonical dealywhak to put up with during the week of living in the installation, was the front window of the museum, which had visitors at all hours. We were central and at street level open for viewing by both foot and auto traffic. That meant putting up with very human banging on the windows by drunken teens in the middle of the night and whole families unconscientiously knocking and waving way before eight in the morning. The horn beeping became a cacophony at times. Feelings of exposure, a kind of indeflectable, pornographic focus were experienced by Adam, Julia and their seemingly less literate friends as well during their term as display animals. Upon leaving the enclosure, Adam and Julia drove down a dirt road appropriately named Hamburger Lane to the nearest Wheatfield/Cow farm and just sniffed the domesticated nature with a hearty inhale. It was nice to be outside of that cage and just stand under the sun near a little house on the prairie.

The non-human Animals stayed on display in the Cleanroom for another seven weeks, well fed and housed by the Art Center staff. Although they were plenty fed, the Frogs continued to eat a Fish now and then. Of the 50-60 mice, (from a start of two Moms and two litters of Pups minus the four-five that were eaten), about ten were given away as pets after a radio advertisement of their availability. I believe there were a few escapes as well. The rest were let go under an abandoned bridge in a streambed, which runs through a wheat field down the road from The Land Institute in Salina. May they enjoy their release. We are aware that many or all of them may have died and/or been eaten upon release. We are also of the opinion that the non-native CD-1 Wild-Type Swiss mice whom have not left the lab for hundreds of generations deserved a chance on their own.

It is our sincere hope that some of them make a niche for themselves in the heartland of the USA. If any of them make it, they have achieved a rodent version of the American Dream. Forcibly deported from Switzerland in the 1920's by the Rockefellers, held as a commodity in Boston's most biotech intensive rivulet, the Charles River, forced to be art collaborators, they now have a chance at independence in the Creekbeds of the Biblebelt... in the GMO wheatfields of Pop Americana... in the Breadbasket of the West.

Quiz 2:

Though we may disagree on some of these points, the stimulus of debate should be a service to all sides and we value your opinions. Please, try to cover each of these important points and please try to describe why you hold these views:

What is your opinion on animal exhibits in general and the essence of pop voyeurism in particular as it pertains to the ethical treatment of animals on display for mass media consumption? Some criticism has been laid against this exhibition for accentuating the popular aspects of Surveillance Television, euphemistically referred to as Real TV. Shows like Survivor have emphasized daredevil tactics around ironic-at-best stabs at emulating 'red in tooth and claw' pop-Darwinism. We are quite obviously referencing these faux re-tribalisms in our installation. What do you think is the effect on living organisms of the omnipresent gaze of spectatorship? Is there a continuity between the ways of looking which are fetishized in laboratories, the complacent viewing of art appreciators and the voyeuristic thrill of surveillance TV as low-brow entertainment? Are the subjects of study also the objects of desire? Or, are they subjects of ridicule and objects for control's sake? Does being a being on display imply stress or suffering? Is it possible that reflections on being a person trying to retain what it means to be human while under the observation of the whole of society has any redeeming social value or is it just a currently accepted form of pornography? Please comment on these questions and explain why are these Your beliefs? and explain why this is your belief?

How do you respond to the intentional release of laboratory grade wild-type organisms into the mostly agrarian landscape of non-urban Kansas? What other options are there to releasing organisms? The ten giveaway pets may also be subject to mistreatment. They may even become food for mouse eating pets like snakes. The lab would gladly take them back for experimental subjects but that would entail a sort of Double Jeopardy, subjects of art and science in one short life, ugh. Is there a rehabilitation program for rodents that would have been more appropriate than The Workhorse Zoo at preparing domestic animals for the 'freedom' of the Outside World? If the mice are able to establish their own colony independent of human command and control, is that a good thing? Why is this Your belief?

How well trained are you in judging artistic merit of independent, multi-species performance? Do you have any experience in art criticism or art history? Are you a bioethicist by trade? Not

being a fan of expert knowledge, we ask, how do you decide what is real art, hollow art, farcical art or credible art and are those judgments mutually exclusive? How do you define what it means to be human, humane, good or just? Is it possible for a human type primate to make real, serious, hollow, semi-humane, anthropoliminal (humandecentric), multispecies art just? Why is this Your belief?

