Growing Semi-Living Art

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* An earlier version of chapter three has been published as Ionat Zurr and Oron Catts, The Ethical Claims of Bioart: Killing the Other or Self Cannibalism, *AAANZ Journal of Art: Art and Ethics*, 4:2 (2003) and 5:1 (2004) 167–188. It won the 2003 Power Institute/AAANZ Prize for Best Journal Article.

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* An earlier version of chapter five has been published as Oron Catts and Ionat Zurr, Big Pigs, Small Wings: On Genohype and Artistic Autonomy, *Culture Machine*, 7 (2005), *Biopolitics*, edited by Melinda Cooper, Andrew Goffey and Anna Munster (online).

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Abstract

In 1996 Oron Catts and Ionat Zurr coined the term Semi-Livings to describe the living tissue constructs that are grown/constructed out of tissues taken from complex organisms and maintained alive with the aid of technological intervention. The Semi-Livings refers mainly to living tissue constructs that have no biomedical purpose. In the case of Catts and Zurr these evocative entities are created for the sole purpose of art. The Semi-Livings are unique examples of a growing class of objects/subjects that are increasingly populating our made environment.

This thesis is the story of these tissue constructs as well as the techno-scientific project which sustains them alive and further articulates their meanings and purposes. This investigation is conducted in times of rapid developments in the life sciences and their applied technologies, when the humanist view of human separation and domination over nature is under great challenge.

The thesis explores issues concerning the nature of living fragments of bodies and how they force us – humans – to reassess our understandings of life. It narrates the history of partial life, beginning a century ago, mainly in the bio-medical field and the fiction stories it created, to the times when actual semi-livings exist, not only in laboratories and tissue banks, but also in factories, museums, zoos and art galleries. The new and re-emerging ethical questions raised by such a phenomenon are discussed. The role of the artist working with living (and semi-living) materials in the context of post-capitalism

and genohype is interrogated. The aim is to reveal and establish a new field within the arts – Tissue Art – pioneered by the artists of the Tissue Culture & Art project (Catts and Zurr) and the ensuing development of SymbioticA, an Artistic Research Laboratory, at the School of Anatomy and Human Biology of the University of Western Australia.[i]

We are living in times when new understandings of life through advances in scientific knowledge and new abilities to manipulate life through applied technologies are increasingly incompatible with traditional cultural and ontological perceptions of life. This gap between current (and potential) bio-technological practices and cultural beliefs is the niche explored by the Tissue Culture & Art project (TC&A). The TC&A's Semi-Livings are conceptual prototypes of a new kind of 'life' that is neither living nor non-living, that can be genderless, multiracial and species-less (or multi-species). The search for articulating these entities and re-taxonomising them within a post-anthropocentric frame is the aim of my writings.

The thesis is illustrated with artworks created by the TC&A and other artists working hands-on with life.

Introduction

‘…for an art is like a living organism – better dead than dying.’

(Samuel Butler, *Erehwon*, 1872)

‘There is no such thing as half an organism. A once living thing suddenly reduced to a collection of non-living things.’

(Steve Grand, *Creation, Life and How to Make it*, 2001)

This thesis is the story of a unique nexus between art and life. Artists have always been attracted to the revolutionary developments of science and its applied technologies, but science has also depended on art to make meanings from these developments. This is because art has in many cases been a means of comprehending things that are yet to be articulated. Nowhere is this more the case now than in the advances of bio-technology, because they challenge the most basic paradigms by which humans have understood their special place in the world as a separate or privileged species. Take the story of the acceptance of the incubator for human infants (a techno-scientific body or ‘epi-body’) and especially the way it was introduced to America.

The incubator was initially ‘modeled after [the] chick incubator by Stéphane Tarnier, an obstetrician who was a pioneer in the care of the premature infant and thus should be considered the grandfather of perinatology’.[ii] However, the American father of neonatology[iii] was Dr Martin A. Couney, a European physician who promoted the idea of mechanical incubators as an aid for the prolonging and saving lives of the neonatal, who otherwise would have died. Couney was not the person who initially designed the apparatus, nor did he publish in professional journals. Rather he was a showman, an artist, who promoted this idea through public exhibitions – entertainment – rather than the more orthodox bio-medical outlets, via professional publications, hospitals etc. '…[V]isitors to Couney's exhibit could watch [after purchasing a ticket and walking through the audience designated aisles] nasal feeding through a glass window; doubtless, the spectacle captured their imaginations as a simultaneously advanced and freakish alimentary display. Breast-feeding, a process central to maternity, delivered itself to mechanical production and an aesthetic display.'[iv]

The creation of the 'need' for a device that will 'passage' the infant from a fragile ambiguous zone into becoming a person is a complex story. One impetus for developing the incubator was to stem population decline. There was a need not only to save these otherwise doomed 'lives', but also to strengthen the mother-child bond (which was directly related to infant survival). The initial design of the incubators was already geared not solely for the purposes of biomedical function but rather as an aesthetic device to make certain meanings out of the technique and the life it sustains; to generate empathy towards the bare life on display. According to Proctor:

> An expensive device, it was designed to be used for either by wealthy private patrons or by the poor, who in lieu of payment allowed their babies

> to be publicly exhibited. Its design is ideal for exhibition purposes, with the large glass windows placed at eye-level and the tiny infant's bed suspended in the center. It is precisely these design specifications, relevant not to health care but to health care funding, which shape the path of the Lionincubator.[v]

The way these incubators were promoted in Europe and the USA was through public fairs, in which the enthusiastic public had to pay for admission to watch the show of the 'Infant Incubators with Living Infants'. 'In Couney's account, no London hospitals were willing to entrust premature babes to the show, so Couney was forced to return to Paris and retrieve "three washbaskets full of premature foundlings"…'.[vi]

Couney had a permanent incubator show at Luna Park on Coney Island, New York, from 1903 to 1943 [Figure 1] and was instrumental in Cornell University's New York Hospital opening the city's first neonatal ward. This happened, after his meeting (initially in 1914) with Julius Hess, a recognised and well-considered physician.[vii] Hess was the first to transfer this technology from the realm of the sideshow to the hospital.

Although, Coney's shows had a high prenatal survival rate, the medical establishment was slow to adopt these technologies. Accroding to an article in the New York Times from 1939: 'There are no comprehensive statistics on the survival of babies as small as that who do not receive specialized attention, but pediatricians concede that the percentage is extremely low. In all, Dr. Couney has had about 8,000 preemies under his care since the day in 1896 when he opened, in Berlin, his first public showing of babies in incubators, and he has saved the lives of about 6,500 of them'[viii] This information is repeated in an article in the history of Medicine: 'From the time Martin Couney came to Coney Island until he retired in 1943, he saved over 6,500 of the 8,000 prematures brought to him – an incredible record rates of survival unknown in organized medicine in that time.'[ix]

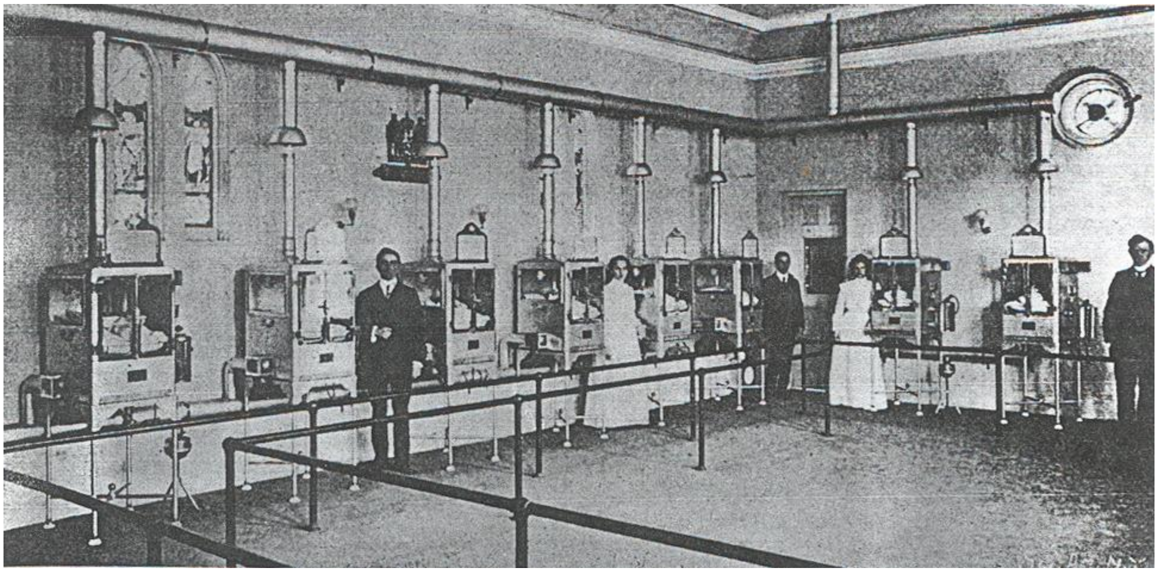


Figure 1

Why was a successfully working technology, which saved so many lives, so slow to be accepted by the medical community, while it was thriving within the public entertainment realm? Some say that Couney never intended the technology to become widely available as it would end his ability to profit from it by charging the public to come and see the living display. It may have been that the context of the Luna Park exhibition and the showmanship prevented the medical establishment from accepting this technology. These are interesting and valid points, however I suggest that such vexed cases, in which liminal beings are in a transition towards not just bare life but also scientific and moral classification, have to be articulated initially via aesthetic rather than scientific modes of presentation. A similar story is evident in the 'cabinet of curiosities' which was a prelude to the natural history refined taxonomy.

Webel suggests: 'As a form of technoscience, incubator shared with leisure spaces (1) a violation of the line between public and private spheres; (2) a cyborgian synthesis of animals and machines; (3) an aesthetics of display and surveillance; and (4) the production of intensities.'[x] Furthermore, 'As liminal beings, the premature babies gathered non-human animal imagery around them, partly through (but despite) the historical trajectory of the technoscientific device itself.'[xi]

These premature babies who were exhibited in a Luna Park (where they were located, beside the bearded woman or the two headed lamb?) were yet to be taxonomised, just like the other 'abnormalities' or 'oddities' presented in Luna Park. As 'a spatial technology, incubators performed a mechanization of life-forms that blurred species boundaries'.[xii] Were they human? Were they living?

In a sense the neonatal technology has assisted in 'classifying' premature babies in the realm of the living and of the human, and therefore as persons. As a result, the context where these new lives dependent on their epi-bodies had to be dramatically changed – from the realm of entertainment to that of the bio-medical.

Today the new cabinet of curiosities is being constructed/grown again in the form of new technologically-dependent and yet to be classified lives, created in scientific laboratories by emerging technologies. These new entities do not conform or fit with the natural history museum classifications let alone with our traditional understanding of what is life and what is alive.

The artworks that are at the centre of this investigation also involve the nurturing of ambiguous life forms using advanced technology, this time in art galleries rather than the sideshow; of lives which defy species, sex and age boundaries. Here its function is not profit driven or providing a public face to bio-technology, but rather a critical engagement with and the fostering of public debate about techno-scientific developments that challenge the accepted understanding of what it means to be human, and indeed, to be alive.

Rapid developments in the life sciences and their applied technologies have created new ways for beings to be and to come into the world, and new categories of existence that are challenging traditional understandings of the order of the world. This requires humans to rethink their understandings of and relationships with their own identity/body, other animals, life forms and the environment in general, as well as the concept of life itself.

This thesis investigates and focuses attention towards one type of these new 'beings' or semi-beings – fragments (cells and tissues) from complex organisms that are assembled in different combinations and variations inside a new kind of body – the techno-scientific body. These semi-living or partial lives are increasing in their presence and complexity (some, as will be illustrated further on, even ask if they should be considered a new species). These semi-beings are rapidly expanding in mass and meanings and transgressing to new niches as well as to the public domain via artistic expression. These artistic 'semi-livings' are the subject of this thesis.

'If a lion could speak we wouldn't be able to understand it'

(Wittgenstein, *Philosophical Investigations*, 1953).

We are living in times when, in many respects, science rather than the arts (or even philosophy) presents the most radical challenges to our understandings of life. This new radicalism is actual rather then theoretical; it involves the creation and manipulation of new types of living or semi-living beings, rather than just observation, contemplation and speculation. Many would say this is the era of the techno-biological revolution, and the humanities are being left behind rather than being an effectively engaged participant in this revolution. As Thacker observed:

> One problem is that the humanities are too often polarized vis-à-vis the biosciences: either you re-establish the impermeable boundaries of the humanities and do not engage at all, or you engage and then follow the advances, always one step behind…[However] Cultural theory should not put itself in the position of always playing 'catch-up' with the latest techno-scientific advances, else all becomes a sort of game about what's trendy and pitching memes based on that.[xiii]

Interestingly, it is mainly artists (albeit a small but growing number) who are challenging this revolution. These so called bio-artists have taken up the contenscious role of entering into scientists' 'lairs', the 'off limits' laboratories, in order to participate practically and conceptually in the fundamental scientific and ethical shifts occurring in the definition and the developments of new lives. It is almost as if these artists are becoming the 'hands-on philosophers' or 'philosophers in the wild' (Kac[xiv]) and experientially engaging with new techno-scientific thinking about life and its shifting limits.

The reasons for this include the historical tendency of artists to engage with new ideas and emerging technologies, 'using wet hands' to make sense of these new 'materials' and test their boundaries. It may be that some artists are less inclined to position themselves, ideologically and theoretically, in opposition to the scientists/technologists, both in their ideologies as well as methodologies. Artists are traditionally fascinated by new cultures, and in their training are encouraged to provoke, to ask the unquestionable and present subjective and fantastical reports of their 'journey'. It is all part of their practice.

My thesis will demonstrate the essential role of the plastic/visual as well as performative arts in not only responding to the changing perceptions of life as manifested by developments in the life sciences, but also in engaging, subverting, and taking a significant role in forming and interpreting the techno-biological revolution. In recent years artists have played a significant role in suggesting new ways of dealing with the radical implications of the new life sciences, both in the scientific and wider community.

Because the thesis focuses on my own practice as the case study, I first need to qualify my position as an artist in the writing of this thesis. I am far from being a distant and objective observer of BioArt. Rather I am one of the players (and have often been referred to as being one of the key pioneers) of this phenomenon. While I have attempted to be objective, I also have not hidden my subjective perspective in the field of BioArt. Indeed, one of the major motivations for this thesis was to develop an historical and conceptual grasp of this emerging field (and the place of my practice in it), but mostly to develop a theoretical understanding of my practice, and specifically of tissue art or the creation of Semi-Livings and partially-living artistic entities for which I am most known. This theoretical understanding is one of many voices which reflect on human attempts to comprehend its position within the life continuum during times of major developments in the life sciences and their applied technologies, coinciding with the breakdown of traditional perceptions and understandings of life and life taxonomies.

The thesis also explicitly searches for a post-anthropocentric position. My use of the term post-anthropocentric is still loosely defined and exploratory, and reflects the need to find an alternative to the conventional dialectic of anthropocentric versus anti-anthropocentric discourses. It is a paradoxical and somewhat futile attempt, as it voices the need to find a 'language' that is not limited by purely human concerns, and may only be possible when the human will better perceive its inherent limitations (and arrogance). However, as a human writer, as suggested by Wittgenstein above, I am yet to be able to understand it.

Science, as well as most of the media arts, normally consists of collaborative enterprises. My work, which straddles the humanities and the sciences (as they are conventionally defined), is collaborative and has been so for 12 years.The ideas presented here were developed together with Oron Catts and published in various articles under both names in different publications. I would like to acknowledge Oron for being my co-thinker and co-writer as well as my collaborator on the Tissue Culture & Art Project. This dissertation, I incorporate original chapters and modified already published materials to create a coherent argument and narrative about the Semi-Living Art.

These days it seems almost impossible to talk about art involving living or semi-living elements or even art using biotech themes in a metaphorical sense, without dealing with the problematic term 'BioArt'. What BioArt is (if it exists at all) is still debated. This thesis makes no attempt to settle this debate. Firstly, the phenomenon is not ready to be defined as it is still undergoing radical change. Secondly, this thesis is not written from the perspective of the conventional art historian above the fray, but from that of a practitioner wanting to better understand, articulate and explain her on going artistic practice. Thirdly, this thesis mainly concerns only a particular aspect of BioArt, namely tissue technologies. Ideally I would like to explore tissue technologies in relation to other forms/genres of art and free from the associations attached to the term BioArt. Nevertheless, the term BioArt needs to be accounted for, even if only for the purposes of this thesis.

As with every attempt at a new definition the debate focuses on what to include and what to exclude under the umbrella term BioArt. Is BioArt a thematic art concerned with contemporary controversies and social issues raised by the biological revolution? In this case, it includes conventional representative art practices such as non-carbon based artificial life evolving on computer screens, or painting, photography and other traditional media representing current biotechnological themes. Perhaps the best known example in the art world and more widely is Patricia Piccinini, who uses 'dead' media such as fibreglass, leather and automotive paint to create realistic and symbolic sculptures of what she envisions as new hybrid creatures of the future.

Is BioArt about the medium – hence art that is alive and partially alive that needs care to survive? It has been described as '…an ephemeral and process based art of transformation *in vivo* or *in vitro* [meaning within glass] that manipulates "biological material" at discrete levels – be it [ecosystems, organisms IZ] cells, proteins, genes or nucleotides – creating displays which allow audiences to partake of them emotionally and cognitively.'[xv] If so, is arranging flowers BioArt? Are agricultural shows BioArt exhibitions? Furthermore, does BioArt include only the artists working with cutting edge biotechnological techniques? A widely acknowledged pioneer of BioArt, George Gessert[xvi], uses traditional selective-breeding techniques that have been used for centuries, as his medium.

The 'BioArt' project hosted by the Department of Cell Biology, Harvard University,'…aims to represent the artistic side of scientists, from the remarkable images of cell structure captured on computer to the explorations of artistic impressions on a canvas'.[xvii] Putting aside the reasoning or intentions of the Harvard laboratory, this is exactly the view that we, artists within the field, contest fiercely. We believe that BioArt, if it is anything, is not about representing the artistic side of scientists or the artistic side of the sciences in general. Rather, it is a conventional aesthetic (or manipulative) expression (i.e., it is concerned with affect not illustration or representation), even if it uses the tools and materials of modern biology. In many cases it is not about promoting the sciences or functioning as a public communication arm for the sciences. In some cases it is exactly the opposite of that – it is about critiquing some fundamental notions of science and the way it operates and is understood within its social, political, economical and cultural context. Having said all that, there are artists who are working with biotechnology who may fall into the category of 'celebrating' the technologies and who are loyal to the scientific dogma which has nothing to do with the activist arm of the BioArt phenomenon. Furthermore, some artists may use these tools or materials only as means rather than ends; the medium becomes transparent and is not part of the artwork's subject matter. In relation to a medium which consists of life, and more dramatically, what consider being sentient life; this approach can be ethically problematic.

The problem with a too inclusive definition of BioArt is that it opens the gates to a huge variety of art practices, both new and old. Nature and biology have been an inspiration to artists for thousands of years, since the beginning of aesthetic expression, and the separation between art and life has been challenged on many occasions by different artists and art movements. This thesis adopts a more limited and thus more useful definition of BioArt that is media rather than content specific. Hence BioArt is not defined as the aesthetic engagement with biological processes using non-living and more traditional mediums, such as computer graphics, photography and painting on canvas, as was shown, for example, in the exhibition, *BioArt – a new kind of art [exhibition]*, António Prates Gallery, Lisbon Portugal which opened in Septemebr 2005.[xviii]

For the purposes of this thesis, BioArt literally is art using the materials of life, hence living and semi-living organisms, as the art object on display. On this score, Wikipedia (in 2006, although since then the entry has kept changing and now has a different definition) began well:

> Bio-art is one of the most recent developments of contemporary art; it takes biotechnologies as a medium. Living tissues culture, genetic, morphologic modifications, biomechanic constructions are some of the many techniques those artists use, posing technological, ethical and social questions. Those experimentations may involve the artist's own body (skin culture, animal blood transfusion), and often embody traditional fears and hopes linked to the technology.

However, unfortunately the Wikipedia article adds, almost as an afterthought:

> There is some debate on the inclusion of works which can be considered bio-art that do not use living tissue, but it should be recognised that artists whose work as a minimum, reflects social concerns or social commentaries on biotechnology, may be included as, or consider themselves as Bioartists.

Against this, Hauser writes: ‘Bio-fictonal manifestations such as chimera-sculptures, DNA portraits, chromosome paintings or mutant-depicting digital photo-tricks are no more examples of Bio Art than Claude Monet’s impressionistic paintings could be classified as “Water Lilies Art” or “Cathedral Art”.’[xix]

If BioArt ‘takes biotechnologies as a medium’, not all ”Bioart” is concerned with the issues (ethical and otherwise) raised by these technologies. For example, the Portuguese artist Marta de Menezes, taking a formalist stand, asserts that her piece *Nature?*[xx] (in which she used microsurgery techniques to modify butterflies wings while in their pupa stage), is purely about aesthetics or beauty, although most of the audience responses to it have been on its ethical grounding. Another example is Joe Davis’s *Microvenus*, ‘[an] artistic work constructed from synthetic molecules of DNA. The first of these artistic molecules, Microvenus, contains a coded visual icon representing the external female genitalia and by coincidence, an ancient Germanic rune representing the female Earth.’[xxi] Its concerns are archetypal symbols, a conventional concern of much artistic practice, not biotech. However it is fair to say that biotech issues are integral to most ”Bioart” as defined by this thesis.

Luigi Capucci, in the Italian edition of L’Art Biotech[xxii] defines Bioart as ‘any work of art that is alive or contains living components that are not human’[xxiii] This definition may be appropriate to the post anthropocentric theme of this thesis however it excludes artists working with the human body or artists working with human tissue and cells.

The history of BioArt – however it is defined – has yet to be written. In its wider definition it may even encompass a longer history than the conventional history of art – perhaps back to the very origins of art in the mists of time.[xxiv] Bioart, especially if to follow Capucci's definition, as well as to suggest existing post anthropocentric artistic expression, has strong roots to the Eco Art movement of the 60's and 70's.[xxv] But this thesis does not even attempt to write a history of BioArt, even as it more narrowly defines it. There are two reasons for this. Firstly, this thesis is not primarily concerned with the so-called BioArt phenomenon in itself, but rather with the crisis in human perceptions and understandings of life and life hierarchy caused by biotechnological developments, for this is the main narrative of the Tissue Culture & Art project which is the central subject of this dissertation.

Secondly, the dissertation focuses on just one aspect or niche of this narrowly defined BioArt – Tissue Art or the art of the Semi-Living and partial life. Unique to this particular aspect of "Bioart" is the examination of the conceptual, the social/political, philosophical, ethical and aesthetical elements at the level of the cells and tissue. This specific level of 'resolution' is intriguing and different in many respects to other levels of life; it is universal to all the living (all living beings consists of cells); and it emphasises notions of community labour (cells 'need' each other to survive). But at the same time it presents difficulties to the notion of the individual body (cells can survive in vitro and without the traditional meaning of a body); and cells can transform in function (differentiations) and life span (they can become immortal). They have been referred to as living (whether human, animals or chimera) beings (mainly fertilised somatic cells), a gift (in the context of transplantation), waste (blood cells, umbilical cord)[xxvi], weapons, food, and in our case semi-living artistic entities. Cells have some sort of agency and they are becoming part of our constructed and living environment in new and unique ways. Cells are part of us (us as living animals) but in other ways are very different to what we perceive as ‘us’ or ‘I’. They are liminal beings[xxvii] and both reflect and project what is a living being and its position within the larger changing ecology.

The Tissue Culture & Art Project

The starting point of this thesis is the artistic work of the Tissue Culture & Art Project (TC&A) by Oron Catts and the author. TC&A was initiated in 1996 as an exploration into the use of tissue technologies as a medium for artistic expression. Through the years we have researched and developed tangible artworks, protocols as well as conceptual frameworks which are outlined in this thesis. As the semi-living medium does not conform to conventional systems of categorisation it calls into question many of the presumed understandings about life, ourselves, and our environment.

The Semi-Livings and partially living beings are a new class of objects/beings grown/constructed of living and non-living materials; cells and/or tissues from a complex organism grown over/into synthetic scaffolds and kept alive with artificial support (called the techno-scientific body[xxviii]). They are both similar and different from other human artefacts (*Homo sapiens*’ extended phenotype) such as constructed objects and selectively bred domestic plants and animals (both pets and husbandry). These entities consist of living biological systems that are artificially designed and need human and/or technological intervention in their construction, growth and maintenance.[xxix]

TC&A uses regenerative medical technologies, mainly tissue engineering. Tissue engineering is a technology that is predominantly used in the medical field for the creation of neo-organs or body spare parts. These are mostly temporary 'entities' designed to be implanted back to a host body. The tissue is harvested from a body only on a temporary basis, to be proliferated, repaired and grown into shape for the sole purpose of returning it to its previous context – a body. However, in other cases such as TC&A (and increasinglyin other fields/contexs), these three-dimensional tissue constructs are not intended to be implanted back into the body but rather to be incorporated into an artificial techno-scientific 'body'.[xxx]

This different context can be used (and is used in this thesis) to develop alternative notions of life to the dominant humanist model that uses the human as a skeleton on which the rest of thinking is built. One of the main premises of TC&A, when it formed in 1996, was to explore tissue constructs as entities in themselves, rather than as being designed, grown and designated to be implanted into a "full" body. Instead, these semi-living entities are treated as bodies in their own right (at least at a symbolic level), albeit an extended body supported by the technoscientific body. As observed by Thacker: '…the types of monstrous bodies SymbioticA [should be TC&A, IZ] designs are biologically and physiologically non-functional, and yet still "living". They occupy that ambiguous, intermediary zone between subject and object, a sort of "tissue actant".'[xxxi]

Although the author is aware that she is a human she will use the Semi-Livings as a point of departure toward an idealistic and problematic position – a post- anthropocentric perception of life.

SymbioticA

In the year 2000, based on the model of artistic research developed by TC&A, SymbioticA was established. It is important for me to mention this development as SymbioticA, in many ways, is a formal institutional acknowledgment of the importance of the fine arts in actively participating in research in the life sciences (as advocated by Professor Stephen Wilson in his work exploring Art as Research[xxxii]), and into new and alternative developments, both practically but even more importantly from a critical position (following the ethos of the TC&A project). SymbioticA, an Art and Science collaborative research laboratory at the School of Anatomy and Human Biology at the University of Western Australia,

> is an artistic laboratory dedicated to interdisciplinary research, learning and critique of life sciences. SymbioticA is the first research laboratory of its kind in the world, in that it enables artists and academics to engage in wet biology practices in a biological science department. SymbioticA also offers a new means of creative inquiry, one in which artists and scholars actively use the tools and technologies of science, not just to comment about them, but also to explore their possibilities.[xxxiii]

Partly as a result of the recognition and the availability of resources and expertise (provided by us) in the field of tissue technologies, other artists working in SymbioticA and elsewhere began to use tissue technologies and their associated terminology and discourses for artistic ends. This wider artistic interest in the use of tissue is now being recognised as one of the major areas of wet ”Bioart” alongside transgenic art, ecological art etc. It is interesting to note that some of the artists who are working with tissue as part of the practice do not see the need to problematise it, and in a sense render this medium transparent.   This phenomenon of making cells and tissues an established medium for artistic engagement encompasses the paradoxes inherent in the role of the critical artist working with emerging technologies. On one hand, the artist literally explores the medium to critique and subvert its use by the techno-scientific section of the Western capitalist society, while at the same time seeking to democratise it and by default domesticate or normalise it to the wider community. How much and in what ways the artistic exploration creates alternative uses of the technologies as opposed to following a technological deterministic path is one of the issues continually addressed in the thesis.

Methodology

This thesis, like the art practice and writing of TC&A, is a hybrid of narratives which do not always seamlessly interact. Adele Senior (2007)[xxxiv] pointed out that, in this way:

> Zurr and Catts' both/and (rather than either/or) logic, their use of 'already interpreted' terms and the (dis)placing of those terms within

> the text, marks the undecidability of the Semi-Living within academic discourse as already resisting binary opposition, whilst acknowledging a place of viewing from which their reader will ultimately be able to relate, that of the Western philosophical tradition.[xxxv]

Senior continued:

> …the artists' *writing* points towards the 'undecidability' of the Semi-Living. Importantly for the researcher who writes 'academically' about artistic work, this signals towards the potential of (academic) writing to *perform*, to parallel the artwork in its demand for participatory response, implicating the spectator in the process of making meaning.[xxxvi]

In short, the discourse about the semi-living is: '…a semi-discourse that is both academic and artistic, neither living nor dead and always already undecidable.'[xxxvii]

<u>Main narratives explored in the thesis</u>

The new millennium has seen a resurgence in exhibitions and conferences concerning animal-related themes. Examples are *Becoming an Animal* at Mass Moca 2006, *The Idea of the Animal* as part of the International Arts Festival in Melbourne, Australia in 2006, *Bêtes de Style/Animals With Style* at the MUDAC museum in Lausanne, and an exhibition on homosexuality among animals in the Natural History Museum in Oslo. This is not coincidental but rather a symptom of a wider situation created by the advent of biotechnology.

One of the major propositions of this thesis is the need to re-evaluate conventional categorisations of the different living systems, and the need to search for a new way of 'taxonomising' our environment and the human position within it. Furthermore, this thesis implies that what is human, in the physical and conceptual sense, is changing and will go through further changes. I also look for ways to accommodate new living and more importantly partially living entities as part of this new ecology. The first chapter introduces the phenomenon of the disintegration of contemporary species, both as a concept and through examples of recent cross species and cross living/non-living chimeras and hybridised beings. Focusing on the level of the cell and the tissue, I explore some new semi-living entities which further problematise Linnaean based taxonomies and introduce TC&A notions of the Extended Body as a fresh means of dealing with the categorisations of living beings.

Ideas regarding liminal beings, such as organs, tissues and cells that are kept alive through an artificial support mechanism, have been explored before in the writings of Squier (*Liminal Lives*), Waldby (*Tissues Economies*), Andrews (*Body Bazaar*) and most recently by Landecker (*Culturing Life: How Cells Became Technologies*). However most of these writings focused on human tissues, or in the case of other species, were explored from a completely anthropocentric view (e.g., how they are used in the service or disservice of the human animal). My analysis of these new semi-living lives explores them as themselves, giving them some, if symbolic, agency (or semi-agency).

By constructing a ‘new stage’ where bodily boundaries are disintegrating into fragments that can be reassembled in different combinations. In chapter two, I will investigate the history of partial life from the first time a nerve cell was grown outside of ‘its’ body and in-vitro (in glass) to current examples of partial lives whether used for utilitarian purposes or artistic ones. This chapter will demonstrate how tissue technologies have, from their beginnings, overlapped the two fields of art and science. The nature of these technologies and their ‘assaults’ on conventional perceptions of life have ignited different understandings, emotions and imaginations of the people experiencing its ‘wonders’. I will extend this discussion to introduce the ‘new body’ for the fragments of life – that of the techno-scientific body – by presenting its precursors and tendencies for the future.

However, this ‘playfulness’ with disintegrating and re-assembling life fragments into new entities raised many profound ethical considerations. Chapter three will interrogate the ethical questions raised by the use of living systems for art in general and focus on the ethics of the work by the TC&A project.

Chapter four explores the possibility and importance of the experiential engagement of life manipulation as ethical as well as political conduct. It argues against the view of life as information (by the sciences, the arts and the popular media) and looks for alternative metaphors rising from the engagement with cells and tissues.

Chapter five examines further the phenomenon of genohype, drawing on TC&A's Pig Wings project as a case study. Issues concerning biological artists and their operation within different institutions, private and academic, especially when contesting a central dogma, are analysed.

Chapter six will survey other artists working with tissue as a medium and how their approaches are similar to or different from that of the TC&A. I will present and emphasise the variety of approaches. However as most of the artists have been working, or are influenced, by the work of the TC&A and SymbioticA, some of TC&A's concerns, mainly to do with the taxonomical crisis in regard to definition of life, are present in their work. This chapter will demonstrate a taxonomical crisis within the art world itself as well as in wider personal, social, political and ontological spheres.

The final chapter will return to the Extended Body metaphor through a discussion of the TC&A Victimless Utopia series as a case study looking at the relations of technology to the violent act. I will suggest that technology is widely used as a way to conceal the violent act (or push the victims further away) and by that to mask the basic ethical questions governing our exploitative relationships with our other fellow living beings. These ethical considerations are under strain yet again in the light of the changes in our cnceptions of the life continuum demonstrated in previous chapters.

I will conclude by contesting conventional ideas of classification as proposed through natural history in contrast to the ‘cabinet of curiosities’. The position of the TC&A project and its entities of curiosities will be questioned. Together, the chapters demonstrate how the artistic work of the TC&A and its conceptual underpinning have penetrated, in different (and sometimes contrasting) ways, the academic, industrial and popular culture fields, not only to comment on the changing perceptions of life but also to actually effect and hopefully subvert in one way or another its development.

This thesis offers the ‘tissue actant point of view’ as a point of departure towards a post-anthropocentric vision.

Chapter 1 – The Extended Body

Recent rapid developments in the life sciences and its applied technologies are in the process of creating radical new epistemologies and ontologies, and with them new perceptions and even new tangible entities that require us, humans, to rethink these classical problems. This chapter will explore some of the new epistomologies and ontologies through the introduction of the TC&A concept of the Extended Body, a term that refers to those communities of cells and tissues that are growing and living outside of us and in a new kind of 'body' – the techno-scientific one, the epi-body.

The relationships of humans with their living environment have always involved some form of exploitation, as well as collaborative relations. Human survival, just like that of almost any other animal, depends to different degrees on the consumption of other living beings – even a lettuce is a living entity.[xxxviii] All share limited amounts of interdependent resources. Just as the cyanobacteria (alsoknown as blue-green algae) that evolved in the early atmosphere of the Earth changed the environment irreversibly to an oxygenated one[xxxix] some 2.8 billion years ago, so too are humans, through their extended phenotypes – their technologies – making changes that increasingly and directly effect living and non-living elements in the environment, including humans themselves. Arguably, in the previous fifty to one-hundred years these effects, while perhaps not as radical as those of the blue-green algae, have been profound. However, unlike the algae, humans as part of their biological make up, can partly assess this process according to a moral evaluation and by that introduce the concept of motivations and responsibility to this process.

The recent use of actual animals and increase in animal themes by artists can be seen as a response to these profound developments on planet Earth. While they can be considered part of a long tradition in human art and public 'entertainment', today these themes are re-evaluating and questioning traditional assumptions about what is human as well as human relationships to other living beings and the environment. Further, as K. D. Thornton observes, 'in the 1990s, the use of living animals in contemporary art has exponentially increased in all categories'.[xl] She suggest that: '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'.[xli] Giorgio Agamben goes so far as to argue that we are at a critical point where differences that were once decisive to the former order, are 'threaten[ing] to vanish'. For him the decisive difference that is dissolving before our eyes today is that between humans and the rest of the animal kingdom.[xlii] This is happening both in the physical sense, by the creation of animal-human chimeras, and also in the conceptual and ontological sense.[xliii]

Let us examine the phenomenon of species leaking and merging, and the position of the human within the life continuum, as they have been expressed in the level of the tissue/cell, or in other words, in in-vitro conditions. New knowledge about life and new ways in which this knowledge is being exploited require many cultural and scientific assumptions regarding life to be re-assessed. One of them is the notion of the individual and the species as a discrete and defined entity. Individual is defined as: 'Individual (Disambiguation), a person, or any specific object in a group of things'.[xliv] Species can be broadly defined as: 'A fundamental category of taxonomic classification, ranking below a genus or subgenus and consisting of related organisms capable of interbreeding'.[xlv] Both the individual and the species as a defined 'category' are presently becoming strained in the light of biotechnological manipulations; the fragmentation of the individual body into a community of cells that can assimilate with other body fragments into a new kind of 'body' is one example.[xlvi] The species barrier is being breached on the levels both of the production of organisms which may be phenotypically the same by combining elements (whether genes, cells or organs) from what is considered to be a different and unrelated species; and of the ability to interbreed. Some organisms from the same species cannot interbreed 'naturally' anymore (e.g., the vast different in size among different dogs means that some of them cannot breed ue to physical constrains), while different species can interbreed with the aid of technology.

The mixing of these supposedly 'discrete' entities, as I have said, is manifested in a continuum of levels; from the molecular to the biosphere. As my main concern is with the level of the cells and tissues, this thesis will consider these issues through the work of TC&A, and particularly its project of the *Extended Body*.

The creation of partial life and semi-living entities can be seen as an attempt to establish a reference to a new kind of body – an 'extended body'. Once a cellular fragment is taken from a body and sustained or kept alive by human technology rather than natural body processes, it becomes a part of the extended body. The living fragment becomes part of a different order that includes all living tissues regardless of their current site. In many respects it is a symbolic device that enhances the bond humans share with all living beings, as well as our ever-increasing dependence on technology for survival – a technologically mediated existence.

TC&A asks: Can we make a tangible symbolic gesture (or a conceptual prototype) towards something or someone that is exemplary of the flux of the life continuum? Our answer was to create a partially living being, with some kind of agency (an actant[xlvii]) that consists of different parts of (what we tend to perceive as) different species and individual beings, but is yet to be classified as a new species or a new animal.[xlviii] Such an entity, we reasoned, would constantly defy definition or conventional categorisation, and will continually remind us that we are part of some thing or system that we cannot fully comprehend. A prime goal of the extended body concept of the TC&A project is to examine such an entity and the ontological problems (amongst others) it raises. These problems or issues were formulated during the rapid developments in biological knowledge from the eighteenth-century Enlightenment to twentieth-century neo-Darwinism, and have been given a new urgency by recent biotechnology. At the heart of this ontological issue is the relationship among species.

Taxonomy or the species barrier

In order to develop meaningful discourses (and so increase our chances of survival) the human mind relies on a system of classification or language; it needs boundaries and constructions. In short it needs to draw some ‘lingual’ meanings from a purely visceral experience, if we are to explain it. This ‘lingual’ structure reflects our own biological limitation in interpreting and acting on the world around us. At least since Kant it has been realised that this taxonomic structure by which we reason limits what can be known and that knowledge is to a large extent an artefact these structures or taxonomies.

Biological taxonomy might be a convenient framework on which to build a discussion, but it should never be forgotten that its systems demarcate differences in our perceptions of what in fact is the continuum of the living world. Current taxonomy is based on a combination of biblical creationism and evolutionary relationships of taxa manifested in the ability of the two sexes of the same species to create a fertile offspring. This is a reaffirmation of the story of Noah’s Ark, as articulated by Marc Ereshefsky, in *The Poverty of the Linnaean Hierarchy*[xlix]. He argues that the underlining perception of species’ essentialism (created by God) governed the Linnaean taxonomy and still lingers in post-Linnaean hierarchies by the continuation of taxa naming. Ereshefsky is calling for a radical change in the philosophical study of biological taxonomy.

The word ‘taxonomy’ comes from Greek *taxis* meaning arrangement or division and *nomos* meaning law. One of the most influential Enlightenment taxonomies was devised by the Swedish scientist, Carl Linnaeus (1707–1778), whose classification for biology is still widely used, with modifications. Linnaeus’ main motivation was a religious one. He wrote in the preface to an edition of *Systema Naturae*, ‘Creationis telluris est gloria Dei ex opere Naturae per Hominem solum’ (The Earth's creation is the glory of God, as seen from the works of Nature by Man alone). The study of nature would reveal the Divine Order of God's creation, and it was the naturalist's task to construct a 'natural classification' that would reveal this Order in the universe.[l] Linnaeus's plant taxonomy was based solely on the number and arrangements of the reproductive organs. This simplicity lends it a scientific credibility, although it did not stop it being criticised for its lack of detail and also for its sexually explicit nature. Taxonomies are never value free, and are always embedded within society's moral code.

In his early years, Linnaeus followed the traditional belief that the species were not only real, but fixed; all having been created by God at the same time. In 1753 he wrote, 'Unitas in omni specie ordinem ducit' (The invariability of species is the condition for order).[li] However, after observing how different species of plant through hybridisation create forms which look like new species, he abandoned the concept that species were fixed and invariable, and suggested that some, perhaps most, species in a genus might have arisen after the creation of the world, through hybridisation.

Darwin's *On the Origin of Species* (1859) "sealed" the notion that species are not fixed, and that humans are a unique entity separated from the rest of nature. The concept of the gene and the subsequent discovery of the structure of the DNA molecule by Watson and Crick in 1953 revealed that the genetic material of all living beings shares the same chemical language. This means that genetic material could in theory and practice be exchanged between organisms as different as bacteria, plants and animals. The mixing of species on the sexual level (think mule) and the genetic level (think selective breeding as well as the more recent genetic engineering, transgenic organisms) is now common knowledge. There are, however, other levels that seem to be under-represented in public discourse; they are to do with developmental biology, xenotransplantation and tissue and cell culture.

Former taxonomic boundaries between humans and other animals are further collapsing and merging through developments in life sciences and their applications, as manifested by biotechnology and biomedical R&D. The attempts to bridge or breach the species gap are moving rapidly from the realm of science fiction and futile pseudo-scientific experiments to the realm of mainstream science and billions-dollar biotechnological industries.

'We overlook only too often the fact that a living being may also be regarded as raw material, as something plastic, something that may be shaped and altered',[lii] wrote H.G Wells as early as 1895. A few months later he conjectured, in the voice of Dr Moreau, that the living body of an individual could hypothetically be so 'extensively recast as even to justify our regarding the result as a new variety of being'.[liii] Now, in 2008, this assumption is not just a fictional hypothesis, and as fast as it becomes reality so are the hopes and fears it generates. Today such species-mixing technologies range from the non-living (DNA out of context) to the living (the whole organism and its living organs out of context) and the in-between – the partially living or the semi-living (cells and tissue out of context).

Species-Mixing Technologies

Non-Living – DNA

All living organisms on Earth share the same hereditary ‘language’, that of the five nucleic acids; adenine, cytosine, guanine (in DNA) and uracil (in RNA) which are the ‘letters’ of deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). This phenomenon allows for the transfer of genetic information among different organisms using the tools of genetic engineering. Genetic engineering can create chimeras such as a mouse with genes derived from a jellyfish and a goat that produces spider’s silk protein in its milk.[liv] The sameness of the DNA across the living kingdom required a new theory of uniformity at the meta level of the gene world. Thacker explains that Watson and Crick used the language of information theory and cybernetics when they published their papers on the structure of DNA in 1953.[lv] References to DNA and genetic engineering are dominated by the discourse of the code. As a result the ontological discussion tends to be somewhat abstract and reductionist, as in Richard Dawkins’ *Selfish Gene*[lvi], in which bodies are referred to as ‘vessels’ whose only purpose is to carry the genes (or their information) to the next generation of ‘vessels’. As will be illustrated and woven into this dissertation, the Extended Body project, along with other TC&A projects, is devised to avoid this reductionist and currently dominant perception of life, to suggest and emphasise notions of epigenetic inheritance, environmental factors in gene expressions and in general, alternative metaphors for life.

One of the first BioArt artworks in the tradition of the artist researcher was the above-mentioned *Microvenus* (1984), an embedded artwork in a bacterial genome. The work was created by Joe Davis (an artist/researcher in the Biological Department of MIT) with molecular geneticist Dana Boyd at Jon Beckwith's laboratory at Harvard Medical School and Hatch Echol's laboratory at the University of California, Berkeley. A different approach was taken in one of the best known BioArt artworks, the transgenic (genetically engineered) creature titled *Alba* by the artist Eduardo Kac. In this case the artist has requested to use a transgenic rabbit (made by a laboratory for scientific research purposes) and use it for artistic purposes. *GFP Bunny* (2000) was originally supposed to take place in a gallery in France, in which the artist Kac would share a domestic environment with a green fluorescent transgenic rabbit, borrowed from the Jouy-en-Josas laboratory in France. However, the laboratory refused to release the GFP rabbit to Kac and as a result Kac, who named the rabbit Alba, started a public campaign to 'release' Alba back to him, eventually to his home in Chicago. This campaign gathered a large amount of media attention around the world. Some of the criticism leveled against this piece is that Alba was 'marketed' to the public as a somewhat cute fairy creature of a technologically deterministic future. The invasive procedures and excess animals casulties (or those that have to be culled) in order to create a transgenic animal were somewhat under played as well as the complex effects of transgenic animals once they are released to the environment.

<u>The Living – Organs out of context</u>

Xenotransplantation enables the crossing of the species 'barrier' in the stage of the fully formed organism. Xenotransplantation, the transplant of organs from one species to the other, was already experimented with in 1921[lvii], when slices of baboon testicles were grafted onto human testicles with the promise of sexual rejuvenation.[lviii] David Hamilton, a transplant surgeon himself, wrote in the Monkey Gland Affair that animal tissue once inserted into human would not be absorbed and be immidiatly rejected (unless imuune suppressant drugs are taken etc). Therefore in a case of a scar tissue may lead a person to believe that the graft is still intact and consequently due to the pacebo effect believe in the supposedly "effects" of the transplant.[lix] Since then though, the development of immune-suppressant medicines as well as the techniques of genetic engineering has made xenotransplantation more viable. Xenotransplantation has two different but significant moral problems. One is the risk from the introduction of retroviruses, which may be harmless while residing in one species but become lethal when transferred (together with the organ) to the new species. The threat is not only to the individual organism but also to the larger community as viral infection may occur. The other ethical problem concerns the speciesist or anthropocentric assumptions of the project. The designer Elio Caccavale explores this second ethical problem in *Utility Pets*, a piece which examines the new relations humans will have to form with their pets who are also the carriers of their replacement organs. Caccavale, a product designer, has designed utility pet products that range from a smoke-filtering device which allows the pet owner to smoke while keeping the smoke away from the animal that carries the potential new set of lungs [Figure 2], or the 'Comforter', a psychological product made from the sacrified pig's snout 'which serves as a momento after the xenotransplanation has been carried out, and helps people come to terms with the contradictory feelings generated by this complex situation'.[lx]

Figure 2

Fragments of life – Cells, tissues out of context

In 1910 Dr Alexis Carrel and his assistant Montrose Burrows, of the Rockefeller Institute, together coined the term 'tissue culture'. The growth and reproduction of cells and tissue outside of the body, rather than their mere survival, became the defining characteristic of tissue culture.[lxi] Now the terms tissue culture and cell culture are being used interchangeably when it comes to animal cells. The growth of parts of plants is commonly called tissue culture, while the culture of bacteria and yeast is known as cell culture. The art discussed in this dissertation is biased towards the use of parts of animals. There are different techniques to grow isolated cells, tissues (explants), and organs, but the principle is somewhat similar in that the human technological intervention emulates the conditions of the bodies from which these fragments have been obtained.

Dr Alexis Carrel became interested in in-vitro life during research into transplantation. He considered tissue culture as almost a new life form and definitely as a way of prolonging the life of body parts inside a new artificial body, theoretically in the journey towards human immortality.[lxii] Eduard Uhlenhuth wrote in 1916: ‘Through the discovery of tissue culture we have, so to speak, created a new type of body on which to grow the cell’. [lxiii] TC&A refers to this ‘new type of body’ as the techno-scientific body (which can be a Petri dish, a bioreactor or a host organism, as in the case with the mouse with the ear on its back) in which to grow fragments of body - the Extended Body.

When animal cells are extracted from their host body and its immune system, they can still grow and proliferate in vitro subject to certain conditions such as sterility and nutrient supply. Different cells from different bodies (regardless of sex, race, age or animal species) can be co-cultured. Furthermore in some cases the cells fuse. Cell fusion is ‘the nondestructive merging of the contents of two cells by artificial means, resulting in a heterokaryon that will reproduce genetically alike, multinucleated progeny for a few generations’.[lxiv] When an undifferentiated stem cell fuses with a mature differentiated cell, the resultant cell retains the mature cell phenotype.[lxv]

The phenomenon of cell fusion, besides its practical applications such as a method for passing on specific genes to specific chromosomes, compelled Oxford University Professor Henry Harris to write about his experience as a pioneer in cell fusion techniques.[lxvi] Harris' 2005 article opens with a somewhat romantic quote:

> There is a tendency for living things to join up, establish linkages, live inside each other, return to earlier arrangements, get along, whenever possible. This is the way of the world.
>
> The new phenomenon of cell fusion, a laboratory trick on which much of today's science of molecular genetics relies for its data, is the simplest and most spectacular symbol of the tendency. In a way, it is the most unbiologic of all phenomena, violating the most fundamental myths of the last century, for it denies the importance of specificity, integrity, and separateness in living things. Any cell – man, animal, fish, fowl, or insect – given the chance and under the right conditions, brought into contact with any other cell, however foreign, will fuse with it. Cytoplasm will flow easily from one to the other, the nuclei will combine, and it will become, for a time anyway, a single cell with two complete, alien genomes, ready to dance, ready to multiply. It is a Chimera, a Griffon, a Sphinx, a Ganesha, a Peruvian God, a Ch'i-lin, an omen of good fortune, a wish for the world.[lxvii]

In the body of the article, Harris presents a more complex view in relation to the phenomenon of cell fusion, and the breach not only with the essentialist view of a species but also with the sanctity of the human as a separate and unique species: ‘What caught the imagination of journalists was the fact that species barrier could be crossed. This seems to have shaken some deeply cherished assumptions about the uniqueness of man, and many of the newspaper reports showed striking similarities with the paintings of Hieronymous Bosch.’[lxviii]

Cell fusion among different species and different families along the evolutionary tree has been carried out successfully since the 1970s. One example, the fusion of *Xenopus* and carrot cells, was written about in 1978:

> Cultured *Xenopus* cells have been induced to fuse with carrot suspension cell protoplasts using PEG at high pH in the presence of high Ca^{2+}. Ultrastructural observations confirm unambiguously that the fusion bodies seen by light microscopy are animal/plant cell heterokaryons. The cytoplasmic events occurring in these *Xenopus*/carrot fusion products during the first 48 hours of culture provide evidence for their viability.[lxix]

There is evolving research of ‘interspecies mixing’ in which stem cells from one species are transplanted into foetuses of other species. The technology involves the use of embryonic stem cells, which are isolated from the inner cell mass of a very early human embryo (called a blastocyst), that have the ability to differentiate into any other kind of cell. These cells are then transplanted into other animals’ foetuses.

Such experiments have been widely discussed recently in the UK following a proposal for the fusion/nuclei transfer of human and cow cells for the production of embryonic stem cells. As the heading to an article in *Nature* states: 'Avoiding a chimaera quagmire: Researchers need to take the initiative in addressing a controversial and urgent ethical issue: under what circumstances should the fusion of cells of animals and humans be permitted?'[lxx] However, the debate tends to be anthropocentric and does not engage much with the ontological issues generated by the biotech/biomedical project. This is because the ethical question discussed is the sanctity of the 'human' from an assumption that there is an obvious and agreed upon entity defined as such. Issues concerning the fuzzy and problematic definition of a species and the human being an integral part of the animal kingdom (a fact that makes the technology discussed possible!) are not discussed.

Human and non-human animal cell fusion (mainly in the form of hybridomas) has been known and used for scientific research and biotech production since the mid-1970s. In 1975, César Milstein and Georges Köhler at the Laboratory of Molecular Biology at the University of Cambridge developed the production of therapeutic antibodies using hybridoma – research that won them the Novel Prize for Medicine in 1984. Why then, 34 years later, does a respected scientific publication like *Nature* consider it urgent to deal with the ethical issues of cell fusion between human and non-human animals? Maybe, *Nature* realises that it is now crucial to engage with the very fundamental questions underlying the notions of biological taxonomy. However, as I have mentioned above, this discussion seems still to be 'bogged down' with traditional perceptions and understandings of what is a human, which prevent considerations that are more thorough (and yes, more uneasy and risky to these traditional values) about ontological theories concerning life.

Another intriguing example is of the Stanford University researcher, Dr Irving L. Weissman, who created mice containing 10% human stem cells, and who is applying to create a mouse that will contain 100% brain nerve cells derived from human stem cells. Weissman explains: '…making mice with human cells could be an enormously important experiment', but if conducted carelessly it could lead to outcomes that are 'too horrible to contemplate'. As an example, there is the very slight possibility of human cells migrating into the mouse somatic cells to create sperm or egg. Once a male and female mouse with human somatic cells mate, there is the possibility of a human embryo developing inside a mouse body.

These days, tissue and cell cultures are being used for many applications; they are used as a scientific tool (in many cases as a 'model' for the whole organism), for therapeutic ends (from medical devices – tissue engineering as defined by the FDA – to the production of antibodies, and other biological agents), as a diagnostic tool (such as in the field of virology), in reproductive technology and in stem cell research. Tissue culture is also used in contexts other than the bio-medical. For example, scientists at MIT are trying to develop mini-bioreactors with living cells as bio and chemical sensors[lxxi] (the modern canary), in UC San Diego there are attempts to grow living muscle to drive miniaturised machines[lxxii], and in the last twelve years artists have been using tissue culture as an art medium.

The Tissue Culture & Art Project intentionally explores the field of 'species mixing' on the levels of cells and tissues. Here visceral collapses of the border between different types of animals (including humans) are common occurrences. The creation of partial life and semi-living entities is an attempt to establish a reference to a new kind of body in its own right – an extended body. It is a body in its own right because, while taken from a living body, this former fragment becomes part of another order to the one it occupied in the organism body. It has even been suggested that such Extended Bodies, as we call them, should be discussed as a new species, as in the case of the *Helacyton gartleri*.[lxxiii]

The Extended Body

> Naturally, when they are parts of a living body the cells are disciplined, they do not wander about where they like, growing actively and reproducing themselves, as the cells in culture do. An organ such as the brain or liver is like the City during working hours, a tissue culture is like Regent's Park on a Bank Holiday, a spectacle of rather futile freedom. [lxxiv]

A rough estimate would put the biomass of living cells and tissues which are disassociated from the original bodies which once hosted them in the thousands of tons. In addition, there are many tons of fragments of bodies (cells, tissues, organs) that are maintained in suspended animation in cryogenic conditions, all of which requires an intensive technological intervention to prevent transformation to a non-living state. This type of being (or semi-being/semi-living) does not fall under current biological or even cultural classifications. In using symbolic means to suggest that the extended body is a category of life in its own right, artists deliberately aim to destabilise conventional perceptions and classifications of living beings. Much of this living biological matter can, in theory, be co-cultured, and fused (cell fusion), or shares with each other its sterile environment (in varying degrees of success). Age, gender, race, species and location do not play the same roles in the extended body as with other living bodies. This means that, in theory, every tissue in every living being has the potential to become part of a collection of living fragments brought together as an extended body.

Thacker asks: 'Can there be a politics that effectively takes into account these nonhuman actants, entities that are much more than inert objects and yet much less than autonomous organisms? How can we keep from falling into the too easy habit of reducing all actants to agential origins (e.g., the notion that, yes, there are these nonhuman machines, but ultimately humans design and operate them)?'[lxxv]

The extended body can be seen as an amalgamation of the human extended phenotype with tissue life – the fragmented body that can only survive by technological means, and be something more than human life. However, whatever one decides the extended body actually is, and how independent it is as life, TC&A uses it symbolically as a unified body for disembodied living fragments, an ontological device that draws attention to the need for re-examining current taxonomies and hierarchical perceptions of life. In this respect the extended body is by no means fixed, it is rather a soft, artistic and conceptual view of the subject of technologically mediated and augmented life. The Extended Body is a device that allows TC&A to symbolically present the bond humans share with all living beings.

Chapter 2 – The Ecology of Parts: The History of Partial Life

The history of partial life is both a story of scientific and technological advances, and one that tracks the evolving debate around biotechnology and larger ethical issues associated with it. It is also immersed with epistemological and ontological issues concerning fragmentation of living entities and their different integrations into the larger living and constructed ecology. Therefore, it is a story of our culture trying to make meanings out of these changes through artistic expression.

The somewhat limited story told in this thesis emphasises two narratives. One is concerned with the shifting perceptions and the use of metaphors to explain the ‘nature’ of fragments of life. The other is concerned with their position within the life continuum and in relation to the bodies they were derived from, as well as the new techno-scientific body they have been delivered to.

Before Tissue Culture

The realisation that communities of cells can be sustained alive and even grown externally to the body if given the appropriate conditions is not just the result of scientific advances. It also requires cognitive shifts in regard to what is a body, or more appropriately, what constitutes a body, as well as new interpretations of what life is. The first shift required an ‘assault’ on the notion of the singular body. In western philosophy, which is based on dialectics and dichotomies, it arose from the realisation that an individual body can be fragmented into smaller entities or semi-beings and that these 'collectives' have complex and autonomous relations even when they are completely disconnected from their host body. Hence, the divide between a body and its environment is not a sealed one but rather is diffused by membranes, and furthermore the divide between a whole body and parts of body is gradual and enables the fuzzy zone of the semi/partial living. The earliest expressions depicting such fragmentation (which can be seen also as leading towards symbolic continuation and harmony with the rest of the living world) can be seen in myths of half-human/ half-animal creatures. The first known painting of a man, a cave painting at Lascaux, depicts him with an animal head. Tribal totemic cultures suggest continuities between human and animal worlds, however it does not suggest the possibility of a fragment of a body which is not a fully living organism; a semi-living dependent on the human techno-scientific project for conception and survival. This came much later with the birth of the modern Prometheus, Frankenstein.

White dates the origin of the idea of tissue culture back to Aristotle (340 BC) and Theophrastus (320 BC), because they described animals and plants as being made up of unified elements: blood and sap, flesh and fibre, nerves and veins, bone and wood. Malpighi (1675) and Grew (1682) theorised that these elements are literally 'woven' (*tissé*) into tissues of still finer elements.[lxxvi]

In 1667, Robert Hooke, using one of the earliest microscopes, observed cell structures in a thin slice of cork. He coined the word 'cell' as the structure reminded him of a honeycomb. As observed by Canguilhem, already at this point the underlying notion of a body as a collective of cells has been raised by the choice of the word 'cell'. Canguilhem asks: ‘Yet who can say whether or not the human mind, in consciously borrowing from the beehive this term for a part of an organism, did not unconsciously borrow as well the notion of the cooperative labour that produces the honeycomb?’ He then answers: ‘What is certain is that affective and social values of cooperation and association lurk more or less discreetly in the background of the developing cell theory’.[lxxvii] Hence the notion of the cell was intrinsically linked to a larger body, the way an individual citizen is linked to her social community.

The second important development was the realisation that the cell was in fact an autonomous agent, as if a ‘little body’ by itself. In making this claim, Wells and Julian Huxley argued that the term ‘cell’ was thus misleading, and expressed their disapproval in a somewhat emotive way in their book, *The Science of Life: A Summary of Contemporary Knowledge about Life and its Possibilities* (1929):

> The word ‘cell’ is a most unfortunate word in this connection. That is why the triplex writer has put fastidious inverted commas about it in the last two sentences. He dislikes handling and using it… and many people at the outset of their biological reading are misled, therefore, into imagining that our living tissues have a sort of honeycomb structure. Nothing could be farther from the reality. The proper word should be ‘corpuscle (little body) and not cell at all.[lxxviii]
>
> We may compare the body to a community, and the cells to individuals of which this vast organized population is composed…

> It is very important to realize that this is not a merely allegorical comparison. It is a statement of proven fact, for – we resort here to the stress of italics – *single cells can be isolated from the rest of the body, and kept alive*.[lxxix]

The botanist Schleiden (1838) and zoologist Schwann (1839) were the first to formulate this modern 'cell theory'. Schwann wrote:

> One can thus construct the following two hypotheses concerning the origin of organic phenomena such as growth: either this origin is a function of the organism as a whole – or growth does not take place by means of any force residing in the entire organism, but each elementary part possesses an individual force. We have seen that all organisms consist of essentially like parts, the cells; that these cells are formed and grow according to essentially the same laws; that these processes are thus everywhere the result of the same forces. If, therefore, we find that some of these elementary parts…are capable of being separated from the organism and of continuing to grow independently, we can conclude that each cell…would be capable of developing independently if only there be provided the external conditions under which it exists in the organism.[lxxx]

Roux (1885)[lxxxi] isolated a chick medullary plate and kept it alive for some days in saline solution. Arnold (1887)[lxxxii] was 'cultivating' leucocytes and other cells by soaking very thin slices of elder pith in aqueous humor of the frog. These were then implanted under the skin or in the peritoneal cavity of frogs where they were soon invaded by leucocytes.

He then removed the slices of pith at intervals to dishes of saline solution or of aqueous humor and observed that the leucocytes migrated from the pith into the nutrient, where they survived for some time. The first successful 'tissue culture' was grown by Ross Harrison (1907, 1910) when he cultivated the neuroblast of the frog in clotted lymph and observed the growth of the fibrillae from the central body.[lxxxiii] Because Harrison was able to grow and proliferate cells rather than merely sustain fragments of a body, he can legitimately claim to be the first to have successfully 'created' partial life. However, Harrison had devised the method only to solve a particular problem, and once this was done he made no attempt to develop it further.

Harrison experimented with isolated pieces of living frog embryonic tissue and grew them in hanging drops of lymph enclosed in glass slides. His aim was to view and learn about the growth of a neuron cell over time.[lxxxiv] The experiment was designed for the purpose of solving a specific 'riddle' which puzzled neuroscientists at the time; the debate whether an axon grows from its stem (like a fingernail) or from its end part. The then current method of histology, in which the cells are fixed (killed), dyed, mounted on a slide as a two-dimensional specimen, did not allow such an observation. It was Harrison's technical solution to a problem of representing change over time in living biological matter that led to the technique of tissue culture. Harrison's ability to sustain life in in-vitro conditions did not come as a result of a development of a new technology but rather as shifts and combinations of ideas: 'Any originality, therefore, that may be claimed for this work is due to combination of ideas rather than to the introduction of any particularly new device' (Harrison, 1913).[lxxxv] Harrison though, being more interested in finding the solution for a specific problem, did not see the long-term consequences and philosophical shifts of this method. In retrospect, he said:

> …it seems rather surprising that recent work upon the survival of small pieces of tissue, and their growth and differentiation outside of the parent body, should have attracted so much attention, but we can account for it by the way the individuality of the organism as a whole overshadows in our minds the less obvious fact that each one of us may be resolved into myriads of cellular units with some definite structure and with autonomous powers.[lxxxvi]

Harrison did not make the mental shift that would enable him to see the long-term implications of the technique he developed not only in the scientific sense (tissue culture is a technique that is widely and extensively used for many purposes from tissue engineering, stem cells research to therapeutic cloning as well as other pharmaceutical techniques), but also in the sense of its radical implications to conventional ontological understandings of life and bodies.

Montrose Burrows (1910) studied with Harrison and introduced the idea of substituting blood plasma for lymph in the cultivation of chick cells. Together with Alexis Carrel (1910 onwards) they developed the use of embryo extracts as growth-promoting nutrient and elaborated the methods for growing a great variety of animal tissues. Carrel continued to explore the technique of tissue culture as the beginning of a wider investigation into the notion of partial life.

Alexis Carrel

The person who made in-vitro life a central object of scientific (and beyond) interest was Dr Alexis Carrel. By prolonging the life of body parts inside a new artificial body, he showed that cells in culture were almost a new life form. Eduard Uhlenhuth wrote in 1916: ‘Through the discovery of tissue culture we have, so to speak, created a new type of body on which to grow the cell’.[lxxxvii]

Harrison’s interest lay in observing differentiation and movement. However Carrel’s was directed towards observing ‘life’ and its essential characteristics – growth and reproduction – outside the body, as part of his continuing interest in the field of organ transplant, suturing and surgery techniques. Carrel was the first to look at the technique of tissue culture and growth of cells/tissues outside of the body as a central object of interest separated from other techniques – a technology, that he believed, would enable him to capture the ‘essence’ of life and by that not only extend life but make immortality possible.

Carrel was a well-known and respected scientist who advanced the medical field in new techniques of suturing arteries as well as transplantation and tissue culturing, and won the Nobel Prize for Medicine in 1912. He was also a complex and controversial figure – a person who, unlike Harrison, pushed the ontological implications of his discoveries to some extreme and morally questionable places, far from its strictly bio-medical or even scientific realms into ontological, political and ethically questionable ones as will be later discussed Carell published a best seller book as well as presented enthusiastically attendant public lectures, a very ideological perspective on socio-political issues.

Carrel's obsession with prolonging life led him to consider what the absolutely minimum essential organs might be for the progression of life through experiments in transplantation and xenotransplantation. According to Landecker, 'Carrel had the desire to access the internal life of the body…an artificial, technological, transparent body that would take over the functions of the obfuscating animal body that had been cut away'.[lxxxviii] In his visceral organism (or reduced organism) experiments, the most explicitly stated goal was to attain "autonomous life" for isolated organs or systems of organs…. maintain the life of organism "without itself"…to make life of living tissues an integral part of a technological system that would both make life processes visible and suppress death'.[lxxxix] Needless to say, these experiments involved invasive vivisection procedures. Together with the famous aviator Charles Lindbergh, he devised the Organ Perfusion Pump, a mechanical pump for circulating nutrient fluid around large organs kept alive outside of their host body. This was successful in keeping animal organs alive for several days or weeks, but this was not considered long enough for practical application in surgery.[xc] To describe the use of the perfusion pump, Carrel and Lindbergh jointly published *The Culture of Organs*[xci] in 1938.