Food:

There was a focus on food during this first week of the Zoo. Processed food for animals was given at regular intervals to all the denizens of the Zoo for all the days of the installation except for day five and six. Adam also ate mostly pre-prepared and pre-packaged food. For the feeding of Adam, we had actually exerted selection pressures on some of the most processed foods on the planet. He literally lived on sugar cereals, frozen entrees (in particular Hungry Man Dinners) and canned products like Beefaroni. Sara Lee pound cakes and orange sodas were a staple of his diet. He entered the clean room with about three days worth of junk food but he stayed in the box for seven days. On the fourth day, the townspeople of Salina were asked to feed the Human. They showed up with more Fast Food and Junk Food, assuming that this was his preference. Happymeals, Gummy Worms and Animal Crackers were among the signs of 'Animal Care' among the local populace. All of the other animals were fed proper rations on day four.

On the fifth and sixth days, pre-processed food was withheld and a botchy attempt at a bioshere-esque, field-ecology-like 'unsustainable in the long term' food chain was enacted. It was our faithful presupposition that the habitat was a friendly commensurate faux-eden with its necessary compliment of prey/predator relations as well as some natural parasitism possible. The number of organisms and their reproductive rates were high, and it was not mere strange conjecture to think that no organism would starve, even without food aids from the outside world. It was also reasoned that if animals did die of some inability to escape domestic security habits... they would be eaten by the other animals and not go to waste.

Suffice to say, the food was live but not improper, no animals starved in the Workhorse Zoo and these two days were not that different than the days before or after with the exception that no factory was producing the Frog Brittle or the Hungry Man TV Dinners. They were instead, internally produced by the farm, zoo, kitchen, lab, garden, natural area which was

capable of short-term self-preservation as a contained and interactive multi-organismic earth bound space station. This is not unlike everyday life.

Quiz 3:

What is food and what is not food? Is eating ever humane? We are chained to the food chain but often we cannot stand to be reminded of the origins of our nutrition. How can we have such an inordinate focus on food and still pretend that food comes from a box? What is processed food? Has farming, hunting and herding actually become a taboo activity? If so, what has replaced these activities? Why are these your beliefs?

Should we, as artists, have protected the fish from the fish eating frogs? Should we have tried to prevent the eating of fruit flies by the tropical fish? Is there a difference between these two diets in captivity? Why are these your beliefs?

Is vegetarianism automatically more humane than carnivorism? Plants share sex, birth, death and many of our developmental stages. Do plants have feelings? We know they do go into shock when they are cut down. We also know that they enjoy meat as food. Many organic farmers feed their plants bone meal; blood meal and fish meal along with varieties of manure from animals of varies diets. A piece of fruit is, like an egg, food for the unborn kindred of a living organism's fertile seed. Are plants assumed to be a more cruelty free choice for the moral dietitian? Why is this your belief?

Death:

Another everyday life experience was the death exposed during those two days of deprivation, death without a repackaged gloss. With issues of food inevitably come issues of death as there is no food that is not derived from the once living. Some animals were killed for consumption. Their deaths were brought about as quickly as possible. The four neonatal mice that were eaten were caught and killed by Adam's hands while dressed in a Disney Tigger suit. Their necks were broken by hand; they were gutted and deep-fried. They were eaten whole, head and bones Et. Al. They tasted a lot like bacon. The Frogs which were eaten were decapitated and skinned (their skin is poisonous), gutted and fried. The fish were beheaded. Plants were sauteed. All this was actuated by Adam dressed as a caveman. Any leftovers from the gutting and/or after the meals were buried in the soil of the installation.