In the TC&A project work, *Victimless Leather* (see appendix for description) we have designed a perfusion pump chamber for the semi-living coat to grow in, loosely based on

Carrel and Lindbergh perfusion pump. Several reasons led us to adopt this strategy. Technically, the system of feeding the cells through a mechanical dripping method proved to be useful in a situation in which a laboratory is not constructed in the gallery and the cells cannot be fed manually. Aesthetically, both systems (Carrel and Lindbergh's as well as TC&A) are geared for better viewing of the semi-living entity by the external audience (or scientist). The pumping system also depicts the aesthetics of the alchemical associations attached to tissue culture in the early eighteenth century. We refer to the perfusion pump chamber as the Techno scientific body in which the semi living entity is hosted and recieveing all the nourishment and protection a body provides. The techno-scientific body is not limited only to tissue constructs but in its larger context refers to all life (including our own) which are increasingly further dependent on the techno-scientific project for its articulation (what type – or value - of life) and survival (sustained alive). As will be discussed at length in a later stage of the thesis, the *Victimless Leather* project is an ironic look at the victimless utopia offered by technology, or in general terms, a vision of a utopian future promised through scientific and technological 'progress' (an idea propagated by both Carrel and Lindbergh, which obviously led to their technological apparatus design). [Figure 3 & 4]

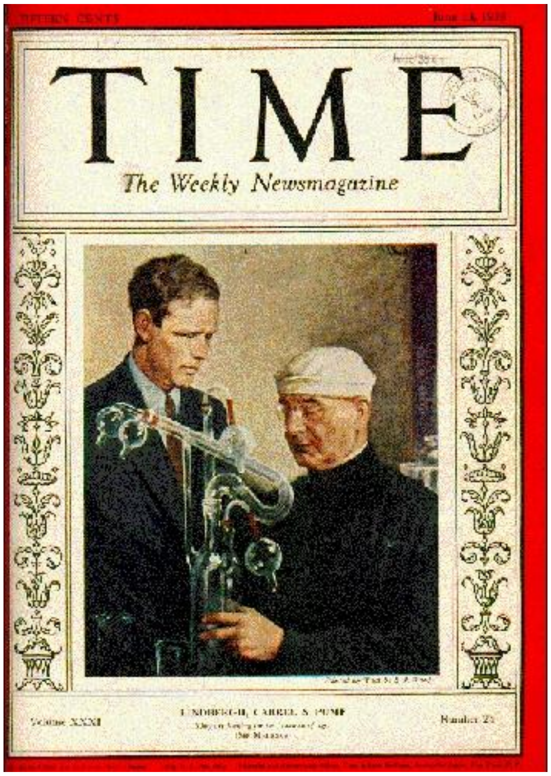


Figure 3

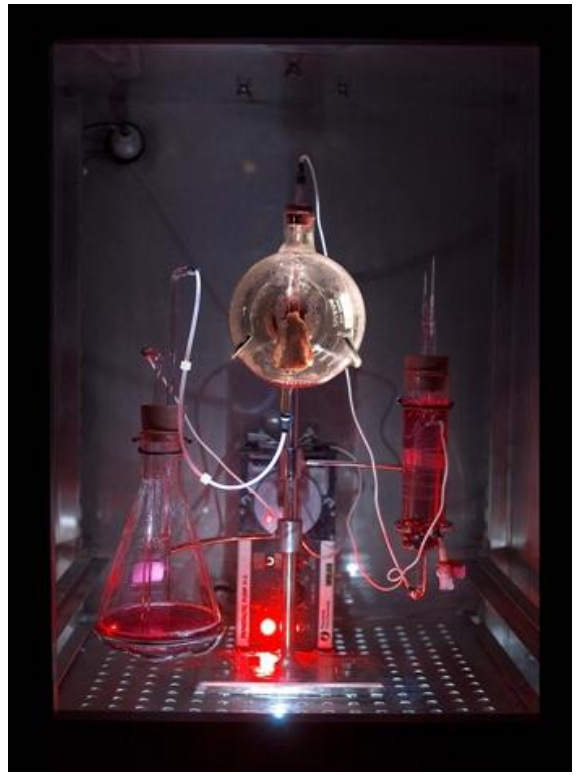


Figure 4

Carrel's affiliation with Lindbergh, the great American hero, extended to a shared ideology of eugenics, which he outlined in his 1935 publication, *Man, the Unknown*.[xcii] A conviction view of science, combined with religious, even mystical declarations, led him to speculate on the great problems of human destiny. Carrel theorised that mankind could reach perfection through selective reproduction and the leadership of an intellectual aristocracy. Through scientific enlightenment humanity will be free from disease and will gain long life, and spiritual advancement. Carrel suggested gas chambers as a solution to eradicate unwanted elements in society.[xciii] 'Eugenics', Carrel wrote in the last chapter of *Man, the Unknown*, 'is indispensable for the perpetuation of the strong. A great race must propagate its best elements'[xciv]. The book, a worldwide best-seller translated into nineteen languages, brought Carrel international attention.

The Laboratory

Carrel was not an innocent player in the development of the myth around himself. He produced elaborate theatrical performances, to the point that he was also accused of being 'a hindrance rather than a positive force in the further development of tissue culture after its initial establishment'.[xcv] This was also due to Carrel's eccentric, mystic attitudes towards 'life'; Carrel's practice and laboratory were heavily involved in rituals. While heading the laboratory for experimental surgery in the Rockefeller Institute in New York, he designed it to conduct his experiments in a unique way. P.R. White (1954) writes:

> I have sought to strip from the study of this subject its former atmosphere of mystery and complications. The grey walls, black gowns, masks and hoods; the shining twisted glass and pulsating coloured fluids; the gleaming stainless steel, hidden steam jets, enclosed microscopes and huge witches' cauldrons of the 'great' laboratories of 'tissue culture' have led far too many persons to consider cell culture too abstruse, recondite and sacrosanct a field to be invaded by mere hoi polloi.[xcvi]

A 1954 article in the *Collier Magazine* described Carrel as, 'A brilliant man… Dr. Carrel made valuable contributions to the science of tissue culture'.[xcvii] Yet he is considered an eccentric mystic and fascist, or at least a Vichy-collaborating eugenicist.[xcviii] His contemporaries criticised him on the grounds that he treated tissue culture as an occult art (he insisted his assistants wear flowing black robes and hoods in the laboratory) and promised all kinds of advances in the conquest of disease – promises he was never able to keep because of the limited techniques then used. 'The whole tissue-culture field suffered in the 1930s because of his eccentric behavior'.[xcix]

Carrel had a 'colourful' persona. He was accused of being 'a vain man who stole the limelight for tissue culture when it did not properly belong to him'.[c] His eccentric personality was very much entangled in the original social/artistic perceptions of the tissue culture field. Carrel together with the popular press assisted in mythologising tissue culture, as illustrated by the headlines in the *Daily Express* when Carrel visited London in 1924: *Alive without a body, heart that throbs by itself. Twelve years. US wonder surgeon here*.[ci] What Carrel sought was a partial life, or rather the essence of life or pure life, that could be grown independently by an artificial 'body' – a technological device. By giving a scientific technique a theatrical edge, whether through the use of mise-en-scene, performative elements, etc., Carrel was attempting to ignite human imagination to the 'nature' and possibilities of these new 'lives'.

It can be argued that the Hollywood version of Dr Frankenstein was based on Dr Carrel through the laboratory aesthetics, rituals and the mythical stories propagated about him, as well as his belief in a technological utopia that leads to conceptual (in Carrel's case) disastrous consequences. Carrel was called a 'modern Frankenstein'.[cii] On 27 March 1910, 'ten days after the release of Edison's *Frankenstein* – half a page of the *New York Times* Sunday edition was devoted to Carrel's success at what we would now call open-heart surgery on cats and dogs…He stitched a damage vein in a newborn's leg to a major artery in her father's wrist, thus creating a live transfusion that, according to the article, saved the life of the baby'.[ciii]

Was it the realisation that life is much more complex than previously thought which led Carrel to mysticism? What lead him to Eugenics? One can argue that the experience of developing partial life forms, which contradicted the Christian/humanist perception of the whole body, drove him to engage with the occult. In short, the ontological questions thrown up by Carrel's scientific experiments ironically resulted in his mystic and eugenic tendencies. However, rather than looking at tissue culture or partial life as a metaphor for the pure and perfected life, TC&A explores partial life (or semi-life) as a hybrid, dependent and far from perfect entity.

While the TC&A project abhors Carrel's mysticism and belief in eugenics, and considers his aesthetic accomplishments the poor cousin of his science, his work cannot but help set the tone for aesthetic engagements with tissue culture. It is also a constant reminder that the sciences, and especially the life sciences, do not operate independently of the society and culture they stem from. For this reason, the design of the TC&A laboratory, used in the 2003 exhibition *L'Art Biotech* in Nantes, and described in detail below, referenced Carrel's laboratory where the first successful tissue culture experiments were performed in 1910.

Because TC&A is an artistic rather than a scientific collaboration, it is intensely interested in the wider history of the development of tissue culture technique and its different articulations, and makes many references in its work to this history. Of particular importance to TC&A have been the scientists Alexis Carrel and Honor Fell, because these two researchers were driven by their investigations and discoveries to ask fundamental ontological questions about the nature of semi-life.

As opposed to Carrel's ideology, in which he proclaimed: 'A great race must propagate its best elements', and by default eradicate those elements perceived as bad or 'weak', TC&A 'forces' the audience to care for the defenceless, the most bare life, or semi-life – an aggregation of cells. TC&A, through its ritualisation, seeks to create an intellectual and emotional situation in which the act of caring or neglecting life, even partial life, is not devoid of self reflection regarding the act and what it symbolises.

Honor Bridget Fell

Tissue culture came to Great Britain when Thomas Strangeways made the technique the sole focus of his laboratory (the laboratory was founded in 1905). In the early 1920s, Strangeways decided to focus the laboratory's activities on the microphysiology of disease and for that he introduced the new techniques he had learned from Dr Carrel – tissue culture. With his death in 1926, Dr Honor Bridget Fell became its director (by then the laboratory was funded by the Medical Research Council of Great Britain).[civ]

Fell independently developed a quite different type of investigation of animal materials. Whole embryonic 'organules' such as bones, teeth, eyes, and glands were grown in relatively large volumes of nutrient in simple watch glasses and their metabolism was studied. This approach is different to Carrel's single-tissue pure-line studies.

The British engagement with tissue culture presents a different approach to the field not just scientifically but also in perception and ritualisation. The reasons might partly stem from the fact that the head of the tissue culture lab, called (when considering the wider context of tissue culture – somewhat poetically) 'Strangeways', was a woman. In her laboratory, the personal relationships with the cultures were openly discussed, and she coined the term 'the tissue culture point of view' in an attempt to explore partial life from the perspective of the fragment of the body in the dish. In that sense the fragment of life was not only transformed to be some sort of semi-being but furthermore it was anthropomorphised.

This empathic, even somewhat romantic, approach to tissue culture created a different kind of ritualisation; more of a nurturing one, as illustrated by Squier in her article, 'Life and Death at Strangeways; the tissue culture point of view'.[cv] Dr Fell, a known and credible scientist, was able to take the scientific method of tissue culture beyond the methodology and scientific discourse into the philosophical realm, discussing tissue culture as a method which drew attention to the permeable border between life and death, the embryonic and cancerous, the relations between humans and other animals and more.

Tracing back through the history of tissue culture, it is noticeable that the relations between the tissue culturalist and the tissues growing in vitro were more than just an objective experiment.

> Tissue culture often suffers from its admirers. There is something rather romantic about the idea of taking living cells out of the body and watching them living and moving in a glass vessel, like a boy watching captive tadpoles in a jar.[cvi]

'The writings on tissue culture reveal a tendency to identify with the tissue culture as subjects rather than objects of study.'[cvii] However, '…the Strangeway's researchers had no access to the point of view of the culture itself. The point of view they articulate is that of the tissue culturalist.[cviii] Though this position might skew the scientists from their objective view it also "encouraged" scientists to draw on their imagination as an aid to epistemology'.[cix] And in relation to this thesis, Honor Fell offers a small and symbolic gesture towards a post-anthropocentric view, in which the point of view taken is that of the fragmentary and dependent entity.

The TC&A Semi-Living Worry Dolls

In *The Worry Dolls* installation (originally, *Tissue Culture and Art(ificial) Womb*) in the Ars Electronica Festival (Linz, Austria) in 2000, TC&A exhibited semi living art for the first time. The 'worry dolls were handcrafted from biodegradable polymers, PGA mesh, P4HB, PLGA and various surgical sutures. The dolls are approximately 10 mm tall by 7 mm wide by 5 mm deep. The polymer constructs were sterilized using ethylene oxide (ETO) at 55°C for two hours; we seeded the dolls with McCoy Cell Line (derived from human, now classifed as mouse endothelial cells, and used in virology studies). We statically cultured the dolls for 14 and 21 days in a 37°C/5%CO2 incubator. We then moved them to the Synthecon RCCS ID4 (a rotating bioreactor that provides conditions of micro gravity) for the duration of the exhibition. The tissues were cultured until proliferated cells largely covered the polymer surface, growing into the porosity of the polymer scaffold.[cx] It was the first time we were able to take the Semi-Living outside of the laboratory and into the gallery while they were still alive. This meant constructing a fully functioning tissue culture laboratory in the gallery. In installations, TC&A incorporates the laboratory as part of the installation to present the environment in which the Semi-Living entities can thrive. This also enables us to perform the duties needed to care for the Semi-Living sculptures while the exhibition is being held, in a way that enables the audience to observe and comprehend the commitment and responsibilities that we have towards the living systems we create. This involves the construction of an enclosure and a tissue culture laboratory, including: a sterile hood, an artificial environment for the Semi-Living entities (a bioreactor), a microscope, laboratory consumables and compliance with the safety requirements of physical containment level two laboratories. All are designed/constructed as an integral part of the conceptualisation and theatrical intentions of the installation. Thus TC&A continues the long tradition of ritualisation when growing/dealing with partial life, as seen with Carrel and Fell.

The Semi-Living Worry Dolls were grown from McCoy cell line, Mouse 3T3 cell line (for the *BioFeel* exhibition, Biennale of Electronic Arts, Perth, Western Australia, 2002) and frog XTC cell line (*L'Art Biotech* exhibition, Nantes, France, 2003) over/into biodegradable polymers and surgical sutures in the shape of small doll-like figurines [Figure 5].

Figure 5

To quote from the exhibition statement:

The Semi Living Worry Dolls are created as [an] iconic gesture for the audience to care for and express their innermost worries and anxieties. We chose to grow modern versions of the legendary Guatemalan Worry Dolls in the artificial womb (a bioreactor).

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

We decided to 'give birth' to seven dolls, as we are not kids anymore. They may not be allowed to have more than six worries but we surely have. The genderless, child-like dolls represent the current stage of cultural limbo. We gave them alphabetical names as we think that we can find a worry for each letter of the language that made us what we are now. While working on the Tissue Culture & Art Project, people expressed to us their anxieties. These dolls represent some of them. You are welcome to find new worries and new names… You will be able to whisper your worries to these dolls and hope that they will take these worries away.

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

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

Doll C = stands for Capitalism, Corporations

Doll D = stands for Demagogy, and possible Destruction.

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

Doll F = is the fear of Fear itself.

G = is not a doll as the Genes are present in all Semi Living dolls.

Doll H = symbolizes our fear of Hope…

An exhibition as part of Ars Electronica 2000, themed under the title *Next Sex*, explored the future of sex and was presented in Linz, Austria, the city Hitler proposed during his reign to be the cultural capital of the Third Reich. Furthermore, in 2000 there were concerns over the rise of Austria's far-right Freedom Party and its leader Joerg Heider who had entered into a coalition with Austria's government. Presenting the first living tissue engineered sculptures in such a context prompted us to create a piece that exposed our worries (as well as other people's worries) in relation to the use of biotechnology in a contemporary political context. The *Semi-Living Worry Dolls* installation encompassed an array of 'worries' from the political and social to the personal.

The *Semi-Living Worry Dolls* project can also be seen as a way to examine the complex relations formed between the people who manipulate partial life and their creations, and the rituals they have devised to deal consciously and unconsciously with the intricacies involved in dealing with partially living beings. To this end TC&A created a 'worry machine' for people to express their worries and anxieties to the Semi-Living worry dolls. A computer station with the 'worry machine' application become an integral part of this installation and it remains a feature in the TC&A web site. This ever growing document of worries written to the semi living worry dolls reveals a variety of cultural but mostly personal anxieties which exceeded our expectations. It was as if people treated the worry dolls differently to ordinary dolls, presumably because they knew they were sort of alive; they became a kind of voodoo doll.

Anthropocentric attitudes, as expressed in Fell's 'tissue culture point of view', are also prominent towards the Semi-Living sculptures. Examples can be found in some of the worries posted on the 'worry machine' on the TC&A web site, as well as in the interactions with the TC&A installations. People, whether members of the public or art critics, tend to fall into the assumption that the cells we are using are human cells. In regard to the *Worry Dolls* project, we have been criticised for using human skin to grow worry dolls. In our writing we have said that we used skin cells, but never specified the origin of the cells (they are mostly epidermal cells from mice). Such concerns directly address the ethnocentric and anthropocentric attitudes that the project raised.

<u>The TC&A Laboratory in Nantes, France 2003</u>

[Figure 6]

The laboratory is shaped as a hemisphere (avoiding the usual square-shaped laboratory) with dark grey wall colour. Viewing of the interior of the lab is possible through six 50 cm diameter round portholes windows (corresponding in style to the round bioreactor vessels, as well as to the building and doors in which the exhibition *L'Art Biotech* (2003) was performed). A person of average height has to bend slightly and peep through the different windows in order to see different aspects and different angles of the 'ritual'. There is no general view of the interior of the lab, but purposely it is semi-concealed and fragmented, implying that there is more happening than what is revealed to the eyes, as the actual technique is only one layer of the experience that is transferred through the laboratory.


© AXEL HEISE PHOTOGRAPHIE > SYMBIOTICA / TC&A "Disembodied Cuisine", le lieu unique, 2003.

Figure 6

In the 2003 installation, the TC&A artists/carers/nurturers (and in this specific installation also farmers and cooks) wore matching grey laboratory coats (though as the installation dealt with growing/constructing Semi-Living Steak, the design of the gown was a hybrid of a laboratory coat, a mechanic's overall and a chef's jacket). Every day or so they would enter the laboratory dressed in their specially designed lab coats; put on latex gloves and begin their caring duties for the Semi-Livings. This was done quietly and efficiently. Usually there were a couple of the artists in the lab (maximum three and sometimes only one person).

In the middle of the laboratory, where the large sterile hood was positioned, one of the artists would perform the following activities: turn on the sterile hood, which in response would hum and shine a bright light (replacing the blue/purple UV light); clean the surface of the stainless steel sterile hood with ethanol and sterile tissues; clean and arrange the tools needed for the feeding – sterile tweezers, sterile pipettes, sterile 20 ml syringes, plastic containers filled with bleach for waste, ethanol, tissue box and a stand for the nutrient tubes.

The next step involved taking the nutrient from the fridge located in a small room attached by a passageway to the laboratory. The passageway walls were clear and the audience could follow some of the activities and see other instruments positioned in the small room. The redish coloured nutrient media inside a clear bottle, as well as the brown serum, were put on a stainless steel medical trolley and wheeled towards the sterile hood. In the sterile hood, the artist transferred the nutrient media into smaller clear tubes and added the appropriate amount of serum to each one of them using pipettes.

The Semi-Living sculptures were then brought by the artist to the sterile hood. The semi-livings were growing inside the round vessels which are slowly rotating in the bioreactor. The Bioreactor faced one of the peeping windows to give the audience a better view. The Semi-Living sculptures were always taken inside the vessel (to keep their sterility) which was unscrewed from the bioreactor mechanical device. They were taken into the sterile hood where their nutrient media was replaced using two syringes.

There was no direct touch. The artists' hands were always covered with gloves and mediated by the sterile tools whether pipettes, syringe or others.

At the end of the feeding, the vessels were screwed back to the bioreactor and the rotating device turned on again. In the case of the frog cells (XTC cell line) the cells were kept in room tempratures as the cells are taken from a cold blooded animal. In case of cells taken from a mammalian source, the bioreactor was then covered with the acrylic blanket that maintained a constant temperature environment of 37 degrees Celsius (or alternatively taken into the incubator where a small camera was positioned to enable the viewer to see the semi-living sculptures rotating via a screen). The nutrients were taken back to the fridge. The tools were cleaned and stored in the appropriate shelves. The consumables and waste were thrown into a special wastebin labelled with a 'biohazard waste only' label (this was taken, at the end of the show, to a nearby laboratory for proper disposal). The sterile hood surface was cleaned with ethanol; the sterile hood turned off; the bright white light replaced with a blue UV light; the slot covered with the stainless steel cover. The artists took their gloves off and threw them into the appropriate wastebin. They would then wash their hands in the sink with soap and plenty of water. They took off their lab coats and left the lab via the corridor, where they hung their lab coats on a dedicated hanger. They stepped out of the lab into the audience, and waited quietly for people to approach them.

Tissue culture and literature

> If Dr. Strangeway had lived in the time of Julius Caesar and set a series of sub-cultures growing from a scrap of him, fragments of that eminent personage might, for all we know to the contrary, be living now.[cxii]

The idea of the body consisting of potential partial lives that can be grown independently of their host infiltrated the field of literature around the same time. H.G. Wells, writing a short journalistic meditation, 'The limits to individual plasticity', printed in the *London Saturday Review* in 1895, 'We overlook only too often the fact that a living being may also be regarded as raw material, as something plastic, something that may be shaped and altered'. In this article, Wells wondered just how far shape and mental superstructure in one individual could be altered while the 'thread of life' was kept going. Somewhat similar to Carrel's concerns, the search for the essential bare life and its versatile epi-body were a fascination. His answer, which only months later was put in the voice of Dr Moreau, is that the living body of an individual could hypothetically be so 'extensively recast as even to justify our regarding the result as a new variety of being'.[cxiii] Wells in a sense was creating a unique teratologist discourse, the discourse of monstrosities and abnormalities predominantly through birth defects, rather than the discourse of partial life.

In an article about biotechnology and speculative fiction, Stableford explains: 'Two scientific advances made in the first quarter of the 20th century provided important stimuli to speculative thought. These were the tissue culture experiment carried out by Alexis Carrel, Ross Harrison and others, and experiments employing X-rays to induce mutations in fruit-flies carried out by H. J. Muller and others. It is not surprising that Muller's revelations became the parent of vast numbers of stories in which animals and humans were mutated into monsters, but there is some cause for surprise in the fact that the speculative spin off of the tissue-culture experiments was also uniformly anxious.'[cxiv]

Judging by the literature of the day, it seems that there was more anxiety about the use of parts of living complex organisms than that of the whole body. The sustenance and manipulation of parts seems to be more disturbing and confronting because it puts into question our sense of the inseparable whole living being. If we can sustain parts of the body alive, manipulate, modify and utilise them for different purposes, what does it say about our perceptions of our bodies, our wholeness and our selves?

In the 'The Tissue Culture King', written in 1926, Julian Huxley[cxv] reflects/articulates some of the anxieties surrounding early tissue culture experiments. 'The Tissue Culture King' is a story about a western scientist, Hascombe, who is captured by an African tribe. In order to save his life, he employs his skills in the service of the African king. He decides to merge scientific principle and techniques with the religious tendencies of the tribe. Hascombe then employs tissue culture techniques to create 'The Factory of Kingship or Majesty, and the Wellspring of Ancestral Immortality'.[cxvi] The idea is to culture parts of the kings' (or other ancestors') bodies and by that increase the biomass of the king, enable the people of the community to own parts of the king, and to physically nurture, care and worship it. Furthermore, this technique will 'increase the safety, if not of the king as an individual, at least the life which was in him, and I presumed that this would be equally satisfactory from a theological point of view.'[cxvii] Hence, the fragment stands for the whole.

There is a direct reference to Huxley's impressions from Dr Carrel's personality, his laboratory and its tissue culture rituals:

> "If you prefer a more prosaic name", said Hascombe, "I should call this the Institute of Religious Tissue Culture." My mind went back to a day in 1918 when I was taken by a biological friend in New York to see the famous Rockefeller Institute; and [at] the word tissue culture I saw again before me Dr. Alexis Carrel and troops of white-garbed American girls making cultures, sterilizing, microscopizing, incubating, and the rest of it. The Hascombe Institute was, it is true, not so well equipped, but it had an even larger, if differently colored, personnel.[cxviii]

Huxley considers the wide implications of the disciplines of tissue culture and associated epistemological revelations by looking at the option of mass production and the economic potentials of the use/abuse of scientific knowledge and applied technologies and the social sensitivities of the society: ‘The most important new idea which I was able to introduce was *mass production*. Our aim was to multiply the King’s tissues indefinitely, to ensure that some of their protecting power should reside everywhere in the country.’[cxix] Or in another part of the story:

> “This laboratory is the most amusing,” said Hascombe, “Its official title is ‘Home of the Living Fetishes’.”[cxx]

There is a great emphasis on the idea of life (rather than death) and the vast possibilities involved with partial lives:

> Not a necropolis, but a histopolis, if I may coin a word: not a cemetery, but a place of eternal growth…,[cxxi]
>
> A public proclamation was made pointing out how much more satisfactory it would be if worship could be made not merely to the charred bones of one’s forbears, but to bits of them still actually living and growing...[cxxii]
>
> A spurt on the part of great-grand-mother’s tissues would bring her wrinkled old smile to mind again; and sometimes it seemed as if one particular generation were all stirred simultaneously by a pulse of growth, as if combining to bless their devout descendants.[cxxiii]

Huxley’s emphasis on the ritualisation surrounding the practice of tissue culture, the epistemological wonder in regard to the extension of life of parts of bodies, even if these bodies ceased to live, and the complex relations with those fragments of life in vitro is a satire on the role of science in modernity. By setting his story in Africa, Huxley points to the link between modern science and tribal superstition. He thus questions a fundamental supposition of modernity and science, in which a binary opposition is drawn between supposed ignorance and enlightenment, and also points to the cosmological rather than just technocratic issues raised by science. to tendencies to use scientific findings or tools for cultural and ideological means.

Joseph P. Vacanti

The history of tissue culture and the following development of tissue engineering (TE) represent a series of major conceptual shifts in the perception of partial life and its impact on other fields of biomedical research and practice. These shifts span a period of almost a hundred years. It took more than eighty years to discover that cells can be grown in three dimensions to form a functional tissue. This development came from the collaborative work of a surgeon, Dr Joseph P. Vacanti, and a material scientist, Dr Robert Langer, in the early 1990s. They developed a system that used specially designed degradable polymers that act as a scaffold for the developing tissue.

While early experiments with tissue culture emphasised the autonomy of the fragment of life and questioned its ontology, tissue engineering discourse relocates the living fragment literally and conceptually back to the body.

Tissue engineering was developed as a surgical solution for a body fixing/reconstructing problem. In modern medicine, the system widely used to fix the body is a mechanical one, using mechanical, non-living apparatuses to replace failing body organs, such as metal or plastic bits to replace joints, a pump for a heart and an external filtering machine to replace a failing kidney (a dialysis machine). Until the late 1980s the notion of the cyborg – a human body enhanced by mechanical means – was the dominant mental picture both in the sciences and in the arts. As explained by Charles Vacanti:

> It was the tradition of innovative surgical borrowing to rebuild a body part that new materials were sought to substitute for what the patient's own tissues might provide. The idea of improving on nature by using man made materials was nurtured by the discovery and availability of the new synthetics during World War II. Since that time of technological expansion, the quest for substitutes for autologous tissues has been a roller-coaster ride… Many of the postwar synthetics are still in use today, with major questions regarding their efficiency hanging over us.[cxxiv]

The conceptual shift was to look at and treat the body as a regenerative site, to use the body's own tissue to repair itself; the use of the patient's own cells, grown in vitro and reimplanted back into the damaged site. This would not only avoid the problem of rejection of foreign materials and foreign cells (from other bodies) but also, in Thacker's words, tissue engineering '… is able to produce a vision of the regenerative body, a body always potentially in excess of itself'[cxxv] – a body that is not dependent on artificial means to fix itself, but is an endless resource.

The earliest European example of such a concept of the body as a regenerative site is recorded in the sixteenth century, when Taliacozzi of Bologna reported in his book, *De Custorum Chirurigia per Insitionem*, 'a description of a nose replacement that he constructed from a forearm flap'.[cxxvi] However the idea of taking a fragment of a body, and regenerating it in vitro before its re-implantation into the body, hence the technology of tissue engineering '… as it exists today, arose in Boston in the mid-1980s, first with the development of artificial skin by Ioannis Yannas and John Burke, and then with engineered cartilage', pioneered by Dr Vacanti and colleagues.[cxxvii] It was not a scientist or an engineer who came up with the novel ideal of growing tissue in three dimensions over scaffolds, but rather, like Dr Alexis Carrel, it was a transplant surgeon with a pragmatic approach to hands-on immediate solutions for pressing problems – Dr Joseph P. Vacanti:

> Vacanti came up with the solution – one now used for most engineered tissues – in 1986, while standing in shallow water at Cape Cod staring at seaweed. Inspired by nature's use of branching networks in plants, he returned from vacation and proposed a scaffold made out of bioabsorbable material. Cells could be seeded along the branches of the scaffold, and they would grow to fill in the spaces in between. It has been a long haul from seaweed to organs, though. 'When we started in 1986, I was young enough to think it wasn't so hard,' says Joseph Vacanti. But he and Langer had trouble attracting other scientists to their mission. Charles Vacanti recalls that when the team grew its first cartilage, its paper was rejected by a leading research

> journal. ‘The editors said, “We believe you, but we can't see any practical implications”,’ Charles complains. ‘That was one of the most ignorant responses.’[cxxviii]

TE is widely considered a ‘natural’ almost non-technological technique. According to Vacanti:

> It’s like growing the branches of the tree, and then you add leaves… [cxxix]
> As engineers, scientists and doctors, we are simply trying to duplicate nature as closely as possible to work out a successful design…[cxxx]

Thacker, a media scholar, continue and emphasise the concept of “nature” or the “natural” in relation to TE by loking at the flesh value and malibility on TE and its reliance on “natural” body processes:

> Tissue engineering, in implying the potential physical and biological manipulability of the human body, is not suggesting that the body is somehow ‘less real’. It does not accept and in fact rigorously denies that the body is a simulacra or a product of a techno-culture’s hyperreality. There is no body-anxiety with tissue engineering; it is, rather, an explicit (and medical-political economical) investment in the very value of the body as a potentially infinite natural resource.[cxxxi]

However, TE is a highly technological application within the biotech industry. TE work led to one of the most important icons of the late twentieth century – the mouse with the ear on its back, created by the Vacanti brothers in the early 1990s. The image of the ‘real skin and blood' mouse was broadcast and printed throughout the globe. It seemed to represent the horrors and the dreams of the new era of a bio-medical driven consumer society. For many it also indicated that the fantasy of the surrealist project is materialised through the aesthetics of scientists and medical professionals.

According to Charles Vacanti: 'Our goal wasn't to grow an ear, it was to prove you could grow cartilage'.[cxxxii]. One would assume that the Vacanti brothers were very much aware of the impact of such an image when they released it to the popular media. I believe that just like his previous researches in partial life, Vacanti was very much aware of the perplexities his field of research is creating and knowingly and actively 'helped' with creating a larger context around the field of partial life. Such 'creations' as the mouse with an ear cannot but help invade the territory of ethics and art. It goes beyond an obvious public relations stunt and towards more megalomaniac tendencies. While Carrel staged the laboratory, and Fell through her public talks attempted to project a tissue culture point of view, Vacanti brought into the public realm a 'real' chimera. This chimera was more 'successful' in triggering the public imagination than any other biotechnological development of recent times. Art, it seems, must actively deal with the new worlds being created by science, and in many repects TC&A is an example how artists can do this better than scientists as this is one of their primary roles and passion. Artists should not leave the aesthetical and ethical decisions of these 'new worlds' in the sole hands of the scientists, technologists or bureaucrats.

The image of this new chimera triggered many responses worldwide. For artists, it has presented the possibility of sculpting with living tissues – not without feeling concern regarding the use of a living sentient mouse as a tool for such endeavour. Would this mouse look different if a designer/artist were employed as part of the team?

TE was developed as part of the bio-medical exploration of creating body spare parts. It represent a major conceptual shift in the treatment of many ailments, injuries and deformities. 'In essence, new and functional living tissue is fabricated using living cells, which are usually associated in one way or another with a matrix or scaffolding to guide tissue development'.[cxxxiii] TE also offers the opportunity of growing and sustaining functional tissue outside the body for long periods of time, and to create a from of life that could never exist in nature – parts of complex organisms designed and grown independently of the organism from which they originally derived.