Local citizens of Salina joined us for taste tests of fried Frogs, Fish, Plants and Mice with fresh Beer. Adam ate Fish, Frogs, Mice, Plants and Beer. Julia also ate Mice and had her fair share of the un-carbonated mead/beer. Jessica, a local teenager, ate frogs with us; she had no beer as she was underage. PeeWee, a local Blue House Martin bird refuge organizer and road-kill stew aficionado, ate mice and beer with us. Mice ate Plants; in particular they clear-cut all of the fresh wheat that had been transplanted the day before. Frogs ate Fish. Fish ate Flies and Worms and their own Eggs. Worms ate Bacteria and Excrement. Basically, everyone ate whomever he or she (or in the case of the hermaphroditic worms, heesh) could in a sort of anarchist-commensuralist feast.

We are aware of the varieties of ceremony that American culture practices after the death of a familiar organism. Postmortem humans are relegated by law to be buried in designated spots or cremated (incinerated) and redistributed at the surviving family member's discretion. Ceremonial invisibility is practiced by most slaughterhouses and the meat or vegetables are often processed so as to become unrecognizable as the full organisms. Prayer is often offered before consumption of both raw and cooked lifeforms. Excess meat from food preparation is usually just put in the garbage for collection and distribution to a local landfill. A good farmer would compost their excess organic matter or feed it to other livestock or pets. Pets are sort of liminal in their semi-humanness. This allows them the courtesy of ceremonial burial but often within the 'owner's' yard or nearby local plot without legal jurisdiction being enforced. Because of this freedom, a gravestone or similar memento is often created on the spot. Research methods ask for deep freezing (-80C) followed by incineration of what is presumed to be biohazardous material. By burying our dead, we, as culturally immersed VivoArtists, were of course referencing these traditions in a very sentimental way. Even artists are allowed a certain degree of sentimentality, but to no avail.

The mice were also seen digging up the leftover Frog bones that had been buried in the soil of the installation and gnawing them clean.

It was also noticed by Pee Wee that while we ate mice... the mice were also eating one of their own. This was not planned or especially celebrated, but it was a fated cue as to our breaking with metaphor. Here mouse will and co-performance showed that we were engaging the lifeworld as an inseparable part of non-anthropocentric behaviour (of which human behaviour is a minor subset).

After 'Wild Animal Day', regular store bought food was given at standard intervals to the remaining animals for the duration of the exhibition. On the other hand, they were not prevented from eating each other as a dietary supplement because it was presumed that this was an occasion of inter-species communication. Was this the inevitable meet/meat-ing of the mortal forces that call us to be finite as entities yet infinite in the organic recycling that is this ecosphere we call Earth?

Quiz 4:

Is the political or aesthetic simulation/actuation of living and sometimes vertebrate food chains inhumane? Why is letting animals hunt and eat live food (each other) in a display environment inhumane? For instance, why is it cruel to let fish eating frogs eat live fish instead of processed fish pellets?

Do we show preference for the well being of organisms with spines over non-vertebrates? Does the hierarchy of life's value happen to coincide with the proximity of that organism to the look or morphological development of Homo sapiens? Do you think cultural safeguards should protect flies or worms from sadistic artists?

What is your opinion on the accidental witnessing of mouse cannibalism? It is not unusual for mice to eat each other but it was not planned for. In a lab situation it might be left under-reported or filed away. The role of chance in an installation like this is not to be underestimated or under reported. Do you blame the artists for this act or do you give the mice some agency for their own behaviors? How do you differentiate between human effect and animal instinct and/or animal consciousness? Are mice capable of being inhumane or inmousish? Is interspecies guilt a two way street? Why is this your belief?

Is human identity a culture or a cult? Is there a difference between these two conceptions of humanity? Is it less human to kill what you eat? When and why is this appropriate?

In conjunction, what is your opinion on the eating of laboratory strains of animals by performance artists? How is this different from the eating of Beefaroni or Hungry Man TV dinners by performance artists? I am asking two questions here. First, why processed meat (and even vegetable matter) would never get a complaint in the first place while DIY (do it your

self) food preparation is taboo for public display? Second, what is the difference between eating lab animals defined as pests outside of the lab (ie. Mice) lab animals defined as livestock outside of the lab (ie. Chicks), lab animals defined as pets outside of the lab (ie. Doggies)? Is there a difference between laboratory animals used for knowledge acquisition and laboratory animals used for nourishment? Why is this Your belief?

What do you think about the burying of dead organisms within an artistic installation? Why is this Your belief?

Biographies

Professor Lori Andrews

Lori Andrews is an internationally recognized expert on biotechnologies. Her path-breaking litigation about reproductive and genetic technologies and the disposition of frozen embryos caused the National Law Journal to list her as one of the "100 Most Influential Lawyers in America." In 2001, Professor Andrews published two new books. Co-authored with sociologist Dorothy Nelkin, *The Body Bazaar: The Market for Human Tissue in the Biotechnology Age* (Crown Publishers) illuminates the business of bodies by showing the profound psychological, social and financial impacts of the commercialization of human tissue. *Future Perfect: Confronting Decisions About Genetics* (Columbia University Press) outlines the policy models we should consider as we enter an age of increasing knowledge of the human genome. Her media appearances include "Nightline" and "The Oprah Show" and virtually every major program in between. CBS and Paramount Pictures are currently developing a television series based on her career and experiences.

Steve Baker

Dr Steve Baker is the Reader in Contemporary Visual Culture. His teaching interests are in the history and theory of modern and contemporary art, and he is a member of the Quality Assurance Agency's Reference Group for Art & Design. His research on questions of visual identity and on attitudes to animals in 20thand 21st century art, philosophy and popular culture now draws increasingly on interviews he is conducting with contemporary artists in Britain and North America. He has recently lectured on his research at the New Museum of Contemporary Art in New York and at the Natural History Museum in London, and later this year will do so at the Musée d'art contemporain de Montréal. He is also a founding member of the UK Animal Studies Group, and a member of the editorial board of the US journal Society and Animals.

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).

Andrew Brennan

Andrew Brennan has held the Chair in Philosophy at the University of Western Australia since 1992. He has written extensively on topics ranging from philosophy of language to applied ethics. For many years he was chair of the Animal Ethics Committee at the University of Western Australia, and is a member of the council of the Australian and New Zealand Council for the Care of Animals in Research and Teaching.

Redmond Bridgeman

Redmond Bridgeman is a PhD candidate in the Facility of Architecture, Landscape, and Visual Art at the University of Western Australia.

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 DNA via art based encryptions. Artist in residence at SymbioticA research laboratory UWA. Undertaken research in microbiology laboratory at University of Newcastle. Australia. André Brodyk is supported by The University of Newcastle and The University of New South Wales.

Dr. Stuart Bunt MA DPhil (Oxon)

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.

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 and Curator of BioFeel: art and biology exhibition at PICA 2002. 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.

Peta Clancy

Peta Clancy is a visual artist working in the area of digital photographic media. In 2001 she completed a Master of Arts (Media Arts) at RMIT. Peta Lives and works in Melbourne. Exhibitions from 2002 include *body__manufacture™ – gene discovery* shown at RMIT – Project Space as part of the 2002 Next Wave Festival and *About Face* at The Australian Centre for Photography. In 2001 her work was shown in *Our Perfect Dream* an Austrian/Australian art exchange at Galerie 5020 in Salzburg, Austria, *This Skin I'm In* at Platform – Spencer Street Station and *Blindspot* curated by Lisa Byrne at Canberra Contemporary Art Space. Peta teaches photography at RMIT and Monash University. Peta Clancys attendance at this Symposium was assisted by the Conference and Workshop fund of the Australian Network for Art and Technology, a devolved grant program of the Australia Council, the federal Government's Arts Funding and Advisory Body.

Laura Fantone

Laura Fantone is a Ph.D.Student at the City University of New York, where she works as a researcher at the New Media Lab. Her main academic interests are: sociology of science, art and technology, migration, and gender studies. She lives between New York, a small village in Italy and cyberspace. She enjoys playing with machines – videogames especially- more than studying them.