TE is a widely researched field around the world. Although Vacanti is mainly financed by the private sector and the US military (rather than the well established scientific community such as NIH) there are other less eccentric researchers, who are rather more accepted by the scientific community, working with TE. TE is used in American military research – as in Linda Griffith's laboratory developing an external micro-fabricator perfuse bioreactor with liver cells that will be able to detect and analyse pollutants in the environment in case of a bio-warfare,[cxxxiv] or the tiny robots powered by living rat muscle over microscopic silicon chips.[cxxxv] Other researchers aiming at the health as well as the plastic surgery industry include Anthony Atala, whose lab-grown tissue-engineered bladder in 1997 was successfully transplanted into beagle dogs and since then the new procedure is in human trials.[cxxxvi] He has also performed penis replacements in animals.[cxxxvii]

Tissue Culture & Art – Semi Livings and Partial life

The mouse used by Vacanti (discussed above) acted as a life support "vessel", providing the conditions needed for the cartilage cells to grow and gradually replace the polymer scaffold. The aim of this experiment, supposedly, was to prove that cartilage tissue could be coerced to grow into complex shapes and remain viable for the replacement of injured, defective or missing body parts. Developments in the design and construction of bioreactors opened up the possibilities of creating replacement body parts without the need to use a mouse as a surrogate body, and gave birth to the promise of the creation of Semi Living tissue entities.

Oron Catts,[cxxxviii] in his thesis 'Living surface: Biotechnology and the Design Way' (1995), suggested yet another perspective for the development of TE. While TE is mainly concerned with growing neo-organs for implantion into the body, Catts explored ideas surrounding the existence, maintenance and use of 3D tissue constructs as objects in the environment. He suggested:

- The design of 3D structures that are radically different from the original design of the body and the maintenance and growth of tissue construct as part of the environment (rather than the body).
- The use of body parts as autonomous mechanical devices, e.g., kidney cells as a filter, muscle to move and rotate elements, and so on.

Catts asked, ‘If we can grow something as complex as an organ outside of the body, why reimplant them back into the body? If we can grow and sustain alive for long periods of time something as complex as an organ, why stay loyal to the original design? If this is possible, why not grow/construct tools for our use? And if this is possible, there is still the major question, should we go down this path?’.

In 1996, Catts and myself initiated an artistic project called Tissue Culture & Art. Our aim was to look tangibly at the growth/constructions of tissue-engineered entities outside of the body and explore the ethical and philosophical implications of such an endeavour. After receiving funding from an arts funding body, we began working ‘hands-on’ at the laboratories of Dr Traian V. Chirila, the Director of Biomaterials and Polymer Research, at the Lions Eye Institute in Perth, Western Australia. TC&A’s first exhibition, in 1998 at the Perth Institute of Contemporary Arts, presented non-living artworks made in the laboratory as well as some relics of the glass structures on which we grew tissue (for more, see appendix). [Figure 7 & 8]

Figure 7

Figure 8

In 2000 we presented an installation titled *The Stone Age of Biology*, in which we grew muscle and nerve tissue over miniaturised replicas of prehistoric stone tools borrowed from the collections of the Western Australian Museum. We wrote:

> *The Stone Age of Biology can be seen as the lines on the walls of our new cave. The development of stone tools transformed us from being 'intelligent apes' to what we are now, a technologically dependent organism. The mental shift that made the apes toolmakers is now being repeated. We are now only chipping the first biological tools. The increase development of biological tools will change us in ways that we cannot even imagine.*

Figure 9

In retrospect this installation and its premise are the most celebratory of any by the TC&A projects. In the early years we were still captivated by the technology and its abilities in radically transforming the human ape. Since then we have became more critical, and more aware of fundamental philosophical and moral issues raised by tissue engineering. Also, we are emphasizing more the persisting human-animal condition regardless it being a more technologically advanced ape.

Figure 10

Conclusions

> But every biology student should at some time have a dramatic experience of seeing the rhythmic beat of a heart muscle, the sweep of the celia of pulmonary epithelium, the twitching of skeletal muscle, the peristalsis of chorioallantoic of intestinal vesicles, the migration of fibroblasts, and the spread of nerve fibres. And every student can not only see these things but have the thrill of preparing them himself.[cxxxix]

The possibility for the engineering of functional utilitarian tissue constructs is culturally problematic. It might not be surprising to realise that the main examples of such a concept (i.e. the use of TE outside of the biomedical realm) can be found in the US "defence" and in the new area of 'wet biology' art practice. The first is not interested in the broader philosophical and ethical implications, while the second attempts to confront them. The form and the application of our newly acquired knowledge will be determined by the prevailing ideologies that develop and control the technology. When the manipulation of life takes place in an atmosphere of conflict and profit-driven competition, the long-term results might be disquieting; further instrumentalisation of life and the living (including ourselves), damage to the living, interdependent ecology on which we depend, and more. One role that art can play is to suggest more utopian and critical scenarios.

Steve Grand, a pioneer in the field of artificial life, wrote in 2001:

> We have good reasons to be protective of our souls. Quite apart from our fear of mortality, we rely on our veneration of life to guide our everyday choices. Our division of the world into the categories 'living' and 'non living' seems to be one of the most fundamental we make and, whether it is fair or not, we treat each category in very different ways. Perhaps the most profound distinction we make between living and non-living is our application of morals.[cxl]

Grand, in the confines of dialectical Western philosophy, asserts '…there is no such thing as half an organism – life and intelligence are properties of wholes and must be synthesized in holistic way'.[cxli] For Grand there is no partial life, or Semi Livings:

> Dismantling any living organism, whether by amputation of limbs, severing its head or even whittling it away cell by cell, eventually takes away its life, without you ever noticing where it went. As a general rule, if you take an organism to pieces you do not end up with pieces of an organism. All you get is a sticky mess of lifeless bits of meat or vegetable matter. It is possible to remove part of a creature and 'keep it alive' in tissue culture or on a life-support machine, but only by providing artificially all the systems to which it previously had access from being part of a whole. There is no such thing as half an organism.[cxlii]

While Grand has a point – the isolated living tissue has developed a certain anatomy from its original body of which it is now a bigger part, a new class of object/being, that of the

Semi Living, has come into existence. Furthermore, the Semi Living already has a substantial history, as shown in this chapter. As they are the entities which are positioned in the ‘in-between’, whether it is in relation to a whole organism or none, the living and the non living (artificial), life and death, and have no specific individualised, gendered and raced body, they are inherently problematic. It is this problematisation which is of importance for the TC&A project, as it can be used as a starting point for a vital ethical, epistemological and political discussion on certain ‘truths’ that we hold as a society and as individuals

Somewhat like Grand, Huxley refers to tissue in culture as an entity without a purpose – freedom that is futile. Cells in culture might seem to us as ‘a spectacle of rather futile freedom’ as they are operating outside of their natural context and are dependent on an artificial system, supplied by us for their survival. However, by caring for them, observing them and learning from their behaviour they ‘force’ us to reflect back on some fundamental issues. Only when artists are using semi-livings for what seem to be frivolous purposes can a true ethical discussion begin, as in this context there is no fall back to the utilitarian arguments governing bio-medical, agriculture or defence discourses.

Chapter 3 – The Ethics of the Semi-Livings

Introduction

As already discussed, since the late 1990s there has been an increasing interest among artists in the use of the tools of modern biology. While it was a breach in the conventional use and manipulation of living systems in the contexts of both science and art, art and science collaborations are not a new phenomenon. In some of the research areas linked to life sciences there is a long tradition of collaborations between artists and scientists – sometimes in the one person, Leonardo being archetypal. Artists and biologists often worked side-by-side during the eighteenth century with, for example, illustrators on expeditions collecting and recording botanical and zoological specimens, and artists/anatomists dissecting cadavers in the attempt to better understand and better illustrate the internal and external body. More recently artists have also engaged with new visualisation techniques and tools (such as MRI, DNA gels etc.) as ways of representing bodies, identities and contemporary portraits.[cxliii] As a general observation, artists dealing with life sciences often employ biological metaphors using 'traditional' materials and processes of representation (from paint to bronze, photography, video etc).

However the new phenomenon of biological artists is very different from this traditional artistic engagement with science because, with it, biological materials and scientific tools and protocols have become an integral part of both the artistic process and the artwork itself. Indeed this phenomenon has been called transgressive in respect to both science and art, as scientific techniques, tools and methodologies are being used, subverted and elaborated on for the production of artistic knowledge, discourse and objects (which can be seen as contestable tangible items for cultural discussion, evocative objects,[cxliv] non-utilitarian artefacts or conceptual prototypes).

> It's now a reality [that] artists are in the labs. They are intentionally transgressing procedures of representation and metaphor, going beyond them to manipulate life itself. Biotechnology is no longer just a topic, but a tool, generating green fluorescent animals, wings for pigs, and sculptures moulded in bioreactors or under the microscope, and using DNA itself as an artistic medium. (Jens Hauser).[cxlv]

At the same time, the political and ethical issues raised by the introduction of biomedical and biotechnological products into mass culture are demanding urgent attention. These new biological technologies have one fundamental difference from the technologies preceding them in that both the products and the processes use life as the raw material. The very existence of some of the outcomes of biotechnologies brings into question deep rooted perceptions of life and identity, concepts of self, and the position of the human in regard to other living beings and the environment. Art has a long history of dealing with these issues. However, some artists believe that the traditional representational engagement with these concerns is unable to deal with these issues, and that since life through biotechnology is the issue, it should also be the means by which they are addressed. Furthermore biotechnology itself becomes a more intriguing, as well as technically possible, medium/tool for artists to investigate, therefore artists have begun manipulating life and 'inserting' life into new contexts, including the art galleries. By that means, artists and their audiences can engage directly with the living artwork, and in doing so, more cogently face ethical and other issues, not just about bio-technology, but also ontological and cosmological issues about what it means to be human and indeed alive. Artists and their audiences are participating in the living and semi-living installation (for example, through the Feeding and Killing Rituals devised by the TC&A). This makes them accountable. They cannot be (and never have been) solely observers in the biotech revolution – rather they are willingly or unwillingly a part of it.

Whatever else it does, BioArt raises an array of profound ethical considerations in regard to the extent of the manipulation of living systems that range from interventions at the molecular level to the ecosystem and anything (living) in between. I argue that the underlying ethical problem concerned with the manipulation of life is rooted in the perceptions of humans as a separate and privileged life form, a perception fundamental to the Judaeo-Christian and Classical worldviews that underpin Western culture. This anthropocentricism is limiting society's ability to cope with the Darwinist foundations and expanding scientific knowledge of life. It further throws into relief the conventional theocratic and humanist cultural barriers in the continuum of life between the human and other life forms. The cultural exploration of the perceived barrier between human and other living beings is now becoming urgent in the light of scientific experiments in which different kinds of chimerical beings are created.[cxlvi] The actual physical act of manipulating life challenges long held beliefs and focuses discussion about our uses of life in ways that previously did not occur. In the words of George Gessert, a biological artist who breeds irises as his art platform:

> Do artists cross a line when they breed plants or animals, or use the tools of biotechnology? Scientists routinely cross the line. So do farmers, businesspeople, military men, and doctors. Only artists and certain religious people hesitate. Of course, one of the great human dilemmas is that we do not know the extent of our powers. We invent outrageously and as casually as we breathe, but we have no idea where our inventions will take us. Extinction? Slavery? 1000 years in Disneyland? Even if the Holocaust had never happened, we would have good reason to worry about where knowledge of genetics and DNA will take us. We will need all the awareness we can muster to engage evolution. To the extent that art favours awareness, the more artists who cross the line the better.[cxlvii]

As an artist, I believe that our role is to reveal inconsistencies and contradictions in current attitudes to life, and to focus attention on the discrepancies between our conventional cultural perceptions and the new techno-scientific understandings about life. This ultimately amounts to a radical rethinking of conventional notions of the other. This analysis cannot be separated from the current socio-economic and ideological contexts that govern Western society. Therefore, the aim is not to offer a new ethical frame for the readers to follow (or a fixed and coherent alternative framework to replace the collapsing western one) but rather, to further push the limits of existing paradigms and ethical frameworks both from within and without. Because these ethical issues are now being raised most cogently by biotechnology, it is the obvious sphere in which such aesthetic experiments should be conducted.

Ethical Frameworks

One of the major ethical dilemmas facing BioArt is the use of living systems in instrumental ways. Even when one holds the conventional anthropocentric view that all non-human life exists for human needs and desires, it seems that the use of living systems for artistic ends generates resentment, which can be used to highlight the inconsistency of the still prevalent view of the dominion of man. How then do ”Bioartists” in general and in TC&A practice in particular, deal with the ethical paradox of using/manipulating life for the creation of cultural commodities that question the human treatment of life? In answering this question I will first outline some basic philosophical approaches to such ethics, and then develop the approach taken by TC&A.

There are four main approaches to environmental ethics, from the human centric towards ethical considerations of entities to which the human can least identify resemblance, i.e. which are furthest away on the continuum of life:

1. Human dominion ethics which, in the West, mirror Judaeo-Christian attitudes that proclaim human in a privileged role controller and proprietor of the animal kingdom and the environment in general.

2. The preservation of our environment or ‘an ethical treatment’ of the environment for the well being (and survival) of human kind (this is also a Biblical injunction; to care for

God's creation). If we care for humans we ought to care for the environment to the extent that it will provide (such as food, clean air, economic benefits, feelings of well being etc.) for humans. Obviously, this argument is anthropocentric. It is also limited as it can asses the benefits to human beings only in human scale perception, rather than in respect to evolutionary time scale.

3. Sentient-centred ethics based on Singer's Utilitarian Ethics: We should limit our ethical treatment to the sentient beings in the environment that are capable of pleasure and suffering. Each decision in regard to the environment should attempt to weigh the amount of happiness and suffering inflicted on sentient beings. The approach is not absolutist but relativist. There are gradients of sentiency which correspond to the different levels of sufferings; hence there is a difference between a chimpanzee's capability of suffering and that of a cockroach which also is based on level of sentiency. However, our considerations towards non-sentient beings (which are incapable of experiencing happiness or pain) do not raise ethical issues. Singer perceives any ethical consideration towards something which is non-sentient as an aesthetic matter rather than an ethical one. However, cutting down a forest is ethically challenging to the animals dependent on the trees.

4. Life-centred ethics, which draws a strict border between living and non-living beings and argues for an ethical treatment of life – the sanctity of life (whatever 'life' is). This ethical framework is deontological and absolutist by nature (as opposed to Singer's relativist view of sentience as a continuum).

TC&A believe such issues are best approached from a consequential (i.e., utilitarian) or motivist point of view (i.e., Kant's categorical imperative) rather than a deontological one.

W. D. Ross, A. C. Ewing and H. Prichard developed what they referred to as deontological ethics, which has been applied to the animal rights debate by Tom Regan in somewhat more simplified terms. It claims that the rightness or wrongness of an act depends neither upon the motive from which the act was done, nor upon the consequences of the act – but solely upon what kind of an act it is. In other words, a moral behaviour must follow certain principles that are in essence 'good' or 'moral'. This approach is absolutist, and requires either an agreed decision mechanism (such as social consensus) or a presumably divine being to set the 'moral guideline'.

However, if one accepts that living systems, by their ecological existence, manipulate other living beings, the actual act of manipulation cannot be argued against. All that can count from a pragmatic and utilitarian perspective are the motives for the act and the consequences of it. This neo-Kantian position is called consequential or utilitarian ethics, and was developed in the context of animal welfare by Jeremy Bentham and later on by Peter Singer. It weighs moral responsibility by the consequences of the actions; an action is morally right if the consequences of that action are more favourable than unfavourable (in relation to agreed criteria whether personal or social). Peter Singer, in particular, has developed such a utilitarian approach to the issues surrounding animal liberation: Singer focuses on ethically analysing an action by its consequences – which to him is the

Benthamite principle of maximising happiness (pleasure) and minimising suffering (or pain). It thus only applies to sentient beings and is based on growing scientific data (as well as personal and shared experience) developing in relation to the sentiency of living beings. The important point, however, is that this principle is applied equally to all sentient beings whatever their sex, race or species:

> If a being suffers there can be no moral justification for refusing to take that suffering into consideration. No matter what the nature of the being, the principle of equality requires that its suffering be counted equally with the like suffering – insofar as rough comparison can be made – of any other being. If a being is not capable of suffering, or of experiencing enjoyment or happiness, there is nothing to be taken into account. So the limit of sentience (using the term as convenient if not strictly accurate shorthand for the capacity to suffer and/or experience enjoyment) is the only defensible boundary of concern for the interests of others. To mark this boundary by some other characteristic like intelligence or rationality would be to mark it in an arbitrary manner.[cxlviii]

Furthermore, Singer invokes Kant's categorical imperative. He assert that 'Ethics requires us to go beyond "I" and "you" to the universal law, the universalizable judgment, the standpoint of the impartial spectator or ideal observer, or whatever we choose to call it'.[cxlix]

By definition such a universal ethical position is above one's own gender, race and even species (though without referring to a divine being or an abstract notion such as 'nature' or 'aesthetic'). However, is this position possible, and how can we know that utilitarian ethics or ethics in general is not merely anthropocentric or a product of that scientific outlook that has prevailed since the Enlightenment? Singer's argument also begs the question of where one puts the 'limit of sentience' necessary to experience pleasure and pain. From Singer's perspective, based on data produced by western science, the border line for a sentient being is 'somewhere between the shrimp and oyster'.[cl] This boundary, however, obviously has no absolute position and will shift according to advances in neuroscience.

New human/other animal chimeras are further blurring the species/sentience correlation, such as in the sheep-human chimeras created by Esmail Zanjani's group at the University of Nevada, Reno, in which human stem cells were transplanted into a sheep foetus (while still in the womb).[cli] Following Singer's utilitarian principles, how can we assess the level of sentience in this chimera, whether a foetus or mature organism? Also, from a consequentialist perspective, how can we measure the long-term positive consequences of such an action whether to the animal itself (is this new and different sentience causing more happiness or more suffering?) or the benefit for human society (drawing on the promise of reducing the suffering of many humans who are in need of organ transplants). Is it possible to weigh these consequences from a perspective beyond our humanness and furthermore outside the political and economical context these chimeras are being born into?

Tom Regan advances a deontological argument to arrive at a similar conclusion to Singer, namely that animals have rights. Also, like Singer, he uses the same example of a severely mentally disabled human (who cannot experience/feel pain in the same way a conscious, healthy *Homo sapiens* experiences it) and a chimpanzee:

> (1) it is wrong to treat human morons in the ways in question; (2) we would not (and should not) change this judgment, in the ways utilitarianism, egoism, or Kantianism would require, … (3) if, in our search for the most adequate moral theory on which to ground this belief, we are driven to postulating that human morons (even) have certain rights; and (4) if the grounds underlying their possessing the rights they possess are common grounds, as it were, between them and many other animals. If all this correct, then I think the case of animal rights is very strong indeed.[clii]

Regan's argument is based on an anthropocentric argument: hence, Regan feels that severely mentally disabled *Homo sapiens* deserve certain rights because they are human, even though he is convinced that they are incapable of experiencing pain or pleasure. He then applies the same conviction towards another species that can experience pain/pleasure. But are his initial feelings towards severely mentally disabled *Homo sapiens* anthropocentric? Should we argue for animal rights without the need to resort to a bias towards other humans?

> We ought not to maltreat severely mentally enfeebled humans, Kant could hold, because doing so will eventually lead us to maltreat rational free beings. We owe nothing to these humans themselves. Rather, we owe it to ourselves, and to other rational free beings that we do not do those things that in the future will lead us to treat rational free beings as mere means.[cliii]

If one adopts deontological ethics which ascribe rights to animals and object to any form of intervention that might adversely affect their life, then the actual act of manipulating sentient life (regardless of arguments for maltreatment), even if done to either save life or create a platform for cultural debate, is wrong and cannot be justified (to a certain extent this is the ideal to which some Vegans are inspiring).

However, when looking at these aspects from a consequential starting point, following Singer's argument that does not rely on the initial anthropocentric move there is a niche for such a discussion

While anthropocentric arguments have traditionally been based on the God-given right of humans to control the world, they can also find justification in a more Darwinian perspective which positions the human within the animal kingdom; living organisms and systems always affect and intervene with others. As Gessert made clear, humans (as well as other life forms) have always engaged in the manipulation of living systems, either directly through processes of selective breeding and farming, or less directly in ways of hunting, foraging, fishing and altering local ecosystems. Some of these activities have been employed for purely aesthetic and symbolic reasons. Biological artists purposely follow this tradition as a starting point for epistemological and ethical inquiry, particularly in the contemporary context of biotechnological research and production in a consumer-driven society. However, this cannot be used as the sole justification as it opens the way for other exploitative human behaviour. Are there limits to the human use of other animals that will permit survival but will exclude exploitation?

Singer's answer is to assume that 'basic principle of equality which does not require equal or identical treatment; it requires equal consideration. Equal consideration for different beings may lead to different treatment and different rights'.[cliv] Can we pursue an ethical framework, that is secular but also vitalist in the sense that it 'prefers' life or the living, and that goes beyond the 'I' or 'You' regardless of our sex, race and species?

I am not a philosopher, and this thesis does not attempt to explore ethical issues in a strictly or purely philosophical manner, Continually TC&A has had to develop a position with pragmatic and ambivalent contexts that occur in artistic and scientific practice within the institutional and political frame of everyday life, both in respect to ethical system in the institution it operates within, also for personal reasons. However the aim of TC&A is not to provide ethical protocol but to establish a platform for debate on ethics primarily in relation to the notions of life.

Thus, in examining the ethical issues of BioArt it is important first to acknowledge again that BioArt is a pluralist practice, with artists occupying different ethical positions. Some are being used (or happily participate) in the creation of public acceptance for these biotech developments, while others seek to subvert these technologies in order to generate heated public debate about their uses. There are also those who perceive their work to be neutral in this regard, and who opt to use the technologies for purely aesthetic and poetic virtues; or a statement which assumes that aesthetical consideration is an ethics. In practice, the actual art works in general seem in many cases to be much more ambiguous and, once released, in the public domain, they develop their own narrative.

Another important issue to rise is, as the new forms of manipulation of living systems are being driven by political and ideological agendas, it is difficult to draw the line between political/ideological concerns and ethical ones. As a result ethical arguments about BioArt tend to follow conventional ethical positions – or the contestations between them. This is a cultural consequence of the institutional ethical frameworks set up to deal with issues raised by these new forms of manipulation, and is very much an expression of prevailing ideology. It is almost impossible to separate ethical concerns from the examination of the political and ideological forces responsible for the application of knowledge in the life sciences – as is evident in the following statement by the Australian Health and Medical Research Council (NHMRC) published in 1999, ‘The National Statement on Ethical Conduct in Research involving Humans’:

> The primary purpose of a statement of ethical principles and associated guidelines for research involving humans is the protection of the welfare and the rights of participants in research. There is an important secondary purpose of a statement

> of ethical principles and accompanying guidelines, and that is to facilitate research that is or will be of benefit to the researcher's community or to humankind. The purpose of this Statement is to provide a national reference point for ethical consideration relevant to all research involving humans.[clv]

A clause in section 15.8 deals with waiving the need for consent from the tissue donor when there is a 'possibility of commercial exploitation of derivatives of the sample'. This statement is biased towards a particular political and economical ideology. Its inclusion as part of the ethical guidelines governing research in Australia makes the resistance to such a clause both a political and ethical act. The same can be said about resistance to other forms of exploitation (commercial or otherwise) of living systems.

The link between the prevailing capitalist ideology and the application of knowledge obtained by life science research has the potential to yield many ethically questionable practices and products, as it is based on the value of profit rather the consideration for the other (including the other human). Further, this ideology is not necessarily humanist (it favours humans with capital over those without). The current ethical guidelines for the exploitation of non-human living beings are even worse. The Western Australian regulations dealing with animal research ethics are titled the Animal Welfare Regulations 2003, rather than 'Animal Rights Regulations'.

The practice of BioArt aims to highlight the inconsistencies in the way society perceives the exploitation of living systems. Indeed, through actual engagement with the modes of manipulation of living systems for the purpose of artistic exploitation, the artwork invariably points, either intentionally or unintentionally, to instances of inconsistency in existing frameworks of ethical conduct. Consider, for example, the work *Nature?* by Marta De Menezes.

Living butterfly wings are the canvas of artist Marta De Menezes. The modification is done in the pupa stage of the butterfly using microsurgery techniques: 'the main objective of my project was to achieve wing patterns never seen before in nature, but made of normal cells and tissues in live, healthy butterflies'.[clvi] [Figure 11] De Menezes would like her work to be appreciated from a formalist perspective – to be viewed as a novel arrangement of colour and forms keeping the medium/technology transparent. However she also sees a strictly instrumental advantage in the work: 'Society as a whole can also benefit from this kind of interaction through the resulting increase in awareness and understanding of scientific issues'.[clvii] De Menezes, it seems, perceives science, like art, as a pure discipline. She believes that as long as she follows established scientific protocols she is working within an ethical framework. Furthermore, she sees a great value in her artwork as illustrative of scientific principles. Her intentions are not concerned with a critical view of the science discipline or scientific issues.

Although Marta de Menezes avoids the ethical and epistemological issues of her work, the artwork itself generates these discussions regardless or in spite of her intent. Thus issues concerning the well being of the butterflies have generally overshadowed aesthetic discussions. The reaction probably stems primarily from the fact that de Menezes used an animal rather than a plant. In addition this animal (the butterfly) is considered, in some cultures, to be a symbol of beauty, and has spiritual symbolism.[clviii] If she would have used another animal of equal biological complexity and on a similar evolutionary scale, like a cockroach, the artwork might have been less emotionally charged. In a communication with the author, de Menezes described audience reaction to a presentation she gave in a conference. The speaker before her, a scientist working for a military research laboratory, described his work that involved the manipulation of the nervous system of a cockroach in ways that allowed it to be used as a living surveillance robot under the control of a human agent. According to de Menezes, the audience reacted strongly against her work but seemed to accept the other speaker's work with no objection. This story illustrates two points. Firstly it involves a form of speciesism. Secondly it involves a pragmatism in which the cockroach experiment is justified because of its utilitarian ends, while that on the butterfly are not because its ends were perceived as purely formal.[clix]


Figure 11

Is there a place that will allow the aesthetic motives of artists access to advanced biotechnologies with the expertise needed, as well as a place for a free critical and sometimes provocative exploration? This question contributed to the founding of SymbioticA, in 2000, at the School of Anatomy and Human Biology of the University of Western Australia.

One aim of SymbioticA was to create a space for artists (and other non-biologists) within a biological scientific department, to engage with critical experiential research in the manipulation of living system or parts of living systems. SymbiotoicA referred to this kind of experiential work as ‘getting one’s hands wet’ with life manipulation. An important part of SymbioticA’s original purpose was, from the beginning, an ethical one. Engaging directly with the act of manipulating life will enable artists to reflect on the wider cultural and ethical implications of biotechnology and art practices which, in modern times, have generally been defined in binary opposition to the living and the natural. As SymbioticA is located within a science faculty, and the artists are working in laboratories alongside scientists, this wider reflection of the ethical and epistemological consequences of life manipulation is shared with the work of the scientists themselves, who are examining their own practice from different perspectives.

SymbioticA also aspires to make artists feel equal to the scientists in their investigations and to make the artist knowledgeable as well as critical of these issues. Again, there are ethical reasons for this. Catts (2002) states:

> As biological research departments in universities are encouraged by governments to partner with ‘industry’ and ‘defence’, the need for research into non-utilitarian purposes becomes urgent. The exploration of contestable possibilities is important to the understanding of the ways technology may develop. By fostering artistic critical engagements with biological research, SymbioticA provides a ‘greenhouse’ for developing alternatives to the commercial mainstream.[clx]

Finally, SymbioticA’s staff and residents have to deal, on a daily basis, with ethical decisions based on a case by case basis, both at a personal and bureaucratic level. SymbioticA is obviously obliged to work within the ethical guidelines of the University, and regularly puts new challenges to committees that are geared to deal with animal and human ethics in a scientific rather than artistic context. Thus the best way to consider such ethical issues is through examples of actual projects. I will draw on three of the TC&A and SymbioticA projects:

The semi-living Steak problematises the use of living beings for human basic needs (i.e., food) based on utilitarian argument; Fish & Chips (MEART) explores the limitation of this argument by exposing the gap regarding the sentiency continuum; and the Extra Ear ¼ Scale emphasises the anthropocentric agenda embedded in all of these ethical frameworks.

In Vitro Meat

This project investigates the eating of victimless meat by growing semi-living steaks from a biopsy taken from an animal, which is left in the paddock alive and healthy. As the cells from the biopsy proliferate, the 'steak' continues to grow and expand in vitro, while the source, the animal from which the cells were taken, is healing.

On an ethical level the project addresses the most common zone of interaction between humans and the living world, and also probes the apparent uneasiness people feel when someone 'messes' with their food. The project offers a form of 'victimless' meat consumption. Potentially this work presents a utopian future in which the killing and suffering of animals destined for food consumption will be reduced. Maybe even the ecological and economical problems associated with the food industry can be reduced dramatically. However, by making our food a new class of object/being – a Semi-Living – there is the risk of making the Semi-Living a new class for exploitation.

The idea of growing steak independently from the animal is not new: Winston Churchill already in 1932 suggested that 'We shall escape the absurdity of growing a whole chicken in order to eat the breast or wing, by growing these parts separately under suitable medium'. [clxi] Frederik Pohl and Cyril M. Kornbluth in *The Space Merchants* (1952) describe chickens as a huge mass of cultured chicken breast, that is kept alive by algae skimmed by nearly-slave labour from multistorey towers of ponds surrounded by mirrors to focus the sunlight onto the ponds.[clxii]

The TC&A Semi-Living Steak project is the outcome of a residency at the Tissue Engineering & Organ Fabrication Laboratory at Harvard Medical School in 2000. The first steak was grown from pre-natal sheep cells (skeletal muscle), harvested as part of research into tissue engineering techniques in utero. The steak was grown from an animal that was not yet born.

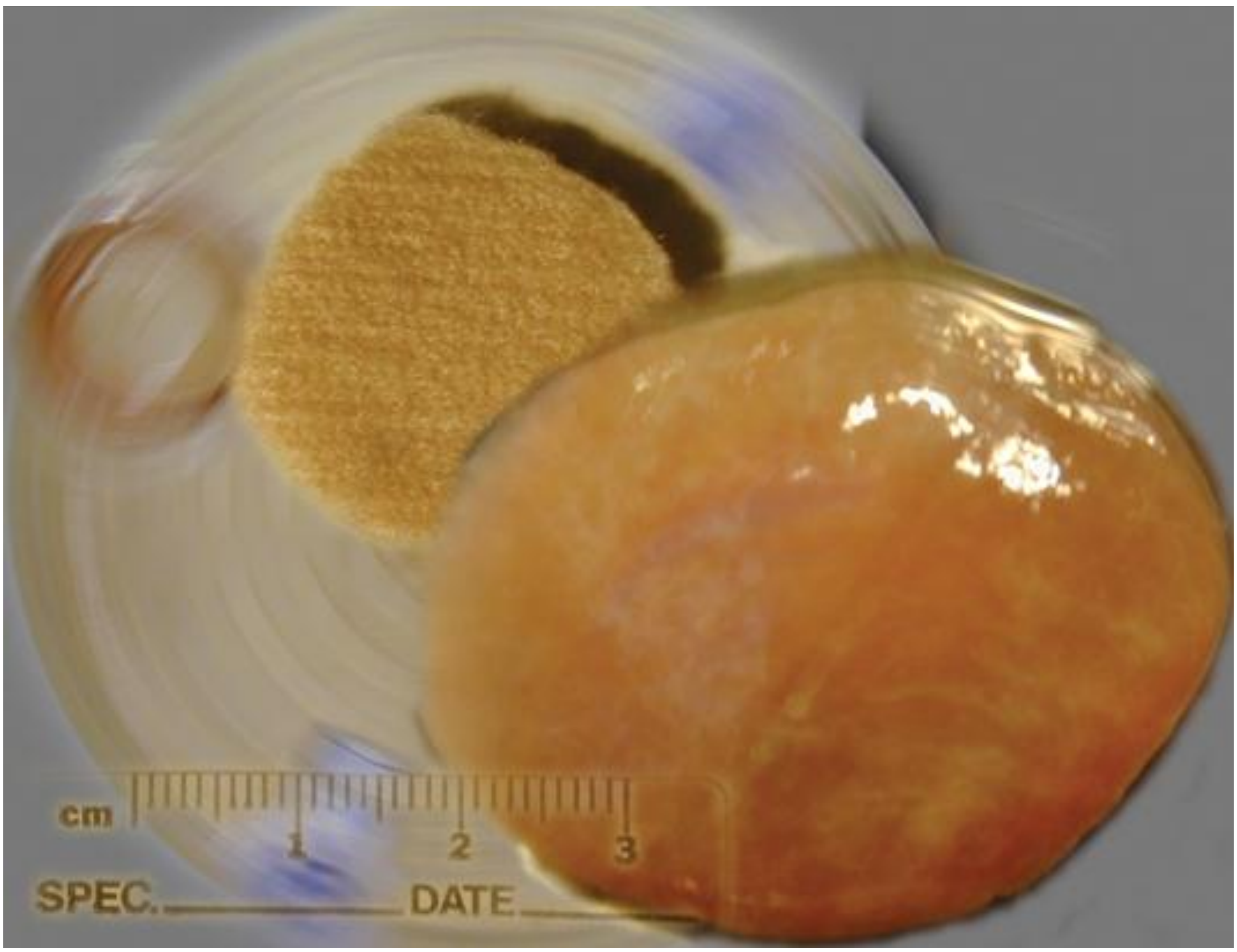


Figure 12

The project was realised in 2003 as part of the exhibition *L'Art Biotech* in Nantes, France. Titled 'Disembodied Cuisine', the installation played on the notion of different cultural perceptions of what is edible and what is foul. The art project was, from start to finish, envisaged as a light satire that would create a comic ambience so that it would not be sidetracked by emotions of disgust. Semi-living frog steaks were grown, thus poking fun at French taste and their resentment towards engineered food, and the objection by other cultures to the consumption of frogs. Frog skeletal muscle was grown over biopolymer for potential food consumption, while the healthy frogs lived alongside as part of the installation. In the last day of the show, the steak was cooked and eaten in a Nouvelle Cuisine style dinner, and the four frogs that were rescued from the farm were released to a beautiful pond in the local botanical gardens.