George Gessert

George Gessert was born in 1944 in Milwaukee, Wisconsin. He has degrees from the University of California, Berkeley, and the University of Wisconsin, Madison. From 1985 to the present his work has focused on the overlap between art and genetics. He has exhibited at New Langton Arts and the Exploratorium, both in San Francisco, the Smithsonian Institution, Exit Art in New York, and many other places. He has received various awards, including the Leonardo award for Excellence. His writings have appeared in Leonardo, Art Papers, Design Issues, Circa, Northwest Review, Art Press, LifeScience (1999 proceedings of Ars Electronica), and elsewhere.

Susan Lewis

Susan Lewis, Bachelor & Masters degrees in Agricultural Science, previously involved in research in general area of reproductive physiology in farm animals & humans. Currently employed at UWA as Manager of Research Ethics & Animal Care - first employed as Animal Welfare Officer in 1986 & position has developed from there. Mid to late 1990's worked closely with Andrew Brennan who chaired the Animal Ethics Committee during that time.

Personal -I love my job ! because I believe I CAN make a difference - I deeply enjoy family life, photography, animals, gardening - teaching my children about more abstract principles of living & learning how to be a responsible citizens of this planet. I have 4 cats, 2 dogs & a frog & lizard friendly garden with a pond system which I designed & built myself.

Tom DeMarse

Thomas 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 multi-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.
She is currently Artist-in-Residence at the MRC – Clinical Sciences Centre, Imperial College of Science, Technology and Medicine in London. Email: marta_menezes@hotmail.com

Heidi Nore

I am a reformed militant animal rights activist. In my misspent youth I broke into battery farms, 'stole' captive animals, destroyed fishing equipment, dismantled traps, assaulted kangaroo shooters and undertook other such adventures I'm sensible enough not to mention.
Happily, I now employ more productive strategies to promote animal welfare. I have worked with injured native animals in Perth, with victims of the wildlife trade in Asia and am an active member of numerous animal rights groups.
I have a degree in molecular biology and am studing law. I have been a member of the UWA Animal Experimentation Committee for one year and am currently working with an animal rights group to publish information on vegan nutrition. I volunteer regularly at the Aboriginal Legal Service, am an avid athlete and am training with my equine teammate Annie for an upcoming endurance ride.

Julia Reodica

Bay Area Artist, Julia Reodica, also works with the Life Sciences Department and as an Exhibit Facilitator at the Exploratorium Museum in San Francisco, California. She assisted in teaching the first VivoArts class in San Francisco experimenting with laboratory techniques and biological concepts for artistic expression. At the museum, she works with the "live exhibits," supporting and maintaining living systems ranging from bacteria lines to small vertebrates. Continuing her contribution to the museum's 2nd Wednesday Art Series, she has just finished a carnivorous plant installation as a part of the themed show, "Cholorophilia" - the examination of humans and their relationship to plant life.

Grant Taylor

Born in country Western Australia Grant moved to the city of Perth to attend the University of Western Australia. After receiving a Bachelor of Fine Arts and the Hewitt and Australian Postgraduate Awards Grant began researching his PhD into New Media theory, which focuses on the concept of virtuality. Grant also lecture on the nexus between art and science, and is the

founding member of *Digital Craft*, a paper for New Media theory and practice in Western Australia.

K.D. Thornton

K.D. Thornton works with technologies: mechanical, electronic, biological and any others she might find interesting. Generally, her work addresses social issues, conditions or problems, (consumerism, pharmaceuticalism, sexism, mortality, denial, logic [yes, it's a problem] and taxonomies) often targeting these structures through humor and subversion. She has a BFA (honours) from the University of Manitoba and an MFA (Art + Technology) from the School of the Art Institute of Chicago. Her sculptural and installation works have been exhibited in Europe, Canada and the United States, as well as interactive works online, since 1994. K.D. is currently an Assistant Professor of Interdisciplinary Polymedia at Rensselaer Polytechnic Institute.

Amy Youngs

Amy M. Youngs exhibits mixedmedia 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. Rumour 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 p a r a s i t o l o g y ." C o n t a c t : 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.