The relations between biological artists and animal welfare groups are at best strained. Therefore we were wary when we received an email from the organisation People for Ethical Treatment of Animals (PETA) asking to collaborate on the next phase of semi-living steak project. Following Peter Singer's utilitarian ethics and the rejection of speciesist perceptions, we were 'entertaining' ourselves with the idea of creating semi-living steak made out of an adult consenting human. Perhaps surprisingly, the People for Ethical Treatment of Animals (PETA) offered to TC&A this human subject; their organisation director Ingrid Newkirk. Furthermore, Newkirk suggested eating her own flesh.

This is an interesting case as it demonstrates how such projects can have real ethical effects. TC&A does not attempt to give answers or find solutions to the ethical dilemmas it raises, but rather to generate further debate and expose social and ethical inconsistencies towards the living. This works best if the art remains ambiguous rather than didactic.

The Victimless Utopia

One complication arising from the victimless meat endevour as a manifestation of the techno-scientific project is that it may create an illusion of a victimless existence. First, in order to grow in vitro meat, there is still the need for a serum created using animals' blood plasma. Although there is some research to find alternatives for this ingredients there is no solution in the near sight and animals (mainly calfs or fetal bovine) are sacrified for that ingredient. Second, all the "costs" concerned with the running of a laboratory, i.e fossil fuels burned, green house gases produces, water and trees consumed, miles traveled and the waste created. Third, there is a shift from 'the red in tooth and claw' of nature to a mediated nature. The victims are pushed farther away; they still exist, but are much more implicit.

Parts of the living are fragmented and taken away from the context of the host body (and this act of fragmentation is a violent act) and are introduced to a technological mediation that further "abstracts" their liveliness. By creating a new class of semi-being, which is dependent on us for survival, we are also creating a new class for exploitation, as it further abstracts life and blurs the boundries between the living and the non-living, the subjects versus objects (tools).

I have already discussed ways in which TC&A ironically explores the contradictions of tissue culture, particularly in regard to the promise of a victimless utopia, as in the analysis of contradictions in *Disembodied Cuisine* (the use of animal-derived nutrients to cultivate an apparent victimless meat). However, the irony was easily lost, and now a university spin-off company is attempting to secure funding for tissue-engineered meat as a possibility for eating meat without killing the animal.[clxiii] Likewise, following *Victimless Leather - A Prototype of Stitch-less Jacket Grown in a Technoscientific 'Body'*,[clxiv] TC&A were contacted by a commercial company requesting more technical information for potential commercialisation of such an idea.

Growing resurces are being injected into the field of commercial in vitro meat. In 2004, a group of researchers started the non-profit organization New Harvest, with the goal of promoting research into in vitro meat. Among the founders are Jason Matheny and Vladimir Mironov. In 2005, a research project into cultured meat started in The Netherlands. It is carried out under the lead of Henk Haagsman at the University of Amsterdam, the Eindhoven University of Technology and Utrecht University, in cooperation with sausage manufacturer Stegeman. The Dutch government granted a two million euro subsidy for the project. The first international consturium In Vitro Meat Symposium was held in Norway in April 2008.[clxv] 'In five to 10 years, supermarkets might have some new products in the meat counter: packs of vat-grown meat that are cheaper to produce than livestock and have less impact on the environment.'[clxvi] The Wired Magazine reported in response to the In Vitro Meat consurium. On April 21, 2008, PETA (People for Ethical Treatment of Animals) an American animal rights organization, announced a one-million dollar prize for the first group to successfully produce synthetic meat that is commercially viable comparable to naturally sourced meat products.

Back to the TC&A:

> 'There are eight people on earth who have already eaten lab-grown flesh, and artist and tissue scientist Oron Catts at the University of Western Australia is one of those few. As part of the Tissue Culture and Art Project's Disembodied Cuisine, he was part of the team that grew some frog meat on a slide, fried it up and ate it as a part of a "feast" to end their project into the uneasy relationship of meat and science. Following earlier successes in 2001 at growing lamb in a lab, Catts and his team grew coin-sized frog steak in 2003 at a cost of roughly $650 a gram, just millimeters thick. ..They fried the thumbnails of frogmeat in garlic and honey with a dash of Calvados, a recipe which they named "a la Davis" in honour of a fellow bio-artist Joe Davis whose frog muscle-powered ornithopter failed to launch on ethical grounds, a process as cruel as marinating dead amphibian in honey and eating it.
>
> The Lilliputian amphibian steaks were served with a selection of herbs, also lab-grown from plant tissue culture. Eight people sat down to this micro-degustation. The results were a success, at least in terms of replicating an uneasy relationship.

"Four people spat it out. I was very pleased" [clxvii]

In 2006 TC&A performed, for the first time, the *DIY De-Victimizer*s, which more cogently explored the hypocrisies involved in human relationships with other living and partially living systems, by taking the paradoxes and ironies involved in the production of a victimless utopia to somewhat extreme levels of absurdity. This involved the creation of 'The DIY De-victimizer Kit' as part of the Tissue Engineering & Art Workshop organized by SymbioticA and run in collaboration with Dr Stuart Hodgetts, a Research Fellow in the School of Anatomy and Human biology, the University of Western Australia.

The DIY De-victimizer Kit Mark One (DIY DVK m1) was set up to allay some of the guilt people feel when they consume parts of dead animals (as food, for aesthetic reasons or any other purpose) or cause the accidental death of a living being (by a car, a lawnmower, or any other piece of technology). The kit can maintain and in some cases even proliferate and extend the life of parts of the deceased bodies, at least until the guilt recedes. The DIY DVK utilises off-the-shelf items to construct a basic tissue culture facility; a few specialised nutrients are needed – some of which contain animal-derived material – but the latter is so far removed from the end user that for most people remorsefulness is usually not an issue.

We made use of the DIY DVK for a performative installation in which we experimented with bringing back to life (literally) parts of meats. We attempted to reverse the ‘destructive’ effects of human technology by ‘re-life-ing’ its victims and invited the audience to take an active role in the experiment by assisting us in caring for the fragments of life and making different ethical decisions with regard to these fragments’ eventual fate.

Since this project had its debut in Barcelona, we felt compelled to reassess human relations to animals in the context of the Spanish bullfighting ritual. Drawn also by our anecdotal observation that an increase in number of McDonald’s restaurants was paralleled by an increase of criticism against bull fighting. In drawing an analogy between participating in a bullfight ritual and eating a McBurger, one may argue that in the bullfighting ritual, the killing of the animal for aesthetic and recreational reasons is more respectful, as it is exposed and even celebrated. However, the fate of the non-human animal is predestined. As a homage to the fighter bull, we re-lifed its tissue and grew it over a miniature replica of a tourist-shop figurine in the shape of a bull. We contrasted the tissue from the bull with that from a burger and tried to obtain viable cells for re-life-ing. We also asked the audience to choose which one they would like to ‘kill’, that is, take back to its cultural accepted position of dead meat.

MEART

A project by the SymbioticA Research Group, titled MEART (a.k.a. Fish and Chips), is a Semi-Living Artist.[clxviii] It involves the use of rat neurons to move a robotic arm that produces marks on paper. This project is ethically problematic: working with neurons (rather than other tissues) potentially raises questions in regard to consciousness, awareness and the ability to feel pain and emotional stress, even if only in the symbolic realm. The question that needs to be asked is how many neurons in a dish (or in what configurations) is enough to create what we perceive as a sentient being? And although it is a semi-being in an artificial body, where is its ethical location in relation to both the sentient centred utilitarian ethics of Singer as well as in life-centred ethics. The Semi-Living artist seems to fall in between the cracks of both systems.

The original intention was to critique the use of neurons for computational devices and the possibility of the creation of a sentient computer. As this project is an on-going collaboration of many different people with their own sensitivities and ethical frameworks, the reactions to this possibility and its ethical implications are varied and very challenging to all people involved. The way this project can be read – as either celebratory or critical of the technology – will probably depend largely on the context in which it is presented. The first stage of this project (which was known then as 'Fish & Chips') used neurons from goldfish brains to drive the robotic arm. In a later stage of the project, rat's neurons were used as part of the collaborative project with Steve Potter's Neurolab Group, in Georgia Tech University, Atlanta US, which are developing new neuroscience technologies for studying learning and memory *in vitro*, using mammalian – rats - brain cells in culture on multi-electrode arrays (MEAs), to form a long-term, two-way interface between the cultured networks and a computer.[clxix]

Public reaction to the project mainly referenced the species from which the neurons originated.[clxx] However there is no visible or structural difference between human and rat nerve cells. Human neurons have been introduced to rat and mice brains and functioned as part of the animals' central nervous system.[clxxi] Yet another ongoing project had already drawn considerable emotional response because it involved human tissue (be it 'stupid' tissue like cartilage) for a human recipient, grown into a shape of a recognisable human organ – the external ear.

Extra Ear ¼ Scale

This project is a collaboration with the renowned artist Stelarc, in which TC&A grew a scale replica of the ear made out of human cartilage cells. The ear is cultured in a rotating micro-gravity bioreactor which allows the cells to grow into a three-dimensional structure. While we are interested in the various discourses that surround issues of partial life and semi-living, Stelarc's recent projects and performances are concerned with the prosthetic. Stelarc perceives the prosthesis not as a sign of lack, but as a symptom of excess.[clxxii] Rather than replacing a missing or malfunctioning part of the body, these artifacts are alternate additions to the body's form and function. In this project Stelarc's notion of the prosthetic and our notion of semi-living meet to create an object of partial life.

Extra ear – ¼ scale is about two collaborative concerns. In presenting a recognisable (partial) living human part, the project questions the notions of the wholeness of the body. It also confronts broader cultural perceptions of 'life', especially given our increasing ability to manipulate living systems. TC&A are dealing with the ethical and perceptual issues stemming from the realisation that living tissue can be sustained, grown, and is able to function outside of the body.[clxxiii]

Unlike Stelarc, TC&A is mainly interested in the ear as a standalone signifier of an independently existing part of the body, and are less interested in the eventual attachment of the ear to the body. Even so, it seems that this piece has managed to evoke a level of reaction not seen in earlier TC&A projects. The anthropocentric and religious view of the human body made in the image of God, motivated some of the extreme reactions against the Extra Ear ¼ Scale installation in the National Gallery of Victoria (NGV) in September 2003. The NGV refused to allow the use of human tissue for this installation and requested the artists to declare that the work does not raise ethical issues.

According to the curators of the NGV, shortly (about two weeks) before the show was about to open they realized that the NGV has no policy in regard to presenting living tissues in their gallery. The director instructed the curator to seek clarification in regard to the project including a statement from us that the work does not raise ethical issues in general and in particular in the biomedical community. TC&A could not reassure the gallery that this is the case, as we see the primary aim of our work to act as a tangible example of issues that need further ethical scrutiny, and critically engage with the biomedical project. This was stated as an important aim of the project when TC&A applied for the human research ethics clearance from the University of Western Australia.

Disregarding the fact that this installation received ethical, safety and health clearances from UWA, the NGV decided to cancel the installation, only to 'compromise' later and allow it to go ahead on the condition that human tissue was not used. This attention from the art world was motivated by innate psychological and also theological fears associated with the disfigurement of the body, and replayed in some respects the earlier NGV controversy in 1997 over the 'Piss Christ' by Andrew Serrano. TC&A agreed to the compromise of using animal cells, because it did not contravene the core project of investigating all living fragments regardless of species and tissue type.

This example emphasises the cultural sensitivities of a predominantly humanist or human-centred culture. The people who reacted so strongly to this project did not find our previous works, even these that included the use of neurons, worthy of their attention. It was only when the human body was involved that they were offended. Hence, from the initial problems with the NGV to later audience reactions, this work succeeded in revealing the underlying anthropocentrism of human morality

From Semi-Livings to Partial Life

The above issues raised by specific works of the TC&A project are extra to the ongoing ethical concerns that are built into all TC&A projects. By creating a hybrid partial life or semi-living entity which is part of life and part of the constructed environment, and at the same time in need of nurturing, care and mechanical repair, the TC&A project invites the audience to re-examine their preconceptions about their place in the continuum of life. It is important to note that at the level of tissue it is almost impossible (barring DNA tests) to distinguish between different species, and needless to say, between human and non-human tissue. Therefore, the continuum is not only about levels of organisation but also levels of specialisation and perceived differences.

Semi-living and partial life can be seen as interchangeable terms. However each term has its own nuanced meaning. The entities we have termed Semi-Livings are usually shaped to forms that are not recognisable as being part of any body in particular, whereas partial life can be recognised as parts (i.e., an ear) of the whole of a living being. In the continuum of life, the semi-living entities are nearer the non-living part of the scale, while objects of partial life approach the fully living. Therefore, in presentations of the semi-living, technological aspects of the work are emphasised (e.g., constructing a laboratory in the gallery), while with the objects of partial life developed recently, the technology sustaining them in the gallery plays a secondary and often insignificant role in the art experience.

Drawing on Singer's idea of ethics, while pushing the goalpost even further than sentiency, we are suggesting that going beyond the 'I' and 'You', specifically in the light of western ontology should mean going beyond race, sex, species and even more, the continuum of life. For that we have created a tangible evocative entity, for which the concept of sentiency is blurred, if it exists at all, that is partially living and partially growing in the gallery, as part of the artistic experience.

Our works emphasise ethical concerns by staging rituals that expose and symbolise different and usually conflicting relations to living systems. These rituals are located inside a laboratory-like set up situated in an art gallery. The rituals are performed for practical reasons – maintaining the life and growth of the semi-living sculptures – as well as for conceptual reasons. By celebrating and terminating semi-living art forms, we trouble the conventional art viewer's autonomous reflective space and his/her conventional understanding of what art is and is not. Our installations also involve performative elements that emphasise the responsibilities, as well as the intellectual and emotional impact, which results from manipulating and creating living systems as part of an artistic process. For example, the Feeding Ritual is performed routinely. Here we raise questions about the caring and nurturing needed for all life forms, including Semi-Living sculptures. The audience are invited to view the process of feeding as an integral part of the artistic experience.

At the end of every installation we are faced with the ultimate challenge of an artist – we have to literally kill our creations. The works have to be terminated by the end of the show for both practical and conceptual reasons. For that we devised the Killing Ritual. The killing is done by taking the Semi-Living sculptures out of their containment and letting the audience touch (and be touched by) the sculptures. The fungi and bacteria which exist in the air and on our hands are much more potent than the cells. As a result the cells are contaminated and die (some instantly and some over time). The Killing Ritual enhances the idea of the temporary nature of life and living art, and our responsibility as manipulators to the new forms of life. The killing ritual can be seen as either transforming the semi-living back to a 'sticky mess of lifeless bits of meat' or as an essential show of compassion; euthanasia of a living being that has no one to care for it.

We also make a point to invite the people who invited us (curators, gallery directors, etc.) to participate in the killing, as they also are responsible for the existence of the semi-living sculptures presented in their show. On more then one occasion people from the audience have approached us after the ritual and admitted that initially they did not believe our sculptures were alive until they were killed.

TC&A also encourages the artists and the viewers into an active role in the cycle of the life/death of the biological matter. Thus usually the experiment or the process that the artist is conducting is durational rather than 'result' orientated. The experience should also explore the interaction of the living (or semi-living) artwork with the audience (whether the scientists in the laboratory or the gallery visitors, patrons and staff) and vice versa. As the artwork is alive it is constantly changing. Further, the artists often invite the audience to take an active role in the decisions regarding the existence of the artwork, its maintenance and its ultimate death. An indifferent relation to the Other (that is located somewhere in the continuum between the living and the non-living) is almost impossible.

The Paradox

Semi-Living as a replacement for meat production, leather production and other venues of cruelty/exploitation of a whole organism can be seen, at first glance, as ethically justified from a sentient-centred point of view. However, as will be further illustrated in the following chapter, tissue culture is not free of sentient 'victims' as it is still using animal-derived products to feed the cells. Also, with a potential for future creation of somewhat sentient semi-livings, what TC&A is doing is creating yet another class of subjects/objects for human exploitation. Furthermore, tissue culture and tissue engineering involve the use of non-recyclable products and resources (lab ware is only one example) which have a lasting effect on the environment. Therefore, if a utilitarian analysis is employed to weigh the costs and benefits to the living environment the equation is very complex.

The Motivist/Consequentialist perspective is more concerned with the motives of the artist. In this respect the core factor common to all the above projects is the way each troubles the conventional dichotomies that govern traditional and current ethical systems. This derives from the medium of the work. At the level of the cells and tissue there is virtually no difference between human and other mammalian cells and all are becoming only fragments in the further complex and ethically charged techno-scientific projects. There are only semi-rights and semi-wrongs when weighing the ethical implications of the semi-livings on humans and their living and constructed environment.

In the application for ethical clearance from the Human Ethics Committee for the Extra Ear ¼ Scale Project, we stated:

This project is intended to make the viewers rethink their perception of life. This will undoubtedly cause uneasiness to some of the viewers. We feel that forcing people out of their comfort zone is one of the major roles of contemporary artistic practice dealing with the implications of the introduction of new technologies, and in particular when these technologies are dealing with new modes of manipulation of living systems.[clxxiv]

Potential benefits to the participants and to humanity in general were laid out as such:

To the participant:

We believe that the benefits to the viewers are that they will be drawn to reassess their perceptions of life in the light of their encounter with a real tangible example of the concept of partial life. This will hopefully assist them in forming an informed opinion in regard to developments in the bio medical field, and will provide them with the opportunity to meditate on what it means to be alive.[clxxv]

To humanity generally:

This project is part of a larger scale endeavor taken by artists internationally to deal with new concepts of self and life that our society is being confronted with, in the light of developments in the biomedical field. Art can play an important role in generating a cultural discussion in regard to these issues. By presenting tangible examples of contestable scenarios, art can act as a starting point for a broader philosophical and ethical discussion.[clxxvi]

However these aims expose a paradoxical position. On one hand there is the attempt to break down speciesism and make humans part of a broader continuum. On the other hand human artists are using (abusing?) a more privileged position to technically manipulate an aesthetic experiment with other (semi) life forms. This paradox is partially resolved by the realisation that humans are part of the continuum of life, and therefore any action taken regardless of motivation will carry an effect on their surroundings. This is not to suggest the equality or sameness of life and non-life. On the contrary, the project exposes the complexities of life and the continuum between life and non-life to which humans intimately belong. Following Donna Haraway's notion of 'human nature is a multi-species interdependency'[clxxvii] and the work of the TC&A, Bakke argue for a more post anthropocentric way of thinking: 'Rejecting the conviction of human exceptionalism, postanthropocentric thinkers go against the grain of Greek and Christian tradition…they point out the absolute necessity of considering any living being, including the human animal, as an ecological entity.'[clxxviii]

Informed hypocrisy and revealing inconsistencies is TC&A's ethical framework and our transparent strategy. The ambiguity and irony embedded in TC&A artworks creates a niche for such provocation.

Chapter 4 – The Ethics and Politics of Experiential Engagement with the Manipulation of Life

The previous chapter argued that the humanist attitude and its cosmological and ethical bases is under conceptual strain as a result of the dissolution of the species divide caused by developments in the life sciences. This chapter examines the importance of 'wet' engagement with the life sciences for better understandings of the complexities of life as well as for the contemporary framing of mis/understandings and mis/use of biological metaphors.

Recent developments in the life sciences have had a fundamental effect on individual and communal perceptions of life. Some of these developments present a profound departure from conventional cultural (and some might say) biological perceptions of what life is, and what can be done with it. The ways in which these developments are being presented to the wider community play into current socio-economic and political agendas. The ability to manipulate life is not only creating new forms of life and partial life, but also forcing us to re-evaluate different understandings of life and the dissolving boundaries in the life continuum.

The technological application of knowledge in the life sciences has created a wide array of responses from non-biologists who comment about the different aspects of the manipulations of living systems. Among them are a growing number of artists who engage with different levels of manipulation of living systems. This work draws a considerable amount of criticism. Ethicists, philosophers, politicians, theologians, writers and fellow artists respond to the so-called Biological Art phenomenon as well as to the larger issues concerning research, development and application of the life sciences, biotechnologies, bio-medical research and agriculture. Much of the criticism is valid and warranted; this includes questioning the motivations of the artists and funding bodies which support biological arts, issues concerning the responsibilities of artists toward life forms that are presented in artistic contexts, as well as the risk that works of art that are intended to caution and critique trends in the application of the life sciences will instead end up normalising and domesticating these developments.[clxxix] However, in many cases this critique is being marred by the misunderstandings of the different levels of engagement with life, overwhelmed by the complexities of life processes, outcomes and the plain subscriptions to prevailing hyperbolic discourses.

In the previous chapter I proposed a semi-ethical framework for the use of life manipulation for artistic purposes. This chapter will take this argument further: I will argue for the ethical, cultural and political importance of experiential engagement with life manipulation as it can be an effective methodology to confront the complexities and contest conventional and dominant ideologies regarding the life sciences and the social world more generally. This will be done by analysing and questioning the dominant discourse concerning the life sciences and BioArt, the narratives of life as a coded programme – 'biology as information'. This chapter will illustrate how these discourses are not only limited and misappropriated but also serve the ideology and rhetoric of western society advancing towards a false perception of total control over life and the technologically-mediated victimless utopia.

Life is not a coded programme and we are not our DNA

The mainstream discourse regarding the life sciences in the popular media, social sciences, the arts and even to a certain extent within the biological sciences themselves, seems to focus on genetics and molecular biology. This is the case even when the processes discussed have little or nothing to do with that level of biological intervention.

There is a direct relationship between this type of discourse and cybernetics and information theory. This correlation is partly based on a linear technological/historical narrative; the biological revolution follows the digital revolution. The recent biotechnological revolution was preceded by mid-twentieth-century advances in cybernetics and information technology that resulted in the computer and internet revolution of the late twentieth century. Cybernetic metaphors even penetrated the humanities in structuralist and post-structuralist theory, so it is no surprise that they also found favour in the biological sciences.

This linearity follows a path of least resistance – employing established narratives for new phenomena as much as the will to emulate the hi-tech bubble (inspired by its rapid successes and short-term return on capital investment) rather than following scientific findings. Applying the metaphors of the information and digital age to the life sciences acts to reinforce established and even dominant paradigms that now pervade all levels of power and society, the familiar and successful metaphors of ‘the dotcom boom’, drawing a direct correlation from the digital revolution to the biological one while they also conceal some fundamental differences between biology and information technology. Further, it has resulted in the same economic modelling and market-driven product development used to fund and evaluate information technology being applied to the life sciences, when the two have very different agendas. For example, intellectual property laws as they apply to software are very different when applied to living entities. Economic benefits from information technology are usually much more direct and the revenue returns are faster than in biotechnology. Risk assessment concerning information technology is shorter term and different in nature to the risks associated with new biomedical and agricultural products (and their mutative effects on the environment).

Recent investments and developments in the genome mapping techniques may have advanced the knowledge of gene mapping, however, the promised utopian scenarios of understanding life and curing diseases have been slow to follow. This is not to underestimate the advances in molecular knowledge but rather to criticise the ‘DNA mania’ (André Pichot)[clxxx] or ‘Genohype’ (Neil Holtzman),[clxxxi] largely captive of information technology metaphors, that currently prevails. Understanding life primarily by the metaphor of the code (genes or DNA) leads to misunderstandings about the complex mechanisms of life (especially at the cellular and more macro levels) and certainly will limit the potential for different understandings that are not compatible with this metaphor.

The mechanisms of life are enormous in their complexity and it is easier for us, who are 'locked' within our own physiology, to try and make sense of life through simplistic cause-effect formulas. 'We are our DNA' is one of these simplistic and misleading rhetorical statements.

The problem is that many of the developments in biomedical research do not so neatly adhere to information theory, and that the origins of their development and the conceptual frameworks that brought them about are often neglected and ignored. However, many people from different disciplines are consciously and unconsciously conforming to this pervasive discourse. I would also argue that theories lurking behind the development of cell theory and tissue culture, with their own set of problems, are re-surfacing together with the developments in stem cells, therapeutic cloning and regenerative medicine. In other words, I would suggest revisiting the period of Alexis Carrel rather than the discourses stemming from the epoch of Watson and Crick.

Case studies

My concern is with the many examples of critique of the life sciences which are based on what can only be described as sloppy research and misunderstandings of basic biological concepts, such as the difference between genetic engineering and tissue engineering (i.e., molecular manipulation and its effects versus cellular intervention). There is a need for correct terminology rather than careless generic terms in order for a meaningful dialogue to occur.

To an extent these misunderstandings are understandable. While the debate between scientists and social scientists and other humanities scholars may be fruitful, the latter are 'intimidated by the complexity of the science…This suggests a training need: to find ways to familiarize social scientists and humanities researchers with neuroscience, and to equip them to liaise with neuroscientists in a competent manner.'[clxxxii] The same can apply to other streams of the life sciences as much as it should apply in reverse; scientists who would like to comment seriously about social and cultural issues should engage with the relevant discourses. As will be outlined below, the main frame of reference concerning developments in the life sciences, and in particular their applications (whether techno-scientific or cultural-philosophical), tends to be mono-dimensional in focus. This seems to be the case in which a narrow band is used to discuss the entire array of complex interrelationships between different aspects and levels of manipulation of life. Ironically, both the proponents and opponents of biotechnological developments are mostly serving to promote one narrative – the reductionist (information technology) view that manipulation of life through modern biology only happens at the molecular (genetic) level. As a result, shared discourses tend to use the same frame of mind and the same metaphors concerning genetic manipulation to deal with other forms of biological engagement.

An example of this common phenomenon can be found in an article by Carol Gigliotti, 'Leonardo's choice: The ethics of artists working with *genetic* technologies' [my italics].[clxxxiii] Gigliotti discusses two principal case studies, one concerning the transgenic work of Eduardo Kac, the other the work of the Tissue Culture & Art Project, which does *not* work with *genetic* technologies at all but rather with tissue technologies. Furthermore, the key words for the article are: ‘Animals; *Biogenetics*;

Ethics; Aesthetics; Ecocentricism; Anthropomorphism; Animal rights; New media’. Biogenetics? Somehow, it does not seem that the article deals with debunking the notion of spontaneous creation of life; it seems that it is more a combination of the two ‘buzz’ words – bio and genetics.

Throughout the whole article, Gigliotti uses different terms in regard to both case studies, such as genetics, transgenic, biotechnology, as well as the awkward term ‘biogenetic art’. There is no apparent logic to the use of the different terms in the different contexts, which leads the reader to suspect that Gigliotti may not be familiar with, or may be careless in her use of, terms drawn from the different terminologies involved with the life sciences. In this article everything biological is ‘genetic’ (which might be true if one holds a very reductionist view that life is only about origin or development),[clxxxiv] and ignores the fact that genetics or transgenic procedures are different from other levels of engagement with life, such as at the cellular level, the tissue, organs etc.

Such factual inaccuracies and reductive use of metaphors make it very difficult to engage in the very important and relevant issues raised by Gigliotti, which question the anti-anthropocentric intentions of artists who use animals or parts of animals for their artistic research.

The same sort of of 'Genohype'[clxxxv] (using the term biology and genetics as if they are synonymous) occurs in a paper co-written by Carol Gigliotti and fellow social scientist, Steve Baker:

> *Abstract:* This dialogue concerns the nature of ethical responsibility in contemporary art practice, and its relation to questions of creativity; the role of writing in shaping the perception of *transgenic art* and related practices; and the problems that may be associated with trusting artists to act with integrity in the uncharted waters of their enthusiastic engagement with *genetic technologies.*
>
> *Keywords:* Art practice, *Transgenic art*, Ethics, Aesthetics, *Genetics*, Postmodernism. [my italics][clxxxvi]

Furthermore, Gigliotti is very much aware of the power of metaphors. Referring to her statement 'We are all transgenic', she writes:

> I wanted to throw the reader, the artist, the writer, the techno-theorist, the student, who appreciated my very specific points in earlier parts of the essay, a *metaphoric hook upon which they might begin or continue their own thinking.* The fact that there is a vast amount of genetic similarity between organisms, including humans, and we are all related by a shared evolutionary history, is the basis for the idea that we are all transgenic, and the basis, as well, for notions of a bio-centric compassion. *What current transgenic technologies are doing, however, is based on a flawed application of this similarity by reducing complex behaviours*

to single genes completely apart from the context of the formations of those behaviours. The problem with using what might be construed as an ambiguous metaphor is that it, too, might be misread and misapplied.[clxxxvii] [My emphasis]

However Gigliotti does exactly what she warns against: she conducts a reductionist analysis by grouping all biological art under the umbrella of trangenetic art. An example is her use of the term transgenic. Transgenic is a technical and specific term that relates to the transfer of genes from another species or breed. The fact that organisms share ‘a vast amount of genetic similarity’ is what makes the practice of transgenics possible. It can be argued that we are all transgenic due to horizontal gene transfer via viruses and other biological agents, but this is not what Gigliotti refers to. Rather she converts a specific technical procedure into a general metaphor that stands in for an array of other biotechnological procedures

Gigliotti does not follow what she has advocated, ‘the idea that a confrontation with the complexity of a topic or issue precludes the necessity of confronting ethical choices embedded in that complexity’.[clxxxviii] Her ethical critique of artists working with tissue culture does not regard the complexities involved within the relations between tissue culture and ethical treatment of animals. Furthermore, she practises Genohype and perpetuates a reductionist view of biology and biological art. Biological art that deals with other non-genetic forms of manipulation can be used as a way to counterbalance the view of life as determined solely by the DNA code. This is usually done by presenting the complexity of life and its interdependent relations with the environment. The development of living and semi-living entities affects and is affected by its surroundings rather than being just a ‘coded programme’ imposed on the environment.

The range of biological art reminds us how our understandings of life are not only limited by but also filtered by our biology and our anthropocentric make up. Examples range from the author’s practice as part of the Tissue Culture & Art Project, in which tissue technologies are used as a medium of artistic investigation, to artists who are working with the level of the organism and its ecology, such as Phil Ross[clxxxix], Brandon Ballengee[cxc] and Perdita Phillips.[cxci] Another example is the artistic work of Paul Vanouse who does work with DNA, but with the intention of questioning genetic determinism, as in *The Relative Velocity Inscription Device*.[cxcii] In this work Vanouce is ‘racing’ (from an ironical point of view both in the sense of competition as well as in relation to skin colour) DNA samples taken from skin cells of members of his family, using electrophoresis gel. Vanouse’s family is partly Jamaicanand partly white American, and this work sets out to determine the racial variability of individual family members according to their skin colour.

However, electrophoresis gel technique is used to measure the molecular length of specific genes as a way of making identifications between genes. It has nothing to do with qualities of genes as such or with genes as they are translated into a body. This renders the Vanouse family race as nonsense; the measurement of the molecular length of a specific gene does not indicate anything about the respective family members and what race is about.

> Since within any race there are more genetic (DNA) differences than between races, there is no genetic (DNA) basis for existing race categorizations. Optimists believe that such findings will put an end to the concept of race and thus racism. Pessimists note that science has always been used to maintain existing hierarchies and thus will be manipulated for new varieties of discrimination. RVID operates in this tense space between critical and utopian appraisals of contemporary genomics and the politics of race. It transfers the discussion of difference from the physical bodies of its subjects to their DNA, and ironically re-anthropomorphizes their DNA by inscribing value to its movements (through the gelatin) as if each sample were running a foot race to determine genetic fitness.[cxciii]

Vanouse continued his critique of inscribing social prejudices to images of DNA code as part of a residency at SymbioticA in 2006. In the project Vanouse developed at SymbioticA, titled *Latent Figure Protocol*, he ‘utilized DNA sequencing technologies to create representational images in which there is a tension between that which is portrayed/represented and the DNA materials used to generate it. Not simply images of a sequence of DNA in a gel (like a DNA fingerprint), but rather DNA sequences in a gel specifically chosen to create a quasi-photographic representation of another subject.’[cxciv]

When reducing life to the code – abstracting the complexity into its chemical components – the visceral sentient life is being pushed further away. As Noble notes: ‘What the genes do is to contain the database from which the system can be reconstructed. They are the "eternal" replicators. They don't die, but outside of the organism they also don't live.'[cxcv]

The inability to distinguish genetic engineering from tissue culture/tissue engineering leads to the following example, and as will be discussed later, presents an opening to an interesting case in which technology helps to hide its victims even from the eyes of the most avid watchdogs.

In her article, 'Leonardo's choice', Gigliotti identifies the correlation between developments in genetic engineering and the increase in the use of animals in biomedical research, mainly through the use of knockout mice:

> …though the use of animals in experimentation has decreased slightly over the last 40 years due to the diligence and commitment of a vast network of animal welfare and animals rights organizations, ...the impact of genetic engineering on animal use should be carefully monitored, given its potential to reverse the decreases in animal use seen during the 1980s and 1990s (Salem and Rowan, 2003).[cxcvi]

What Gigliotti fails to mention, especially in regard to the work of TC&A, is that one important way to reduce the 'use of animals in experimentation' is the use of tissue culture as an experimental model rather than the use of full bodied animals, a method that been endorsed and promoted by the same ‘vast network of animal welfare and animals rights organizations’.

The European Coalition to End Animal Experimentation, in a statement on its web site,[cxcvii] puts cell and tissue culture as the first example of non-animal research techniques recommended by the coalition. The case is similar to the PETA fact sheet: ‘Alternatives: Testing Without Torture’,[cxcviii] in which cell and tissue cultures are offered as an important substitute for animal testing.

The work produced by TC&A employs the very same techniques recommended by animal rights organisations, and yet Gigliotti accuses TC&A of following paths ‘which are littered with the bodies and lives of millions of animals’[cxcix].

This example represents the problem of discussing all forms of biological manipulation in the context of genetics. As will be demonstrated below there are animal welfare issues concerning tissue culture, but they are not the same as those presented by Gigliotti. By clustering tissue culture with genetics, Gigliotti and others keep on missing the opportunity to meaningfully discuss and expose the multitude of issues that we as a society need to address. Furthermore, by subscribing to and promoting the ‘biology as genetics’ view, scholars, critics, and artists are complicit in the creation of the mythology and metaphors that serve to obstruct the victims and lead to a narrowing of the concerns that society and decision makers take into account in the forging the paths ahead.

The hidden victims of Tissue Culture

In 2003, TC&A was approached by PETA to collaborate on a project that involved growing 'victimless meat'. A representative of PETA wrote, in regard to the latest research project by TC&A, *Disembodied Cuisine*: 'You have extended the boundaries of what is considered natural and given new appreciation to the complexities and paradoxes of life. We are extremely intrigued by the poignant issues you raise regarding the sanctity of human life and the artificial demarcations humans have constructed between human life and all other forms of life and life that has yet to be classified as such.'[cc]

Irony is an important part of the practice of TC&A, and is employed as an artistic and philosophical response to technological determinism and the sort of reductionism discussed above. We are very aware of the paradoxical statements of artists who use certain technologies while critiquing their use. Irony is also useful in subtly countering the tendency of being used by the media and other interested institutions as an agent in promotion and normalisation of different developments. However in this over-hyped area, irony can often be too subtle to be noticed.

In the *Disembodied Cuisine* installation, TC&A ironically offered the possibility of eating meat without killing animals, creating a victimless meat. The meat was formed from cells from a biopsy taken from a live animal proliferated in vitro.

However, current methods of tissue culture require the use of animal-derived products as a substantial part of the nutrients provided to the cells, as well as an essential part of different tissue culture procedures.[cci] This point about tissue culture seemed (until recently) to go unnoticed by the advocates of its use as a replacement for animal experimentation. The abstraction of these animal products in the technology associated with tissue culture served to obscure the very real victims from the eyes of organisations such as PETA and the European Coalition to End Animal Experimentation. For example, on a rough estimate based on TC&A experience in growing in-vitro meat, growing around 10 grams of tissue will require serum from a whole calf (500ml), which is killed solely for the purpose of producing the serum. Furthermore, at the request of a researcher (who later founded New Harvest, a spin-off company of the University of Maryland that is a nonprofit research organisation working to develop new meat substitutes, including cultured in-vitro meat[ccii]) we were asked to calculate the costs of such meat. We calculated that the one gram of in-vitro frog steak we grew in Nantes in 2003 cost us then US$650 (this is without calculating in monetary value the costs for the environment such as discarded plastic ware, energy etc).

The Art History Narrative

As mentioned above, Carol Gigliotti is not alone in her ‘biology = genetics’ view. In the context of the emerging area of biological art or BioArt, much of the discussion of BioArt seems to follow a neat, but problematic, linear historical narrative. The case of this narrative is not so different from the general genohype in its outcomes, but its intentions are specific to the field. Nevertheless, it can illustrate the problems associated with the patterns that lead to the limited public engagement with biology and focus on only one aspect of the biotechnological story.

Many scholars draw a direct line from genetic art (using genetic algorithms to generate artificial life entities and/or computer generated objects and forms) to BioArt. Some examples can be found in the writings of scholars such as Gerfried Stocker, Suzanne Anker, Ingeborg Reichle and others. In order to rationalise this leap from computer-generated art to art that involves the manipulation of biological life, the proponents of such a narrative take the view that biological life is all about the code; that the artists and the work involved with biological art deal with the 'code' of life. One can speculate that the combination of genohype and the need for cohesive narrative leads to ignoring the complexity of the different levels of engagement with life.

This proposition leads to an assumption of a linear, controlled, and progressive history of BioArt that seems to be the line of choice of most art historians, curators and theorists, who find it hard to cope with the multiplicity of sources, concerns, motivations, backgrounds and references of BioArt. The need to create a seemingly coherent, yet simplistic, narrative to explain the somewhat abrupt appearance of biological art created an array of swiftly forced postulations regarding the origins and progression of the field.

Even though practitioners in the field have diverse backgrounds, ranging from formalist and conventional art through eco-art to body-art (see chapter 6), in the eyes of published art historians, BioArt seems to be linked to and originated from digital art. This line propagates a teleological and historicist stance that sees knowledge production as an inevitable and deterministic progression of unidirectional growth. One example is from the curatorial premise of an exhibition titled *Genesis! Creation in the Age of Electronics* (2007):

> …it was not before the development of air pumps that we could say that 'the heart pumps blood'. Before the age of information, we could not understand that the genome was a program,…
>
> …. Is creation a haphazard construction shaped by accidents and contexts or does it require a program, with defined sets and rules? How has information, program and other concepts from the age of computer sciences structured how we think of creation? And what are – if any – alternative ways of creating in are and science? This is what the exhibition *Genesis!* is about.[cciii]

Fox-Keller cautions about the discourse of 'genetic programme': 'In identifying genetic continuity and change as the sole fundament of evolution, it contributed powerfully to the polarisation of debates over the relative force of genes and environment in such highly charged arenas as eugenics and the "hereditability" of intelligence and other behavioural attributes'. [cciv]

BioArt is far from being a coherent movement with a common origin. Most artists who work with the manipulation of living systems seem to dislike the term Bioart and would rather distance themselves from being bunched up with the other so called bio-artists. The art historians' and curators' desire to cluster these discrete modes of operation under a unifying banner is understandable, but the forceable fitting of a common history and lineage is often inappropriate and misleading.

Community versus data: cells versus DNA

Dennis Noble:

> DNA never acts outside the context of a cell. And we each inherit much more than our DNA. We inherit the egg cell from our mother with all its machinery, including mitochondria, ribosomes, and other cytoplasmic components, such as the proteins that enter the nucleus to initiate DNA transcription. These proteins are, initially at least, those encoded by the mother's genes. As Brenner said, 'the correct level of abstraction is the cell and not the genome'.[ccv]

Evelyn Fox Keller:

> I want to argue that taking the cell rather than the gene as a unit of development does make a difference: not only does it yield a significant conceptual gain in the attempt to understand development, it also permits better conformation to the facts of development as we know them.[ccvi]

The issue is that many of the developments in biomedical research do not so neatly adhere to information theory and that the origin of their development and the conceptual framework that brought them about are often neglected and ignored. For example, arguably the developments in regenerative medicine (such as therapeutic cloning, stem cells research, tissue engineering) can be traced back to early cell theory and to the work of Alexis Carrel and its tainted history in 1913 rather then to Watson and Crick in 1953.

As explained by Noble:

> …at this stage of our exploration of life, we need to be ready for a basic re-think…It requires that we develop ways of thinking about integration that are as rigorous as our reductionist procedures, but different. This is a major change. It has implications beyond the purely scientific. It means changing our philosophy, in the full sense of the term.[ccvii]

Decisions that are made now in regard to the type of application of the biomedical research tend to conform to the reductionist view of life. In many cases these decisions (and more often the critique of these decisions) are being made from a conceptual and ontological framework that is not relevant to the actuality of the processes and outcomes.

This dissertation does not underestimate the importance and significance of the field of molecular biology. Also, as discussed by Eugene Thacker in *The Global Genome*, the relationships between information theory and cybernetics and the field of molecular biology are closely related, but the two niches have mutated in their respective meanings. Thacker continues to argue that genomics re-materialised the information rather than virtualised the biological material. It is interesting to note that although Thacker discusses the problems associated with the concept of information and the concept of life itself, he himself, when discussing regenerative medicine, felt compelled to insert it into the 'Decoding' section of *The Global Genome*,[ccviii] but not as a technology that 'debugs' the information/cybernetic analogy.

As a critique of the reductionism of much genomic-based research Thacker quotes Canguilhem: '…these relationships [organism and its environment] are not simply a matter of information processing, but of informatic-based understandings of biological life that is inseparable from the material, meaning-making process of the organism: "Biology must therefore first consider the living as a meaningful being…To live is to spread out; it is to organize a milieu starting from a central reference points that cannot itself be referred to without losing its original meaning".'[ccix] Thacker also offers Lewontin's new view of genetics as a 'triple helix' of genes, organism and the environment.[ccx] However, the problem that arises from that metaphor is that it is still rooted in the code/informatics view of life. It is not the double helix that interacts with the environment but rather a whole organism that exists, grows and changes together with its environment. Noble argues that: 'The statement suggests that organisms are defined only by their genes; whereas in truth they are also defined by the very varied ways in which genes actually operate within a living cell, and these gene expression patterns are most certainly influenced by the outside world'.[ccxi]

It seems that even in the field of genetics we are witnessing some fundamental problems with conceiving life in relation to the metaphors of information and cybernetics. The situation becomes even more acute when this conceptual mind-frame is applied to the areas of regenerative medicine, stem cells and therapeutic cloning, not only by the biologist who works in the field but also by other people supporting the field such as engineers, biomaterial scientists etc. The 'language' of the code not only perpetuates misunderstandings regarding the processes involved; it also severely limits the developments of new understandings that are ‘true’ to the biological materials involved. This is becoming apparent in the growing field of synthetic biology which attempts to develop genetically modified organisms as building blocks for engineering ends, using the logic of engineering to create these biological circuits:

> ‘You write the same software and put it into different computers, and their behavior is quite different,’ Mr. You said. ‘If we think of a cell as a computer, it’s much more complex than the computers we’re used to.’
> For that reason, some scientists say, it might be difficult ever to make biological engineering as predictable as bridge construction.
> ‘There is no such thing as a standard component, because even a standard component works differently depending on the environment,’ Professor Arnold of Caltech said. ‘The expectation that you can type in a sequence and can predict what a circuit will do is far from reality and always will be.’[ccxii]

Tissue engineers, who are mostly working at the level of cells and tissue, seem to be just as aware of the problems of applying engineering logic on living systems:

> The cell is at the center of the developmental world. Truth be told, we cannot, as tissue engineers, actually claim to engineer tissues. We can only engineer an environment for cells that might induce, enhance, or mediate their

> developmental processes. But progress has been buoyed by biomimetics – lifting recipes from nature for the design of tissue engineering systems.[ccxiii]

As some of the current major developments in the life sciences are concerned with cell/tissue development (rather than genetics) it is worthwhile to look at cell theory and tissue culture in the beginning of the twentieth century (as discussed in chapter two). These theories are concerned with the materiality of 'life' and the environment in which it develops. Rather than code, there is an emphasis on communal interrelationships as a reference point.

In Canguilhem's discussion of the early formation of cell theory, there are a couple of narratives that have developed concerning ideas and research on cellular formation. The first is the narrative of individuation (or where the Haecceity resides)[ccxiv] and its relation to the bigger 'whole', and the second is of the community. Metaphors of community, labour and the nation state have been attached to the conceptual understandings of the way cells, tissues and organs operate within and without a body:

> In fact, the cell is both an anatomical and a functional notion, referring both to a fundamental building block and to an individual labour subsumed by, and contributing to, a larger process. What is certain is that affective and social values of cooperation and association lurk more or less discreetly in the background of the developing cell theory.[ccxv]

Animal cells are a complex system which behaves according to its environment and the signals it receives from its constitutive community of cells. Hence the same cells will behave differently if in the body or in a dish. In the case of embryonic stem cells which have the ability to differentiate to any cell type, they receive many of their 'differentiation instructions' from their surrounding cells. This is especially relevant to cells grown in culture.

In a way, while the metaphors surrounding information theory and the code refer to some sort of a central processing unit (or a control mechanism that operates on the materiality), cell theory allows autonomy to parts which can operate, evolve and mutate independently and in direct relation to their surroundings. 'Oken anticipated the theory of degrees of individuality. This was more than just a presentiment, though it did anticipate that techniques of cell and tissue culture would teach contemporary biologists about differences between what Hans Peterson called the "individual life" and the "professional life" of cells.'[ccxvi]

As always, metaphors are a fruitful source for new understandings and misunderstandings. What is unique to the dominant metaphors developing in cell biology is that they tend to be more morphic and adaptive to their environment, however, at the same time they tend to become anthropomorphic in our interpretation of their individual and communal 'behaviour'.

Getting close to the victim and the need for informed experiential engagement

As demonstrated above, much of the perception of development in the life sciences is marred by misappropriation of prevailing metaphors, ideologies and hype. Working in different laboratories with living materials, TC&A project members are faced with the complexity of life in a multi-levelled way: how living entities (whether cells, organs, organisms or populations) cannot be separated from their environmental factors and are always in flux. In Fox-Keller's words: 'To be sure, the concept of program has changed considerably since the 1960s, but it has not lost its facile assimilation with information, or, more generally, its disembodied aura.'[ccxvii]

One way to understand the different concerns and complexity of the different levels of engagement with life, as well as a way to reveal the obscured casualties of the new technologies, is by hands-on experiential engagement. By working hands-on with tissue technologies, we were confronted with the 'hidden victims' of this field; the animals from which the tissues are obtained, animal-derived ingredients in the nutrient media as well as the waste created (mainly in the form of plastic lab-ware), which has a lasting effect on the environment. To use another metaphor, being in the lab is akin to going to the slaughterer rather than to the supermarket to obtain beef. This approach can and is being utilised by artists who are working with biology. For the non-scientist the 'wet' experience in the laboratory involving some degree of life manipulation can be seen not only as an ethical conduct but also as a political act. As a political act it goes beyond the democratisation of the technology to the actual act of dominant discourses, dogmas and metaphors to reveal new understandings of life and the power structure it operates within. This experiential engagement can sometimes reveal that critique levelled against some biological art is embedded within the dominant dogma, and is less than relevant to the actualities.

To further illustrate TC&A's engagement with semi-livings in the context of 'genohype', I would like, in the next chapter, to draw on a specific occasion which led TC&A to the development of *Pig Wings*; a project that celebrates the 'aesthetics of disappointment', to counter-balance the unrealistic expectations and fears generated by the biotech hype.

Chapter 5 – Big Pigs, Small Wings: on Genohype and Artistic Autonomy

Introduction

On Thursday 23 November 2004, the headline on the front page of the *West Australian* newspaper was: ‘Gene tests to pick junior sports stars’.[ccxviii] The news item begins with the following prediction: ‘Parents wanting to know if their child has what it takes to be a sports star will soon be able to buy a genetic test for about $100 from local sporting clubs and gyms’. Finally, it seemed, a tangible outcome for the Human Genome Project (HGP). Is this the great promise that was delivered so ceremoniously just a few years before? Exactly four years prior to the publication of the above story in the *West Australian*, TC&A received a letter from the Wellcome Trust’s Two10 Gallery inviting us to submit a proposal for a commissioned work in an exhibition titled *Working Drafts: Envisioning the human genome*.

‘Genohype’ is a term coined by Neil Holtzman to describe the discourse of exaggerated claims and overstatements concerning DNA and the Human Genome Project.[ccxix] Genohype is the hype generated by scientists, the media, the public and the arts in regard to genetic research. One of the effects of genohype, as will be illustrated, is that genetics became synonymous for all life sciences. In this chapter, genohype will be examined in relation to the role of artists dealing with the application of newly acquired knowledge/technologies, using TC&A's *Pig Wings* project as the case study.

Genohype

As Nick Brown points out:

> … it is often the case that, for a time at least, various areas of technological innovation become saturated with stratospherically high expectations of immanent and revolutionary change. Biotech is no exception and is today synonymous with the language and imagery of futuristic breakthroughs. The whole area is literally spilling over with heated aspirations, promises, expectations, hopes, desires and imaginings.[ccxx]

This type of hype is required, according to Brown, to persuade investors, regulators, and the public of the need to invest and take risks to accomplish the revolutionary breakthrough promised by the developers of the technology. However, by creating these unrealistic expectations the promoters run a double risk. In the case of biotechnologies, the first risk is that the promises for incredible future scenarios will simultaneously raise great concerns that things will go horribly wrong. The second risk is that when it becomes obvious that the promise is not going to be fulfilled, the extent to which it was hyped will become known, disillusion and mistrust will then set in, to the point at which the level of funding subsequently drops and public confidence is lost.

How has biotechnology in general and the Human Genome Project (HGP) in particular dealt with these issues? The Critical Art Ensemble addressed aspects of this question in their project, *Cult of the New Eve*.[ccxxi] They were interested in the type of rhetoric that is employed to sell biotechnology generally and the HGP especially. They argue that the biotech industries needed to remove themselves from the dark past of the biological-inspired ideologies of progress manifested in Nazism, by using rhetoric borrowed from religious discourse. This, in turn, created a new type of scientific promise that the public was less able to read through, creating more hype, unrealistic expectations and fears than other techno-scientific developments. This was done through combination of electronic information systems with performative theatre practice, done in public spaces.

As early as 1994 (a year after the HGP began in the UK, known then as the British Human Genome Mapping Project) some scientists, such as Steven Ross, a professor of Biology, expressed their concern that supporters of the project were '…guilty of extraordinary hype. They call it things like the book of life, or the code of the codes'.[ccxxii] This kind of rhetoric had reached an unprecedented level by the joint announcement of the completion of both the public and the private working drafts of the HGP in June 2000. Both the US President, Bill Clinton, and the UK Prime Minister, Tony Blair, appeared in a press conference to announce this event.[ccxxiii] A short survey of the press releases produced that month by only one of the players in the public HGP, the Wellcome Trust, revealed the extent of this hype. According to the Director of the Wellcome Trust: 'A few months ago I compared the project to the invention of the wheel. On reflection, it is more than that... But this code is the essence of mankind, and as long as humans exist…is going to be important and will be used.'[ccxxiv] The Chief Executive of the Wellcome Trust Genome said: 'I think there is something magical…. I think this is quite extraordinary and awe inspiring'.[ccxxv]

But even the Wellcome Trust conceded in February 2001 in an online article titled 'History of the Human Genome Project: The First Draft, June 2000', that: 'The joint announcement was probably more grandiose than the situation warranted but it ended concerns that one side or the other would be pre-empted, and it took the pressure off in terms of press coverage'.[ccxxvi] The author of this article, identified only by the initials 'GF', tried to soften the message by assuring us that:

> While the timing of the announcement may have been dictated more by political than by scientific criteria, there is no denying the importance of what has been achieved, and what will be achieved. The next few years will be devoted to filling gaps in the draft sequence and improving the overall accuracy.[ccxxvii]

The cover story in the *West Australian*, cited at the beginning of this chapter, shows that genohype endures. The idea that one test examining variants of one gene can determine the potential of a child to be an 'elite' athlete, demonstrates genohype in action. Although the newspaper report quotes a scientist expressing concerns about this scenario, this only serves as a prelude for the main thrust of the story; the concern that these tests will 'add to the existing pressure on young people to succeed academically and in sports'.[ccxxviii] The scientific report does not seriously question the feasibility or validity of gene-testing technology in determining specific attributes such as athletic traits or intelligence. The starting point of the ‘debate’ is instead genetically and technologically deterministic. In other words, the story gives the impression that one gene is all that it takes and that these kinds of tests are here to stay.

Contemplating the post-genomic future, we hear voices that advise against being seduced by genohype. These include, for instance, Neil Holtzman, Director of Genetics and Public Policy at Johns Hopkins University, who coined the term ‘genohype’: ‘Exaggerating the importance of genetic factors stops people thinking about the need to clean up the environment and tackle socioeconomic inequity’.[ccxxix] His argument is with those who exaggerate the clinical benefits that may arise out of the HGP. He describes claims, such as those made in the editorial in the ‘Genome’ issue of *Nature*, that ‘…the application of knowledge from the project will, in time, materially benefit almost everyone in the world’ as ludicrous.[ccxxx] These claims are based on the assumption that it will be possible to unravel the polygenic forms of common diseases even though the clinical outcome is determined by complex genetic, environmental, and behavioural interaction. In his view, however:

> It will be difficult, if not impossible, to find the genes involved or develop useful and reliable predictive tests for them. It may keep the ethicists and philosophers in business but I think the term ‘ethereal debates’ describes them best, for they are built on a house of cards. The idea that we will be able to select genes we like and weed out those we don’t to produce customized children is absurd.[ccxxxi]

After steady lobbying, Holzman and others have now persuaded the US Food and Drug Administration to regulate the use of genetic tests. As observed also by Nick Brown, an interesting phenomenon occurs when knowledge is transferred from specialists' peer-reviewed scientific publishing to the public sphere, via the vehicle of press releases:

> … much of the careful qualification of scientific texts is abandoned for the more strident language of 'breakthrough', 'the first', 'the best', 'never before'. In other words, science communities suddenly metamorphose themselves into the highly competitive news conventions of the media code. When press releases arrive on the desks of science correspondents there is often precious little time to interrogate claims about new cures and revolutionary promises.[ccxxxii]

Brown also observes that different voices compete in representing the future and progress. He suggests that: '…like any other contestable field, actors engage in such struggles with unequal access to resources with which futures are manufactured'.[ccxxxiii] This type of struggle is clearly evident in the relationship between the public face of the HGP (represented by the Wellcome Trust) and the private interests involved in it (represented by, for example, Celera). One resource that the Wellcome Trust called upon, which Celera could not match, was access to the public's imagination through the Wellcome Trust's prior standing in and involvement with the arts.

Genohype as a dominant factor in the discourse of the new biology

One of the outcomes of genohype, at the level of public discourse, is that everything biological becomes confused with genetics. TC&A artists are constantly surprised by how many people tend to associate engagement with visceral messy cells, tissues and organs with the reductionist, controlled, clean promises of genohype. This seems to happen often with reactions to art that deals with biology. As discussed previously, TC&A artists are often referred to as 'genetic artists' and our work, which deals with tissue engineering, is described as 'transgenic'.

An example can be found in Suzanne Anker and Dorothy Nelkin's book, *The Molecular Gaze: Art in the Genetic Age*, where it is claimed that TC&A produces transgenic artwork.[ccxxxiv] In other cases, the words genetics or DNA are somehow inserted into discussion of our work for no apparent reason except as a result of the recurrence of genohype. For example, a review of our work was titled 'Giving (Real) Life to Art: Genetics and tissue culture find new forms – and a new audience'.[ccxxxv] Suffice it to say that in the body of the text there is no mention of any issue concerning genetics.

It is important to emphasise through artistic or curatorial work the diverse approaches encountered in biological art.[ccxxxvi] These deal with all levels of life from the macro to the micro and include research about the social life of organisms, the whole body, tissues and tissue culture, as well as genetics and DNA. Ironically, often the same work that criticises the reductionist view of life is used purposefully or by ill-informed people/journalists/curators to further the hype of the absurd idea that ‘life is what is in the genes’.

One example related to this hype is in the case of the ‘Who plays God?’ advertisement from 1999 featuring a photograph of Vacanti’s mouse with a human ear attached to its back. [Figure 13] The advertisement was sponsored by The Turning Point Project, a coalition of technologically concerned and environmental groups including Greenpeace, the Sierra Club and the American Public Interest Research Group. The caption states: ‘This is an actual photo of a genetically engineered mouse with a human ear on its back’. The text rails against genetic engineering:

> The genetic structures of living beings are the last of Nature’s creations to be invaded and altered for commerce... the infant biotechnology industry feels it’s okay to ... reshape life on Earth to suit its balance sheets... Who appointed the biotech industry as Gods of the 21st century... So far, there exist no half-human, half-animal ‘chimeras’ (like mermaids or centaurs) but we may soon have them.

Who plays God in the 21st century?

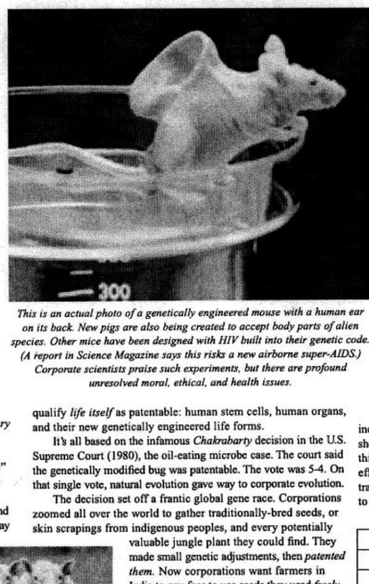
The genetic structures of living beings are the last of Nature's creations to be invaded and altered for commerce. Now they're being seized for corporate ownership. Nothing will ever be the same, and we approach the gravest moral, social, and ecological crises in history.

Earth began over four billion years ago. A billion years later the first sponges evolved out of the primordial soup. Dinosaurs emerged only 215 million years ago. The first human? Barely 50,000 years, a blip of geologic time. The industrial revolution is about 200 years old; television — 50 years; personal computers — 30 years. Genetic engineering? Less than that.

Does anyone think it's shocking, therefore, that this infant biotechnology industry feels it's okay to capture the evolutionary process, and to reshape life on Earth to suit its balance sheets? To put parts of animals into humans and vice versa? To put human genes into pigs, fish, and plants? To put fish genes into tomatoes? To put viruses and bacteria into the genetic codes of other creatures (including the AIDS virus spliced into mice)? To create plants that can't reproduce? To redesign and clone animals (and soon, humans) to fit a market function? To take over Nature's work?

When did we approve all this? Who appointed the biotech industry as Gods of the 21st century? Doesn't democracy function anymore? Why is the government supporting this with tax dollars and Clinton-Gore exclamations of praise? Have we lost our sanity?

Our society is not used to questioning technologies. But it's a skill we need to develop. Here are some issues that deserve your attention.



This is an actual photo of a genetically engineered mouse with a human ear on its back. New pigs are also being created to accept body parts of alien species. Other mice have been designed with HIV built into their genetic code. (A report in Science Magazine says this risks a new airborne super-AIDS.) Corporate scientists praise such experiments, but there are profound unresolved moral, ethical, and health issues.

I. Breaking the species barrier

Whether you give credit to God, or to Nature, there is a *boundary between lifeforms* that gives each its integrity, and identity. We are not fish; we are not plants. They are not each other.

So far, there exist no half-human, half-animal "chimeras" (like mermaids or centaurs) but we may soon have them. We already have similar things. Biotech companies are blithely removing components of human beings (and other creatures) and treating us all like auto parts at a swap meet. An astounding array of new creatures is being created. They include mice with human ears; frogs with no heads; fish with human genes; plants with animal and human genes; animals created for spare parts for later insertion into humans; tobacco genes in lettuce; bacteria genes in potatoes; viruses in vegetables; human embryos cloned for later use. It's like Dr. Moreau's menagerie, but these are not mad scientists at work. They are highly paid graduates of prestigious universities such as Harvard, Princeton, and M.I.T., dazzled by dollars and fame.

Coming soon: cloned humans?

The industry says some of these experiments may save lives, but so far there are few successes. There's an equal or greater chance for terribly negative consequences.

When you transfer body parts, or genes, from one species to another you may also transfer dangerous viruses *across species barriers*. This has happened by accident several times. In the early 1900s, a swine virus jumped into humans. And lately, AIDS probably resulted from a virus jumping from monkeys into humans. Both of these accidental cases of viruses crossing species boundaries produced global pandemics, killing millions of people. *Now our scientists are doing it on purpose.* Nobody can be sure of the long-term outcome. There have been few long-term tests. Shouldn't a sane government require those?

II. Patenting life forms

When you hear "patents," you think of machines and technical processes. Think again. The biotech industry has managed to qualify *life itself* as patentable: human stem cells, human organs, and their new genetically engineered life forms.

It's all based on the infamous *Chakrabarty* decision in the U.S. Supreme Court (1980), the oil-eating microbe case. The court said the genetically modified bug was patentable. The vote was 5-4. On that single vote, natural evolution gave way to corporate evolution.

The decision set off a frantic global gene race. Corporations zoomed all over the world to gather traditionally-bred seeds, or skin scrapings from indigenous peoples, and every potentially valuable jungle plant they could find. They made small genetic adjustments, then *patented them*. Now corporations want farmers in India to pay fees to use seeds they used *freely* for millennia. Many cannot afford what corporations are asking, and more than one million of them recently held a mass protest about it. They called it "biopiracy." Someday when one of these companies finally decides the public mood is receptive, will they make a human-gorilla combo to take care of heavy labor? Will they produce perfect "designer human" embryos creating trendy humans by the year 2050? Already they can protect some such "inventions" with patents. There's no point in creating superior creatures if you can't own them.

III. Genetic roulette

We have mentioned that genetic engineering can cause the transfer of dangerous viruses or bacteria across species. A similar danger exists of *environmental pollution* caused by biotech organisms that escape into Nature. For all their efforts to control these often weird life forms, biotech companies have a huge problem. *These things are alive.* And they don't want to go back to their test tubes.

In agricultural biotechnology, the industry releases hundreds of thousands of new genetically engineered organisms into the environment every year. They say it's safe, but how could we know? Our government does not require independent long-term tests. We are playing genetic roulette.

Biotech creatures and microbes are unpredictable. They can reproduce, cross-pollinate, mutate and migrate. They can jump across species using virus vectors. They can hitch rides in cars, boats and planes or in your socks. They can show up in other ecosystems. Like the Gypsy Moth, Dutch Elm disease, and Kudzu vine, "exotic organisms" can run amok and cause unparalleled environmental destruction.

There are other *truly* terrifying scenarios to at least consider. Some companies have designed GE plants that *resist* herbicides; if one such plant cross-pollinates with a weed, you could then have a pernicious herbicide resistant weed that would be nearly impossible to kill. Companies are also creating plants with sterile seeds. If a gene for sterility crosses over to other plants, you might get a mass die-off of plant life.

Finally, there are new bacteria that researchers are creating to break down plant matter into ethanol. The idea is to provide a new plentiful fuel supply. But what if such engineered bacteria escape into Nature? Could they turn *all* plant life into ethanol? If so, that would surely leave plenty of fuel, but no Nature.

In *Brave New World*, Aldous Huxley predicted a society where human beings are genetically engineered for commercial and industrial purposes. They don't protest because they are designed "to love their servitude." Has that already happened to us? Not yet!

Call us. We will provide you with more information, including lists of genetically engineered products on supermarket shelves. We will also put you in touch with the groups listed on this page, and dozens of others who are working to introduce effective safety requirements for biotechnology, controls and transparency requirements on the industry, and to bring the matter to full public awareness.

International Center for Technology Assessment
Food First / Institute for Food and Development Policy
Foundation on Economic Trends
Council for Responsible Genetics
Humane Society U.S.
Sierra Club
Institute for Agriculture and Trade Policy
Center for Food Safety
Edmonds Institute
International Forum on Globalization
International Forum on Food and Agriculture
Mothers and Others
Friends of the Earth
Center for Ethics and Toxics
Mothers for Natural Law
Organic Consumers Association
Campaign for Responsible Transplantation
Earth Island Institute
Native Forest Network

Signers are all part of a coalition of more than 60 non-profit organizations that favor democratic, localized, ecologically sound alternatives to current practices and policies. This advertisement is #1 in the Genetic Engineering series. Other ad series discuss the extinction crisis, economic globalization, industrial agriculture and megatechnology. For more information, please contact:

Turning Point Project, 310 D St. NE, Washington, DC 20002
1-800-249-8712 · www.turnpoint.org · email: info@turnpoint.org

Figure 13

However, the ear on the back of the mouse is a product of tissue engineering, and the nude mouse itself is an outcome of a naturally occurring mutation which prevents the mouse growing fur and compromises its immune system.[ccxxxvii] There was no human intervention at the molecular/genetic level in making this chimera. Again, those who criticise gene technologies fall into the genohype trap, and do not do their research thoroughly by checking the accuracy of the scientific information they are using, while failing to mention other life science technologies that might be as destabilising as genetic technologies.[ccxxxviii] Furthermore, genohype is a bi-partisan discourse and ironically can attract the same forces that oppose the 'gene revolution' in order to further promote it. After all, we are still promised a certain sense of control when dealing with a body that is neatly and logically codified according to its DNA pair bases, rather than when we are confronted by the messy and irrationally behaving visceral body.

The role of the artist

During the peak of the HGP hype, the author and Oron Catts were research fellows at the Tissue Engineering and Organ Fabrication Laboratory of Harvard Medical School. We were an integral part of the laboratory personnel, surrounded by scientists and researchers and participating equally in meetings and forums with our scientific colleagues. We became more and more aware of the transformation of knowledge as described by Brown.

The head of the laboratory, Dr Joseph Vacanti, was sometimes accused of hyping his field of research, tissue engineering, and building unrealistic expectations with regard to the ability and timeframe of growing custom-built body spare parts or neo-organs.[ccxxxix] We must admit that we were cautious in celebrating our opportunity to join Dr Vacanti's laboratory and work alongside his team. Our appreciation of him, for letting us inside the inner workings of the laboratory to learn advanced tissue engineering techniques, was tainted by our understanding that there is a greater role for the appointment of artists to his laboratory. While the scientist or even the 'responsible' journalist should, at least in theory, report things as they are and support their claims with facts and evidence, the artist has the licence to imagine, to fantasise and to exhibit unrealistic expectations of science and technology (such as in the case of Australian artist, Patricia Picinnini[ccxl]). In the case of artists, who are also research fellows at the same laboratory in Harvard, these presumed separate realms of science/fact versus art/imagination can fuse into each other in the eyes of the wider community. There is a greater chance of this if an exhibition of the artistic results is framed in certain ways by curators and galleries and is marketed through carefully worded press releases. In simple terms, the artist becomes part of the biotech hype.

Can an artist deal with new technologies while maintaining autonomy and a critical approach?

'What is it that the artists have that these corporate interests are interested in? It is not the art, it is the access to the public imagination', Natalie Jeremijenko argues in her review of the exhibition *Paradise Now: Picturing the Genetic Revolution* (New York, 2000).[ccxli] We have noticed that in recent years there has been a significant number of exhibitions dealing with genetics or ‘Gene art’. Jackie Stevens explains this phenomenon in the following way:

> …art about biotechnology, especially with a critical edge, serves to reassure viewers that serious concerns are being addressed. Even more importantly, biotech-themed art implicitly conveys the sense that gene manipulation is a ‘fact on the ground’, something that serious artists are considering because it is here to stay. Grotesque and perverse visuals only help to acclimate the public to this new reality.[ccxlii]

As illustrated by several writings, art or artists serve willingly or unwillingly as producers of a popular discourse on biotechnology. Whether they like it or not, ‘…artists are involved in technological mediation and the intrinsically related processes of disciplining.’[ccxliii] Artists have always played an important role in mediating technologies by appropriating new technologies in order to create a new visual language to deliver new meanings for them. Furthermore, Kockelkoren claims that all of human existence is mediated by technologies and that ‘Language, technology and art teach people how to articulate and even celebrate their ineradicable alienation’.[ccxliv]

According to Kockelkoren, artists must immerse themselves in the dialectics of new knowledge and technologies. They must adopt not just a representational approach but what I refer to as ‘wet engagement’. Hence, artists researching and exploring the role of biotechnology in society can and should engage with the actual technologies and get their hands wet and dirty. They will thus experience the uneasiness involved with the act of manipulation of the lives of others as well as being implicated with such an act.

Artists working with life manipulation, and more precisely with biotech, are participants in that culture. Besides the important act of democratising these technologies for the wider public, artists can ‘suffer’ from the embedded position; hence identification and participation with the situation they came to investigate and report on objectively. What strategies, then, should artists employ in order to keep their integrity and autonomy working within this field, without being self-righteous or resorting to propaganda? In the case of the critical artist, how does she resolve the paradox of using the technologies she is critiquing or working with in the context of engaging with an economy she is critiquing? The second issue is the role of the curator and art producer who then positions and contextualises the art work (which can sometimes sit at odds with or even contradict the original intention of the artist).

In the context of this chapter, what kind of art can an artist create for a show dealing with the ‘biotech revolution’ that would not be serving the interests of genohype? What kind of project should one submit as a proposal for a commissioned exhibition marking the so-called completion of the Working Draft of the Human Genome Project?

The Commission

In November 2000 TC&A received an invitation for a commissioned work by the Two10 Gallery in London, which is fully funded and operated by the Wellcome Trust. This was accompanied by a brief summary of the exhibition theme. According to our reading, the brief implied that by following the gallery's philosophy, which strives to 'challenge received ideas' and 'encourage critical dialogue about important cultural issues (e.g. the HGP)', we might critique the private HGP. This could be done, we surmised, by challenging the issues surrounding gene patenting. So, we thought, this could be a role for artists that fitted with the commissioning brief: to fulfil what Brown referred to as unequal access to resources (in this case access to the artist) in order to favour the Wellcome Trust's version of the future over that of the private HGP.

The invitation was a surprise, as the work of TC&A had never directly dealt with genetics. It seems that the curators of the Two10 Gallery fell victim to the genohype for which their organisation was partly responsible. One can speculate that because TC&A work uses and deals with biological knowledge and applications, it was assumed that our work concerned genetics. We therefore decided to address the type of genohype that was generated by the HGP, rather than directly referring to the issues concerning the patenting of life or dealing with the direct effects of the HGP on medicine and pharmaceuticals.

In the resultant *Pig Wings* project we grew three sets of wings made out of pig mesenchymal cells (bone marrow stem cells) grown over/into biodegradable/bioabsorbable polymers (PGA, P4HB). The size of the wings was 4 cm x 2 cm x 0.5 cm each and they were never intended to be implanted onto pigs. The original proposal was titled: *Wings detached – the good, the bad and the extinct: Installation of three sets of bony wings, grown from pig stem cells.* In our preliminary statement regarding this project we wrote:

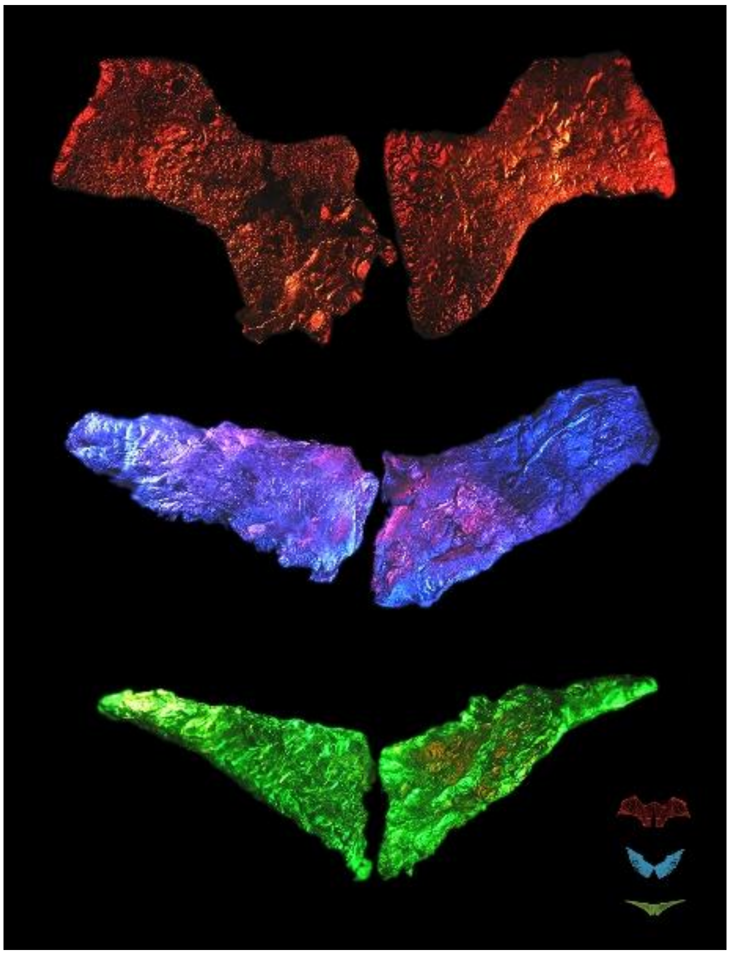


Figure 14

> *Wings detached – the good, the bad and the extinct* can be seen as a representation of the set of values that are attached to gene technologies. The interpretation of genes is not a value free process. Wings carry many associations with them. Cultural representations of wings (mainly in Christian religious art) have been assigned arbitrary values in relation to both shape and origin. Bird-like wings are

symbolically linked to the angels, representing their goodness and purity. Bat-like wings are generally attached to the bad fellows of mythology. But it might help us to remember that the implicit humane/angelic continuum also carries the curse of the mythic Icarus, who burnt his wings trying to fly too close to the sun. As the existence of the Pterosaurs (winged lizards) was not widely known until last century there is no culturally established value attached to their extinct shape. Extinction as we know it may even become 'extinct' as advances in biological technologies enable us to recreate extinct organisms from DNA samples. On the other hand, new kinds of extinction may arise, for example the extinction of the 'bad genes' by genetic-based eugenics. Our cultural perceptions of these three evolutionary solutions for vertebrate's flight can be seen as metaphorical analogs to our perceptions of gene technologies.

The promises and hopes surrounding the Human Genome Project (both private and public) sounded like fantastic claims just a decade ago. Our attempt to make representations of wings from pig stem cells is, of course ironical: generations have made fun of the idea that pigs might fly. Now that we are getting close to fulfilling this dream, we can gauge how people will react to the fulfilment of other fantastic claims.

Stem cells are the working draft of organisms and tissues they differentiate into. They are the raw material from which specialized cells develop. We know how to direct them to go down certain pathways and even how to edit their

> instructions/expressions. This control enables us to impose value systems on genes and enact the processes which lead to the creation of ‘the good, the bad and the extinct’. We can also leave the ‘decision’ to the cells and examine the results of a ‘natural’ situation with no social/cultural values attached. But would we be able to spot the difference? Will pigs be able to fly one day?

We also added: ‘…we will also attempt to file a patent for “Pig Tissue Wings”, and present our desire to “initiate and control” the pig wings “market”. Anyone who will try to make pigs fly (by growing wings on them) will have to get our consent’.

In retrospect it is not surprising that the proposal was rejected, as this ironic piece strikes at the heart of the hidden agenda that involves employing artists as agents in the service of the genohype. The rejection letter from the Two10 Gallery and the events that followed illustrated this point so well that it became, for us, an integral part of the whole *Pig Wings* piece. For legal reasons, I am unable to quote the letter of rejection from the gallery directly, but it is sufficient to say that it was a revealing document. Both the artistic and scientific merits of our proposal were questioned, but one sentence in the letter presented a very interesting insight into what the gallery perceived as the role of the artist. This was a reference to the fact that the advisory group felt that our project presented an unrealistic reflection of the public’s opinion of the HGP. This is a somewhat unconventional view regarding the role of artists in society. Artists are often described as having a unique view of the world, and are hailed as presenting subjective, varied and unique observations about the world. Another point that was raised in the letter was that the gallery felt our work would not fit well with the other exhibits.

Although we respected the rejection decision we felt we needed to respond to these extraordinary claims by apologising to the Two10 Gallery and the advisory group in a letter in the following way: ‘We are sorry that our work did not reflect *your* perception of what the public opinion should be’. Their response to this apology was that their choice of words could have been different, but their main objection was that they did not approve of our vision of what the HGP represented. That was just too good for us to let go, so in setting up the website for the *Pig Wings* project we included the correspondence with the Two10 Gallery as an integral part of the project. This was part of our treatment of the *Pig Wings* project as a process, art documentation or as ‘living art’ as argued by Boris Groys:

> For those who devote themselves to the production of art documentation rather than of artworks, art is identical to life, because life is essentially a pure activity that does not lead to any end result.[ccxlv]

Among these art documentation activities, Groys lists the creation of unusual living circumstances, politically motivated art and so on.

In the meantime, the *Working Draft* exhibition was staged, and to our amazement we found the following statement in the curatorial essay that accompanied the exhibition:

> With an open brief, literal translations of the theme were not expected, nor did the artist have to reflect any specific 'look' or imagery associated with the Genome. Nevertheless the results were surprising. Major scientific discoveries inevitably attract a degree of controversy, and the Human Genome Project is no exception. So having expected an obvious degree of public debate to filter visually through the works, we found the results instead to be more subtle and hence potentially more interesting.
>
> And intriguingly, although the artists had no idea how others were responding to the brief, there is a distinct visual coherence to the overall display achieved through the artists' combining a harmonic palette (including an over-riding incidence of salmon-pink) with translucency.[ccxlvi]

There is not much one can add to such a blunt misrepresentation of the selection process of the Two10 Gallery. The absence of any mention of the curatorial decision with regard to the process of selection and rejection of works, and being 'surprised' by the results indicates that the curator used the participating artists to mask her own agenda. It is not surprising then that when the author of the above statement found out, three years later, that we had posted our correspondence with her on our website she was not very happy. We cannot disclose the full details of what followed but after approaches to our University's legal department and the possibility that funding to other research at our University from the Wellcome Trust might be affected, we removed the correspondence from our website. Indeed Brown was right again in observing the unequal use of resources in the struggle to dominate a vision of our manufactured futures.

The *Pig Wings* project was intended to resist being a mere passive agent in the play of ‘genohype forces’ whether sustained by financial bodies, the media, curators or anyone else. The curatorial ‘politics’ it provoked confirmed the larger politics played out in the ‘Art and Science’ hype.

> The practices of art documentation and of installation in particular reveal another path for biopolitics: rather than fighting off modernity, they develop strategies of resisting and inscription based on situation and context, which make it possible to transform the artificial into something living and the repetitive into something unrepeatable.[ccxlvii]

As suggested before, Kockelkoren argues that artists cannot escape their fate of being part of the process of creating public acceptance for the new technologies they are exploring, even when doing so from a critical perspective.[ccxlviii] Furthermore, critical artists, whose art work has been exhibited in thematic shows about biotech, are ‘fig leaves’. Vested interests require an appearance of actual debate concerning the development of these technologies. Thus the stage is readied for the next phase of implementation of such technologies.

The failure of the *Pig Wings* to gain curatorial acceptance because it refused to be a 'fig leaf' illustrates this well. However the curatorial rejection of the work was not intended by the artists: this was merely a fortuitous outcome. In the original intention – for this was a serious proposal for the exhibition – the *Pig Wings* deliberately adopted the 'aesthetics of disappointment'. People, it was reasoned, would be drawn to see the piece because they believed that flying pigs and other biotechnological wonders will be presented to them. Instead they are confronted with tiny, humble-looking detached wings, made of tissue, which will never fly. The hype is a let down. This was well articulated by Dimitry Bultov:

> … artists transfer the emphasis of their activities from art production to research of the conditions which give rise to works of art. As a result of such an approach, artwork must fail first, in order to be beatified later… I mean such kind of art activity which, while aiming at a conscious expectation of 'failure' and 'misfortune' of the project, has the purpose of representing some bans at functioning of an artwork. As an example of such a strategy, I can mention the project Pig Wings … Using tissue engineering technology which enables one to cultivate organs and tissues of different organisms in vitro, the artists have grown a pair of wings out of a pig's stem cells. And though technological problems with transplantation of the artificially-grown wings to a donor animal have been successfully solved, [this is not correct, IZ] the artists decided to close the project at this stage, not to bring it to the stage of getting a real chimera. The conscious decision not to complete the project points to the fact that it is precisely the pre-programmed uselessness of the pig wings, that are wings only by form, but are not designed for flying in their

> essence and inner construction, which makes them a fact of art…This kind of art engineering has a distinct preventive character because, reporting the failure of modern science and technology, it also gains a human dimension and contributes to our idea that the world has once been different and is still able to become totally different than it is.[ccxlix]

The original title of *Wings Detached* has been changed to simply *Pig Wings*. The project has been exhibited in different configurations internationally (this year, 2008, *Pig Wings* is shown as part of the *Design and the Elastic Mind* exhibition at the Museum of Modern Art, New York and is now part of MoMA permanent collection) and featured in many media stories, including the *New York Times*, *Arte TV* and more. In many instances the galleries promoted their exhibition using statements such as 'come and see pigs flying in the gallery' but the visitor only encountered small objects displayed in cheap jewellery boxes. *Pig Wings* embodies the promise and the disappointment which underlies the rhetoric and hype of scientific discoveries and implications.

Chapter 6 – Tissue Art –

A Taxonomical Crisis: A survey of artists working with tissue

A taxonomy generally appears as a table of difference that firstly fragments networks into lines of demarcation (borders) that isolate the continuity of things, and secondly, orders this distinction of things into hierarchical relationships. Thus the taxonomy is the agent that empowers knowledge. Once the taxonomy no longer functions, the knowledge it enables is powerless. A survey either applies an existing taxonomy or invents a new one. This taxonomy, which determines the way in which the elements of the survey are categorised, plays a decisive role in structuring the survey and hence in the analysis it undertakes. In short, the taxonomy limits as much as it enables the survey. Because the taxonomy is the engine of knowledge, it is also the weak point of any survey, the point at which its analysis is most vulnerable. The vulnerability of taxonomy is due to it being a construct of the human mind rather than innate to the things under analysis. All taxonomies generally reflect the ideological and other beliefs of their inventors and users, and when the demands of societies change, taxonomies no longer do the work they were designed for. Knowledge is subject to the tides of social change.

A taxonomical crisis is a reflection of radical paradigm shifts in society and its ideology, when old systems cease to be relevant. The crisis generally fractures existing configurations and opens up new possible orders that cooperate and compete for attention. At such times conducting surveys is not simply a matter of consigning things to their taxonomical boxes. This is the main problem for conducting a survey of contemporary art work involving living tissue. It touches on some of the most basic assumptions about what is and is not life that have been the basis of humanist thought, and so is having ramifications in all spheres of life. Hence, to conduct a survey of practices at a time when their very ground is shifting requires close attention to these shifts. These shifts must be the context of the taxonomy used in the survey.

Widespread paradigm shifts in the late twentieth century have created a taxonomical crisis on many levels, from the biological and scientific to the social and political. Indeed, it has even penetrated the core of human subjectivity. Admittedly this has been an ongoing project of the modern era, but never has subjectivity been such a contested or at least open zone. The 'I' is no longer just split (post-Freud) between antagonistic conscious and unconscious selves but must also deal with digital lives that can be equally real manifestations of the I – as, for example, in *Second Life*, which is a 3D virtual world entirely built and owned by its residents. Since opening to the public in 2003, it has grown explosively.[ccl] These 'residents' have complex personal, social and economical relationships that can be sustained independently from the non-virtual world, yet can be also translated or 'cashed' into the currency of the 'real' world. At a more mundane level, every person's sense of self-identity on the planet is being affected by new configurations of identity politics. Communities around the world are being defined beyond their conventional geographical and national locations, and have new and different ways in which to 'name' themselves as a community. The old left and right political paradigm has fragmented and assimilated into new configurations, and national identities are being torn between global, local, religious, ethnic and other identifications.

Rapid technological change has always been a major driver of change in our professional as well as everyday lives, ideologies and practices (communal and personal), and never so much as today. This is as evident in the arts (most evident in the proliferation of new media during the previous fifty years) as in most areas of life, and is particularly pertinent to this survey.

The effects of technological change on art practice usually follow a familiar pattern. Firstly, a minority of artists are initially attracted to emerging technologies. At first they focus on how the technology itself mediates, limits and opens up meanings, and how the new technology might provide a distinct aesthetic edge to communicate these evolving and yet to be articulated meanings. In short, at first their art is about the technology itself and the new articulations it generates. This is perhaps why art critics at first use the technology itself as the taxa, with the art 'movements' that initially evolved around new media technologies being described as video art, digital art, net art etc.

However, while video artists may have initially explored the medium of the video as their principal subject matter, it quickly became a widespread and easy to use technology, and many artists began using it for all sorts of other reasons. The technology itself became transparent. Today video is like paint, it is ubiquitous in art practice: it has as many uses as there are ideas. To look for a shared ideology (manifesto) or even agreed understanding of the field among artists using it today is not only impossible but ludicrous. Critics need new taxa; or, as happens, video art becomes absorbed into traditional art historical taxonomies.

The initial attraction of many artists to the field of BioArt was, differently to other media technology, not only curiosity about the technology itself but perhaps even more the profound ontological as well as social, ethical and ideological questions raised by the technological and medical uses of bio-technology. Critics also responded this way because, unlike a technology such as video, bio-technology is not a relatively innocent medium: it carries too much baggage that directly concerns the nature of our own bodies and the environment each of us inhabits.

Biology is not just a technology or machine, it is a resource, it is living (i.e. humans and other animals), it is a material (i.e. organic material) and it is conceptual (i.e. it creates philosophical and ethical issues, as well as aesthetic ones). The current anxieties over the place of humans in the natural world might be fuelled by issues like climate change and global warming, but it is the new biological technologies and paradigms that strike at the heart of existing taxonomies. Humans, who once knew their place in nature as the dominant species, are now perplexed. Much contemporary tissue art begins with this question: it is driven not solely by the new technology itself but very much by the taxonomical crisis that has resulted from not just bio-technology but also other related developments (such as those mentioned above).

Perhaps this is why taxonomy itself – its politics and epistemology – seems to be the main concern of the critics and the audience of tissue culture art. For example, as an artist working with tissue technologies I am frequently asked to locate my practice within an artistic context/narrative/genre/movement. This chapter is partly a response to such a question even though it is, at the present time, unable to be answered confidently due to the very nature of its practice in the belly of taxonomy itself. The medium/technology of tissue might be a 'hook' on which critics can, in their usual disciplinary fashion, hang fragmented, multi-dimensional and shifting practices of artists working with living tissue as a material, but the following survey only confirms the taxonomical crisis we currently inhabit and the impossibility, at the moment at least, of producing a convincing or useful taxonomy. What I am offering, in this chapter, may be a semi and partial taxonomy,…a taxonomy in the making.

Hence, while the following survey of tissue art aims to mark out the field, to show the range of artistic practices using tissue technologies and to establish certain networks and processes of differentiation within this field, it stops short of proposing a taxonomy, and so accepts that the field, and so also the survey, will remain (for some time probably) something of a movable feast. This is compounded by my own position, which is far from being an objective observer. Not only am I a practitioner within the field, I also played a founding role in TC&A as well as SymbioticA. Many of the artists I will discuss started their engagement with tissue art through my teaching and example.

What I would like to demonstrate, however, is how this shifting field of tissue art has enabled artists to begin an exploration of a journey into an imaginary post-anthropocentric future; and away from the humanist as well as the virtual/representational journeys that were predominantly taken by artists working with emerging media. What I am offering in this survey is a partial taxonomy which traces the different interests the use of tissue as a medium evokes.

A preliminary survey (of sorts)

This survey of tissue culture as cultural expression begins by casting its net wide and then delimiting the field by circling it until arriving at certain points that articulate the key parameters of contemporary tissue art today. As such, while admitting that a taxonomy which might adequately engage with tissue art is necessarily in flux, there are points about which it shifts, and these might provide some ground on which to anchor (a temporary taxonomy perhaps) an adequate survey of contemporary tissue art. These points would include, obviously, the use of tissue technologies as a medium of artistic and cultural expression, but also the development of content that engages with the paradigmatic shifts discussed above.

Tissue technologies as a medium: a short history

Arguably tissue art has a lengthy pedigree in the use of blood as a medium of cultural expression. The medium is probably older than paint, and is widely used in various rituals including, symbolically, in the sacrament of the Eucharist in Christian religion. Blood, a living tissue, is always available and carries many significant cultural connotations across all cultures. Technically, it is easy to extract and always available. Blood might even be considered the archetypal example of the partial life that characterises tissue culture. Because red blood cells do not have a nuclei and do not divide, they have a limited life span and cannot proliferate and grow. While in the blood can be found stem cells, white blood cells that can proliferate under specific conditions, like tissue culture, it is the condition in which the blood is being kept or manipulated that determines its mortality.

The use of blood in cultural ritual is associated with tribal cultures, and not the western humanist tradition from which contemporary art is generally considered to have developed. This makes certain developments in contemporary western art difficult to explain by the normal art historical methodology, for since the 1960s blood has again become a medium of cultural expression in the cultural capitals of the West. It was first explicitly used in art practice as a central, even defining, component by the Austrian performance artist, Herman Nitsch, who slaughtered animals in a sacrificial fashion over naked bodies suspended in crucifix positions. While deliberately referencing tribal and Biblical rites, the orgiastic and spectacular nature of the performances perhaps owed more to Hollywood.

More restrained, and more ‘British’, were the performances of Gilbert and George (G&G), British performance artists who began their artistic career in early 1970s London. They used their own blood (as well as other bodily fluids including semen, urine etc.) as part of their artistic work. Nitsch and G&G are exponents of a now well established art genre in which the artists use live bodies (G&G refer to themselves as living sculptures) to create art. However, while the artworks of Nitsch and G&G deliberately blur the boundaries between art practice and life, questioning issues of gender and sexuality, thus responding to the flux and uncertainty of our times, they nevertheless follow the conventional tradition of modern art as humanistic and anthropocentric, in which the human and especially the individual is the referential point. Their achievement for the purposes of this survey has less to do with the content of their work, which if anything confirmed conventional humanist taxonomies, and more to do with legitimising the use of tissue products as a medium of contemporary art.

Closer to the spirit of contemporary tissue art is Marc Quinn, a British artist (part of the Young British Artists movement of the 1990s). In 1991 he made a sculpture of his head from 4.5 litres of his own blood taken from his body over a period of five months and frozen. As opposed to G&G, Quinn creates special conditions to preserve the blood tissue – he freezes it. The artwork containing tissue must be constantly ‘cared for’ by keeping it frozen, which is a characteristic of TC&A artworks (however, differently to contemporary tissue art, the blood is not semi-living but semi-dead as it is not growing and proliferating). Quinn titled the piece *Self*. Like G&G, Quinn may have been exploring the current crisis of identity and selfhood, but he continues to position it within the human body, and more specifically, in the head and blood. Even his 1997 work, *Shit Head*, a cast of the artist’s head made from his faeces, does not depart markedly from the individualistic concerns of G&G.

Nevertheless, Quinn consciously addresses the fundamental issues being raised by bio-technology, and has created one piece that can be considered more typical of the so-called Bioart phenomenon. His portrait of John Sulston, who worked on the Human Genome Project, consists of bacteria containing Sulston's DNA in agar jelly. Interestingly, this type of exploration was extensively used by artists at the same time. Drawing on the hype created as a result of the Human Genome Project, DNA portraits in all sorts of variations and interpretation became the 'flavour of the month' while at the same time a somewhat banal artistic project.

For Quinn the reference point of the taxonomical crisis is the idea and place of the human within a humanistic (modern) framework. However, as Bruno Latour argues, a fundamental but ignored creation of the humanist taxonomy is the non-human as the Other of the human.[ccli] Latour, perhaps the first philosopher to raise this issue of human/nonhuman and so announce the taxonomical crisis, has coined the term 'actant' to refer to non-human, non-individual entities that take a substantial role in Latour's well known Actor-Network Theory. Thacker (2005) refers to TC&A's Semi-Living entities as actants.[cclii] An earlier version of looking at the non-human aspects of a 'social network' has been explored by fellow YBA artist, Damien Hirst.

Hirst, the best known of the Young British Artists, made a name for himself through his large-scale sculptures of preserved animal parts in formaldehyde during the early 1990s. In a spectacular fashion, Hirst's Natural History series drew direct attention to the taxonomical crisis in both the scientific and contemporary art realms, not least by challenging the conventional art/science dichotomy in his hybrid art/science works (through the use of scientific visuals and themes). The marketing and hype surrounding the work confirmed that this issue had become part of popular celebrity culture.

This development was again confirmed with the popularity of an intriguing event of the late twentieth century, Gunther von Hagen's *Body World* shows. Von Hagen, from a scientific background (although there is some controversy concerning his qualifications), invented (or perfected) a technique he called plastination, in which the liquids and fat in the body/tissue are replaced with polymer. While the bodies are going through the plastination process they are also 'sculpted', carved and positioned in carefully staged scenes; a brain is cut into opening draws; a man is holding his own skin; a pregnant woman with her exposed foetus is reclining in a classical style position, and more. The works overtly reference sixteenth-century anatomical drawings (when art and science were allies), in which dissected bodies are given classical poses. Like these drawings, von Hagen's bodies have a classical marbled perfection, beautifully proportioned and odourless. Like the famed ancient Greek sculptors, he chose and/or carves his models according to classical proportions.

Body World is one of the most (if not the most, accrodingto the Guiness Book of Records) visited shows of recent times. Von Hagen frames his work in the realm of art and education, in the tradition of the anatomists. However, the show can be also perceived as new-Baroque entertainment in which we contemporary humans, living a life in which death and dead bodies have been suppressed and hidden by the technologies and taxonomies of modernity, can face death again. This deliberate return to the early Baroque has been a typical and well-studied strategy of the contemporary challenge to the aesthetic paradigms of modernism.[ccliii] Von Hagen's dead, plasticised humans are an entertainment for the postmodern person who has been saturated with mediated violent images of bodies on television and computer.

If von Hagen shows a certain aspect of the animal in the human, albeit disguised as art located within science and pedagogy, Damien Hirst's engagement with animals and animal themes in his art is part of a growing phenomenon of animal art that began in the 1990s. Such works can be considered a prelude to the post-anthropocentric future, if only because the animal or non-human is the centre of the artwork, and not just a metaphor of the human or the human condition. Baker (2000) refers to the aesthetic of this engagement as 'botched taxidermy' – thus alluding to its subversion of traditional taxidermy and its taxonomic assumptions.

In the *Postmodern Animal,* Steve Baker shows how animal imagery is used in recent art and philosophy as a point of questioning basic assumptions about the human condition in postmodern times. Drawing predominantly from Deleuze and Guattari's concept of 'becoming animal',[ccliv] Baker argues that such art undermines the existing secure sense of what constitutes the human and its identity thinking. He writes:

> …the look of the postmodern animal…seems more likely to be that of a fractured, awkward, 'wrong' or wronged thing, which is hard not to read as a means of addressing what it is to be human now. Wendy Wheeler contends that in the experience of most people in the West, 'the word which most adequately describes the period from the 1960s to the 1990s is "fragmentation". It is an experience that calls for new vocabularies, and in the more imaginative art of the period since World War II, the post modern animal appears as an image of difference, an image of thinking difficulty and differently'. [cclv]

While the artists illustrated in Baker's book all used animals as an art medium, it was either in the representational form, or, in case of direct use of the animal body, documentation of an interaction with an animal in the 'field', or, if positioned within a gallery, it was usually a dead animal or its parts which are preserved. Thornton (2002) lists artists presenting living animals as an integral part of their artwork in the gallery, beginning with Philip Johnston's 1934 installation, *America Can't Have Housing*, at the Museum of Modern Art, 'a treatment slum re-creation'[cclvi] illustrated by the use of living cockroaches. However, this metaphoric use of animals (within a humanist paradigm) is different to the exhibiting of fragments of life sustained alive by an artificial body – a technological apparatus.

The first artist to exhibit living tissue culture in a gallery, to the extent of my knowledge, was a media artist named Paul Perry. Prior and separate to the emergence of the phenomenon of Bioart, Perry presented tissue growing inside a bioreactor in the gallery as part of an artwork called *Good and Evil on the Long Voyage* (1997). This was the only time the artist used living materials as part of his work and he is continuing an artistic career using more traditional "dead" media. Like many artists using blood, Perry used his own blood cells as an extension of the artist self; thus following a long tradition of artists' engagement with their own bodies, bodily products, and the self. Perry though took a more post-anthropocentric approach by fusing his own blood cells with those of a mouse.

In *Good and Evil on the Long Voyage*, Perry used hybridoma, a cell hybrid produced in vitro by the fusion of a lymphocyte that produces antibodies and a myeloma tumour cell which proliferates into clones. This technique is especially used to produce a continuous supply of a specific antibody. Perry produced hybridoma by fusing one of his white blood cells (lymphocytes) with a cancer cell (myeloma) of a mouse. A bioreactor with the hybridoma culture was placed in an aluminium canoe that was raised several metres above the floor on a scaffold. In order to see the bioreactor a mirror was suspended above the canoe. Perry, although having the 'real thing' in the gallery, has used a mediated vision of the living cells; a representation of them via the mirror – thus conforming to the unwritten 'rule' of western art as a representation of life, rather than life itself.

The artist claimed that the collapses of several fundamental dichotomies were being investigated by the work; life and death, and ideas about good and evil. 'The project began with a desire to identify and elaborate the "Genesis Barrier", the form that maintains difference, the wall that separates difference in species',[cclvii] and proposes hybrid formations which cross the species or ‘Genesis Barrier’, and indeed those of mortality and immortality:

> I’m very interested in the discussion around immortality and radical life-extension. The hybridoma culture we created is, in principle, ‘immortal’. Thanks to the cancerous nature of the specific mouse cell-line we used, some of my own genetic material will continue to live and divide forever (in a cell culture) and will not succumb to cell death (apoptosis).[cclviii]

However, Perry’s dialectic does not escape traditional humanist (i.e. anthropocentric) concepts. While the normal cells – the human – represents the good, it is the mouse who by default represents the evil, it is both animal and cancerous.

While Perry may have been the first to use living cultured tissues in the context of art, it was TC&A, initiated in 1996, which made the culture and engineering of tissue a medium of art. furthermore, through the establishment of the SymbioticA laboratory in the University of Western Australia, TC&A artists have disseminated their techniques and more importantly their philosophies of the use of fragments of bodies to create semi-living and partial life entities in the context of art and outside it. Terms such as Semi-Livings and Extended Bodies, which were developed by the TC&A, are now widely used and referred to when discussing tissue constructs in the art world and even beyond.

Rapid bio-technological innovations at the end of the twentieth century were quickly adopted by several artists at the turn of the twenty-first century, and with growing pace in the new century. Two such technological innovations prompted the artist Natalie Jeremijenko to create *TOUCH* (1999), an artwork that played on the fundamental humanist notion of the artificial/natural. One was the virtual Tamagotchi Pet, and the other was the first FDA-approved commercial human skin product, Apligraf. Apligraf, a human-bovine hybrid skin is

> supplied as a living, bi-layered skin substitute. Like human skin, Apligraf consists of living cells and structural proteins. The lower dermal layer combines bovine type 1 collagen and human fibroblasts (dermal cells), which produce additional matrix proteins. The upper epidermal layer is formed by promoting human keratinocytes (epidermal cells) first to multiply and then to differentiate to replicate the architecture of the human epidermis.[cclix]

In *TOUCH*, Jeremijenko exhibited an epithelial skin layer growing on a commercially available human epidermal layer (similar to Apligraf) with a fake tattoo. It was positioned in a positive pressure container with HEPA filtered air to minimise bacterial contamination. The artist positioned sterile surgical gloves alongside and by naming the piece *TOUCH*, encouraged people to touch the skin. However, to her surprise, ‘they did not use the gloves!!’[cclx] to touch the skin, but rather touched it with their bare hands. The artist wondered if this was due to the skin being not human enough? Hence, the artificial aspects of the skin rendered it separate from a ‘real’ human skin and therefore less ‘dangerous’ or ‘infectious’ or taboo and therefore more touchable.

Earlier in 1996, the French duo, Art Orienté objet (AOO), had exhibited non-living human/animal hybrid tattooed skin. The human skin was provided by the artists themselves who subjected their own bodies, like guinea pigs, to laboratory experimentation. The work, titled *Framingham* (1996), consists of small samples of the artists' skin (leftovers from a laboratory experiment) grafted onto animal skins and tattooed

> with emblems of our desire to belong to a marginal tribe that is dedicated to the preservation of rare species. So we decorated ourselves outside ourselves with the most popular animal imagery in fashion in tattoo parlors in the United States: varied imagery, honorary totems that would transform our skin into type of wallpaper, a flesh toile de jouy. No new materials here: just us, recycled in our unrefined state as works of art with out utopias….[cclxi]

AOO are referencing in their work tribal and neo-tribal themes and rituals. They discuss magic and the supernatural in relation to science. When western humanist philosophy is going through a fundamental crisis in looking for alternative systems of reference regarding notions of life, it makes sense to look back in human history to times when, supposedly, human relations with their environment were more harmonious. AOO's gateway or porthole into the imaginary post-anthropocentric view is not via a possible future immersed with biological hybrids, but the history of the relations that early humans had with other animals and the environment.

> [AOO] are interested in the various forms of dominant or 'subjectifying' scientific, rational, empirical, occult, and esoteric knowledge. If science and magic are two different forms of knowledge, the former mediated and equipped with its tools and the later immediate, what they have in common is their search for the mystery of life and their ritual and sacrificial practices designed to influence reality. This double heritage of science and magic determines the main themes of AOO's work.[cclxii]

Recently[cclxiii], in discussions with Marion Laval-Jeantet, she told me that her latest project involves again self-experimentation as well exploration of species dissolutions; she volunteered to undergo a new and experimental bio-medical procedure in which she is injected with a horse serum, with the attempt to make her own human immune system gradually become used to other species' blood serum 'donations'. She is, in the most literal sense, attempting to become partly animal – horse. She writes: '…but I am doing it in the full awarness of this intrusion of a foreign body under my own skin, in the full awarness of the *hybridization*, and beyond a purely symbolic gesture.'[cclxiv]

AOO work is exploring in diverse ways and media the idea of the human-animal. This is a very evocative way to explore a post anthropocentric perception of the world either in the physical sense (on the level of the tissue or the whole body and by the intake of experimental substances to reach to physical and mental alter states) as well as conceptual (via alternative approches to understandings of the world such as psudo-science etc). AOO also have been working on the border line of the real and the factual the fabricated and mythological. While some of their artworks are embedded within a scientific paradigm (mainly by becoming experimental subjects themselves) others are more speculative (whether intentionally or not can be argued).[cclxv] One example is the Hadji's aura 2006, in which the artists use the controversial and questionable technology called Kirlian effect or "aura photography" that reportedly generates a visual record of 'an electromagnetic aura given off by bodies changes with the psychic state of the experimenting subject'.[cclxvi] The artists write: 'Far from the question of the scientific propability of such ideas, what fascinated us as artists was its fantastic aspect, of even imagining being able at last to visualize on a large screen the plausibility of telepathy not just with a human being but better still with an animal with which communication is reduced to estimation'.[cclxvii]

The TC&A project was initiated in 1996 and its first public exhibition was in 1998 at the Perth Institute of Contemporary Art. Here we grew tissue culture (epidermal cells and fibroblast, primary culture and cell line) over three-dimensional glass structures. The glass structures we designed took the form of human-made technological artefacts, i.e. a bomb, a cogwheel, a spiral. The semi-living structures were photographed using different biological imaging techniques. The images were than digitised and some of them were further manipulated. The exhibition was of these images as well as the glass figurines with the fixed (dead) tissue that had grown over them.

TC&A was looking to extend the notion of the artist-body as a self referential point to that of a tissue construct, or the Semi-Living as the (semi)agent. It was not about our (the artists) tissue/body, but rather about the positions of these fragments of life in current time, space and taxonomy and whether the audience (as individuals, society or even species) can (if at all) relate to it.

It was only in the year 2000 that TC&A was able to exhibit living Semi-Living entities in-situ, in the gallery context, as part of the *Tissue Culture & Art(ificial) Womb* installation in the Ars Electronica Festival. It was also our intention (in contrast to Perry) not only to offer the audience a direct view of the semi-living, but also to demonstrate what is required from us, the artists, to keep them alive. For that we had to build a tissue culture laboratory in the gallery and to begin the feeding ritual, which has become a tradition in our installation. The laboratory where the semi-livings were positioned and fed was surrounded in see-through walls which enabled a direct view by the public. Also, to further emphasise the semi-living 'liveliness' and (sort of) agency, we positioned a computer in proximity to the semi-livings where the audience could (and still can via the internet) 'communicate' with the Semi-Living Worry Dolls.

The year 2000 was also the year when SymbioticA was established, based on the existing model of collaboration between the TC&A artists and the School of Anatomy and Human Biology of the University of Western Australia. SymbioticA enables us to disseminate our knowledge and understandings of the Semi-Livings and partial lives perspective.

In 2003, Irish artist Kira O'Reilly was funded by the Wellcome Trust to work as an artist in residence at SymbioticA. Her project, *Marsyus,* was a visual arts research and development project in which traditional lace making techniques were interwoven with tissue culture and engineering to develop an in-vitro living lace of skin using cells biopsied from the artist’s body.

In the words of O’Reilly:

> Marsyas, a satyr – mixed species human and goat, lost in a competition of musicianship to Apollo, and as a punishment was flayed alive, becoming ‘one whole wound’ and rendered ‘into the matter of art’, as stuff, as site, as contextual fabric, destabilised body full of suggestions of alterities. >
> These themes echo the contemporary speed of innovation within the biotechnical and biomedical fields and are reflective of the concerns of my research of how to be a body – now.[cclxviii]

O’Reilly, a practitioner within the tradition of Live Art and Body Art, had been using her own skin, through blood letting, and cut or healing, in some of her evocative performances. Examples range from cutting her own skin in a grid pattern (*A Woman To Dream About*) to allowing the audience to either cut or lay a bandage over her skin (*VIEW (nearer to the time)*). Another work concerned the use of wet cupping – the placing of heated suction cups over cut skin – a technique used in the nineteenth century to treat hysterical women – in *Succour*.

‘Kira O'Reilly makes work that considers the body as a site in which threads of the personal, sexual, social and political knot and unknot. By making interventions into the materiality of the body she investigates the narratives of the “self” and the relationships between bodily interior/exterior spaces.'[cclxix] O'Reilly herself writes: 'The permeable boundaries of the skin membrane defy it as an impenetrable container of a coherent or fixed "self"'.[cclxx] O'Reilly's experience in SymbioticA in 2004 has transformed this taxonomical crisis of the self beyond the strictly humanistic realm towards a more post-anthropocentric perspective, by employing the pig not only as a metaphor for the human existence (or as a tool of practice for the use of her own cells), but also as an interrelated 'collaborator' (even if not voluntarily) of her artistic exploration.

During her residency in SymbioticA, for the purpose of perfecting her skin tissue culture skills, and prior to the artist's own biopsy, O'Reilly practised with skin taken from pigs that were killed as part of scientific research. In order to get the best results, the pig skin had to be collected straight after the animal was killed (to prevent contamination and further death of cells). The experience left such an impact on O'Reilly that her project was transformed beyond the artist's own body and self towards the hybridity that characterised Marsyas. But instead of a human/goat mix, O'Reilly explored her post-anthropocentric metamorphosis to that of a human pig.

> When I cut pig I have an urge to delve both hands into the belly, to meld into her warm flesh, my blood to her blood, for a moment the same temperature before one lowers cataclysmically.
> When my clumsy blade accidentally tears her gut I see pig's breakfast spill. In my minds eye I see my breakfast spill.
> Following the pig biopsy I feel deeply ashamed.

> …I begin to conceive of these primary cell cultures as processes and intersections of actions, agencies, materials, transitions, objects and contextual spaces that interrelate and interplay. Moving matrixes of shifting emphasis, to try and describe these complex webs of creativity, be it the actions of changing nutrients, the plastic wear, the consumables, the contextual space, laboratory furniture and myself.
> I am left with an undercurrent of pigginess and fantasies of mergence, interspecies metamorphoses.[cclxxi]

In *Inthewrongplaceness* (2006) at the Newlyn Art Gallery in Penzance (Cornwall, England) the naked artist holds/embraces a pig carcass in a carefully staged space. [Figure 15]

O'Reilly explores these evolving relationships with the pig; the texture of the pig skin and hers as materials, the killing of the pig for the human (whether it is for science or her own art work); the animality that they both share that makes them vulnerable, bleeding, and mortal. The audience, watching Kira's performance with the dead pig, are 'forced' to observe and to experience in some way Kira's metamorphosis experience.

Figure 15

As part of the activities of SymbioticA, the author has taught an academic course titled 'Art and Life Manipulation'.[cclxxii] One of my students in 2003 was the artist Alicia King. In the spirit of Honor Fell's tissue culture point of view, King created a piece titled *I'm growing to love you* (2006). 'I look down the microscope and I see that the cells are alive, and they've grown and they're coming away from the walls. It's a really emotional experience and I do feel really connected to them.'[cclxxiii] This 'connection' prompted her to apply for ethics approval to use her own cells (drawing on the successful approval for artists including herself to use her own cells at SymbioticA[cclxxiv]).

> I have received ethics approval from the University of Tasmania to use my own primary skin tissue. The tissue will be taken by local cosmetic surgeon (whose identity will remain classified as he is donating his services) in sections no bigger than 2cm x 2cm, to be taken from whichever part of my body he recommends. The sample will then be taken to The University of Tasmania's School of Medicine where it will be cultured.[cclxxv]

King outlined the technical difficulties involved with her will to culture her own cells:

> As yet I have not been able to access anyone in Tasmania with the appropriate experience to advise me on the best way of culturing primary human skin tissue. I have attempted to culture mouse skin tissue, taken from the leftover carcass of a mouse which was being used by the medical school for its internal organs. This attempt was unsuccessful, though it was carried out in a PS1 Lab where the conditions were not very sterile. I will wait until I have the appropriate expertise to culture the skin tissue before trying to culture my own. (I'm hoping to do this at SymbioticA…)[cclxxvi]

King also 'received ethics approval to culture the leftover tissue of existing patients at the Royal Hobart Hospital, with their individual consent and full knowledge of the artistic component of the project'.[cclxxvii] She writes regarding the relations between the controversies embedded in her work and its relations to the media: 'My work being in the press in Tasmania caused the hospital to become very uncomfortable and thus refuse affiliation with the project, so as yet I have not used the leftover tissue of any hospital patients…The coverage also gave my work good exposure.'[cclxxviii]

I asked King if her focus now has shifted from the Hybrid to the Personal, after reading this quote. She replied: 'I'm really interested to see if it changes my relationship to my own body, my perspective on self…'.[cclxxix] King '…responds to changing concepts of natures and self, alluding to forms generally not associated with the everyday category of the 'living'.[cclxxx]

However, in her email, King replied that the main reason for the request to use her own tissue stemmed from 'Issues of consent mainly. I think it's more ethically sound for me to use my own skin to begin with, however I am also applying to use the skin of several of my friends who have volunteered their tissue for the project'.[cclxxxi] Her theme is still 'hybridity: between humans, other animals, species and the wider environment, but also the breakdown of the traditional human form (and tissue) into fragmented space (through the laboratory)'.[cclxxxii] Therefore, King's interest remains within the hybridity concept. The use of her own tissue is not intended, like artists such as Quin and Perry, to make a humanist point about her own subjectivity and individual identity, but is more of a convenience that eliminates ethical issues concerning consent from other humans, and animals. In other words, King, like many of the artists working with tissue culture, uses the medium to enable more of a post-anthropocentric, yet embodied, perspective of us in the world. Alicia King's work is of fluid, non-identifiable forms of blown glass engulfed with fix and dyed tissue – moist chimeras.

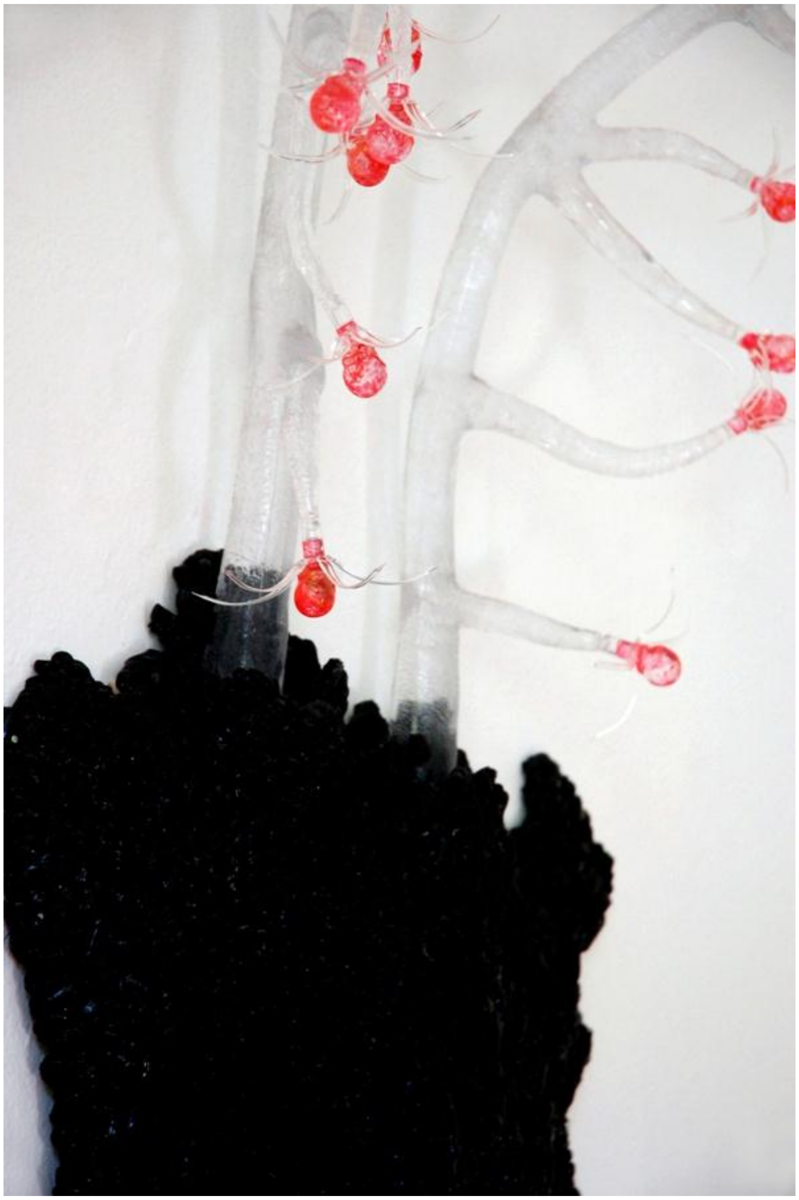


Figure 16

In 2003, following a tradition of artists working with their own bodies and visiting SymbioticA to be able to work with their body in vitro, Stelarc explored his fascination with the body and the machine using tissue technologies as a collaboration with TC&A. Stelarc is a renowned performance artist who, since the 1970s, has explored the ways in which the human body and technology are joining into new hybrid entities. He has been particularly interested in extending 'the concept of the human body and its relationships with technology…'. The human body is his focal point, though according to him, the way we know the body and indeed the body itself is obsolete. In this respect he 'others' the human body, making it just an extension of technology. His performances in the 1970s, in which his naked body was suspended, in great pain, by hooks, were dramatic renunciations of the western humanist tradition. Nevertheless, Stelarc in many ways continues the Cartesian mind/body split and the control of the mind over the body; he treats the body as almost mechanistic.

Stelarc has worked with robotics, the internet and biomedical technology to explore the changing boundaries between the body and technology. His later projects and performances, such as *Third Hand*, a robotic arm attached to his body, or *Ping Body*, in which muscle simulators operated via the internet are controlling the movements of Stelarc,[cclxxxiii] are concerned with the prosthetic. The prosthesis is seen by him not as a sign of lack, but as a symptom of excess. Rather than replacing a missing or malfunctioning part of the body, these artifacts are alternate additions to the body's form and function that will better adapt it to the new technological world being created by humans. Breaking away from the human/machine interface to the body as a regenerative site, Sterlac sought to apply the TC&A's understandings and expertise concerning tissue as an engineering, malleable material.

TC&A collaborated with Stelarc on the *Extra Ear – ¼ Scale* project (discussed above, and see appendix for project description) in 2003. Stelarc was ultimately concerned with the attachment of the ear to the body as a soft prosthesis, while the TC&A was interested in the partially living entity as a stand alone, separated and independent of a 'natural' body. This opened up differences between the anti- or post-humanism of his concerns and those of TC&A.

Although Stelarc is sometimes referred to in a post-humanist context, his work avoids post humanistic utopian perceptions of the future. The works in which Stelarc – the body – was invaded by technology were far from peaceful and seamless human/machine interactions. His performances usually involve pain and malfunction. His concerns are not redemptive (as pain has often been represented in the Christian Humanist tradition), and nor are they critical of the invasion of technology on the human subject and its freedom. Indeed, while performing, Stelarc used to refer to his own body as 'the body'; to distance the self from the body. His interests have always been more scientific and existential: specifically, what are the consequences for humans when technology has outpaced evolution to the point that the body has become obsolete, not from the perspective of humanist regret or nostalgia, but from that of a 'rationalist' wanting to map the parameters of this post-human condition?

In 2003 Stelarc digitally reconstructed his head and face as *Stelarc*, perhaps because it clearly is not Stelarc or perhaps because it clearly is an avatar that begs the question, who is Stelarc? In *Prosthetic Head*, a digital replica of Stelarc's face is 'answering' questions posed by the audience. The answers are retrieved from data based on Stelarc's biography. Hence, the piece is an avatar (or digital extension) of Stelarc which creates the illusion of a 'person' answering questions (although, and Stelarc will be the first to acknowledge it, this is purely an illusion created by a fairly basic chat engine). In *Partial Head* (2006) this extension is morphological. Stelarc has created a semi-living sculpture resembling his face morphed with an archaeological reconstruction of the famous ‘missing link’ fossil named Lucy (*Australopithecus afarensis*). By that Sterlac, like King, touches upon issues of human-animal hybridity as well as evolution both biological and technological. The initial stages of the project were done in consultation with TC&A.

An important aspect that should be raised when surveying artworks containing living and growing elements concerns issues of authenticity. Authenticity, in biological arts, is an important if not central concept. As many of the artworks present or claim to present a biotechnological process or some kind of life that cannot always be seen by the naked eye, the audience need to ‘believe’ the artist that what they see was actually done and is happening. This is very true in tissue art when living cells are presented as the artwork. Hence, within the community of the biological artists there are some artworks that are known to be a ‘hoax’ (though some have not been revealed to the wider community).[cclxxxiv] The ‘hoax’ artwork builds its credentials on the authentic art works, and can be used to question not only the media hype around biological art, or the public fascination with the biotechnological developments, but also the idea of authenticity in art itself (why does tissue art need to be authentic when art, conventionally at least, is an illusion, a representation?). But perhaps the main impetus for such ‘hoaxes’ has been the public expectation of what art looks like.

The technological limits of growing tissue culture have presented problems for artists who still work within human-centric terms. For example, artists who are interested in presenting works that the human audience can immediately identify with or relate to (humans like all animals experience things according to the scale of their own body) are confronted with the current impossibility of growing large three-dimensional tissue constructs – mainly due to the lack of a capillary system. In *Partial Head*, Stelarc got around these problems by creating an almost life-size polymer structure of his face morphed with Lucy, seeded it in a lab and at a certain point, which was known to happen very quickly due to technological limitations, contaminated and fixed it – thus symbolically violating one of the (pre-)taxonomic conditions of tissue culture. Similar things had done before with tissue culture.

For example, in 2001, Polona Trantik, in the artwork titled *37C* (which later travelled to be shown in *L'Art Biotech* in 2003), sprinkled human cells over constructs in the shape of life-sized human organs (a breast, a foot etc) and used non-sterile phosphate buffer solution to bath them. The whole gallery was heated to 37 ^{o}C, though the cells could not have survived for very long in these unfavourable conditions. As with many of the artists using tissue as a medium, the tissue primarily serves a symbolic purpose – usually one that suggests a space where boundaries are being blurred and questioned; a fuzzy divide, a membrane which questions certain dichotomies and taxonomies. This was the case with *37C*. According to Trantik

> The aim of the project is to confront the observer with a fragile boundary between life and death, to envelop him within the presence of life. Life does not have clear demarcations. On the thin, overhanging line, it is slipping into death or is coming back to life. The work seeks to present the experience of such intermediary states of existence.[cclxxxv]

Trantik, like Stelarc, presents large-scale sculptures of recognisable human parts with living cells (in the process of dying due to lack of minimal conditions for survival), which corresponds directly to the human audience as the point of interest and the point of trajectory. It is made by humans, about the human, and for humans.

The issue of hybridization both conceptual and physical explored and described previously by AOO is also the theme of another French Artist, Orlan. In a French (colonial?) tradition, both AOO and Orlan, explore themes of pre-modern cultures using tissue technologies. But while AOO emphsis is on the human animal hybridization, Orlan research stems from a humanist perspective.

Humans and race are the central point of Orlan's work. Orlan began her project titled *Harlequin's coat* in SymbioticA in 2003. In the 1970s Orlan created performances and other object-based works centred on plastic surgeries that were performed on her own body as part of her feminist manifesto. She presented, in the representational format of video documentations of live, very visceral performances as well as other photographic material, critiques of art and beauty, and specifically, of the use of plastic surgery in the dominant ideological aspiration for the ideal Western beauty. More recently, Orlan has become involved in the new media potential of digital imaging. Again using her own body as a model, she has made digital manipulations that hybridise her face with those of pre-Colombian, sub-Saharen and north American Indians. In 2004 Orlan made contact with the TC&A as she wanted to extend her own skin, like O'Reilly, King and Stelarc, outside of herself. She, however, would like to hybridise her skin with those of other races, to create what she calls a 'harlequin's coat'.

> The idea is to present the realization of a composite, organic coat, made from an assemblage of pieces of skin of different colours, races, ages, and origins. This biotechnological Harlequin's coat, consisting of in vitro skins and coloured diamond shapes of a different nature, will be made in the image of cultural crossbreeding.[cclxxxvi]

Orlan's work has always been humanist, even narcissistic. Her recent collapse of racial taxonomy is also human centric, and in ways that preserve the differences of the taxonomy it supposedly critiques. Ironically, this gesture of racial investigation, coming from a white French person can be easily interpreted as racial colonialism and cultural appropriation. In SymbioticA Orlan cultured a cell line commercially obtained in which the ethnicity was of a black person (female). Regardless of Orlan's motivations and ways of dealing with issues of race, the project highlighted the fact that cells are catalogued also according to the ethnicity of the donor (whether this information is of relevance is open for debate) as well as species and gender.[cclxxxvii]

During her residency in SymbioticA, Orlan diverted from using only human cells to incorporating cells from other species as part of her *Harlquin Coat* piece. Orlan is following her research into hybridization and Laicite ('secularism'), still more from a humanist perspective rather than, like the AOO project, the investigation of the human animal.

From race issues to gender issues; a feminist political statement is created by tissue as medium by Julia Reodica (a visitor to SymbioticA in 2002) in the *hymNext* project. The artist, again, would like to use her own cells and other cells for the creation of a symbolic hymen-like tissue. This is a comment on the cultural values embedded in this tissue, which serves as proof for a woman's virginity or 'purity'. Reodica is also concerned with the medical 'treatment' given to women who need to prove their virginity (sometimes as the only way to spare their lives) in which the hymen tissue is reconstructed.

> hymNext Designer Hymen Project is an installation that comments on modern sexuality, confronts the traditional roles of the female body and presents a collection of synthesized hymens. The unisex hymens [made out of both genders' cells and as a symbolic form to break the taxonomy of gender and sex] are sculpted with living materials and the artist's own body cells into a variety of designs for the theoretical application upon the human body.[cclxxxviii]

Following a feminist discourse, the performance philosopher Shannon Bell, who 'lives and writes philosophy-in-action', was a resident artist at SymbioticA in 2005. Bell, who has researched and published books[cclxxxix] concerning issues of sexual politics, came to SymbioticA to research and grow tissue-engineered male and female phalluses as living art objects that show the internal and external female erection (the external clitoris, the internal urethral sponge, or what has been popularised as the g-spot) as a connective integrated whole comparable in size and stature to the male sex organ. Bell has been producing work (images, films, written texts, live performances, and workshops) on the female phallus and female ejaculation since 1989. As a philosopher in action and according to SymbioticA's philosophy of experiential engagement, Bell experienced and lived the philosophy she theorises.

In Bell's project, titled *Two Phalluses and Big Toe*, in addition to displaying the structural similarity of the male and female sex organs, the toe functions as an addendum to writings by the philosophers Jacques Lacan and Georges Bataille on the phallus and big toe. Once in the bioreactor, the three objects merged as a 'neo-sex organ'[ccxc], though without the ability to ejaculate.

Bell and Reodica are dealing with humanist issues concerning human sexuality and gender within the context of human society. Both, however, in order to illustrate their point, used animal cells that are not exclusively human cells. I tend to believe that this is an issue of convenience (access to animal cells as opposed to human ones) rather than an ideological point. Therefore, the human is 'colonising' the other animals' cells to address issues that are more of the human animal interest.

Human interests and the use of (other) animals' cells was taken in different directions in the work of Adam Zaretsky. Zaretsky's *The Brainus/Analolly Complex* project was a cheeky work that also raised questions about animal ethics. While a resident at SymbioticA in 2001, Zaretsky, who learnt tissue engineering techniques from the TC&A artists, created the above project using cells from an animal he killed for his taste buds:

> The Brainus is an anus made of biopolymers, which was then seeded with brain tissue. The Analolly is a lollypop made of biopolymers, which was then seeded with anal tissues. The Public is invited to vote: Which would you rather lick, Brainus or Analolly, and Why?
>
> The primary tissues used for these sculptures were taken from a dying eel. The eel was killed for food and the primary brain and anal tissues were isolated from the waste of culinary excess.[ccxci]

Zaretsky was interested in the different and sometimes conflicting ethical justifications used in killing animals for the use of tissue in scientific research versus food consumption. The project looked at the paradox embedded in the University ethics committee regulations, under which Zaretsky had the approval to experiment on tissue/meat leftovers from a cooking preparation done in his home kitchen (in which an eel was slaughtered for the meal) but could not slaughter the animal in the laboratory for experiment and take the remains and eat them at home.

Zaretsky is blurring the boundaries that supposedly separate us – humans – from the other animals; the brain tissue symbolises the intellect that is associated with the human, while the anus tissue represents the animality (and therefore the taboo) we all share with animals. An added layer addressed in this project is the hypocrisy humans must maintain in their relations to animals, as expressed in the laws and regulations humans have devised for what is allowed and not allowed to do to animals concerning food consumption as well as scientific research. These laws and regulations, as demonstrated by Zaretsky, can be conflicting and paradoxical. Zaretsky, like many of the artists using tissue culture techniques, is exposing the uneasy position of the human animal within the world and the contradictions of humanist thought.

Returning to human tissue, the first human cell line created, in the 1950s, has become not only a source for countless experiments across laboratories around the world, but also a source for closely related artworks. The first artist to investigate this narrative through direct engagement and presentation of the HeLa cell line was Christine Borland in *Hela* (2000), a simple installation containing a microscope with a tissue flask (probably with fixed cells) attached to a monitor that showed the HeLa cell lines.

HeLa cells are an immortal cell line that was derived from cervical cancer cells taken from a black American woman, Henrietta Lacks, who died from her cancer in 1951. The cells were propagated without Lacks' knowledge or permission. According to the law there is no requirement to inform a patient, or their relatives, about such matters because discarded material, or material obtained during surgery, diagnosis or therapy is the property of the physician and/or medical institution. This issue and Ms. Lacks' situation was brought up in the Supreme Court of California in the case of *John Moore* v. *The Regents of the University of California*.[ccxcii] The court ruled that a person's discarded tissue and cells are not their property and can be commercialised. This case reveals many social and political paradoxes resulting from developments in biotechnology; such as that a person (just like any other animal) cannot, according to the law, own her own tissues[ccxciii]; the commercial rights of ones' own tissues; and issues of race, class and gender which are heightened especially when matters of profit are considered.

Human tissue ownership were explored by Cynthia Verspaget (SymbioticA resident in 2003) in *The Anarchy Cell Line* (2004)

> Verspaget produced an artistic cell line called the Anarchy Cell Line derived from the existing cell line of Henrietta Lacks (HeLa cells) and her own cells [but unlike Perry, Reodica and King's post-anthropocentric idea of hybridity with other animals, Verspaget would like to merge her cells with that of a human – a black American woman IZ]. The Anarchy cell line was produced to explore 'issues of tissue ownership, lab techniques, tissue patent/copyrighting, the aesthetics of the inner body and the science and social/human connection (or lack of?) in the petri

dish, the biological representation of women and finally, the story of Henrietta Lacks'.[ccxciv]

This project has a very interesting paradox embedded within it (similar to the one posed in Orlan's project); while it explored issues of ownership and the re-humanisation of cell lines to whom they belong, it is also a project that symbolises exactly the opposite. Verspaget, a white woman, without permission from Lacks or her family, is colonising Lacks' cells and making them into an artwork, that she – Verspaget the artist – owns.

In 2006 Pierre-Philippe Freymond, a Swiss artist, created yet another artwork from HeLa cells, titled *HeLa*, which presents HeLa cell lines on a microscope, alongside a photograph of Henrietta Lacks. These works (especially that of Freymond) put a 'scientific' product, that is much more than just a product, in an artistic context, and by that highlight the social issues it raises as well as ironically continuing the colonisation of the HeLa cell line not only in the scientific but also in the artistic realms. A more interesting approach to the cells as well as their social context comes from a scientist.

As discussed briefly earlier, one of the more interesting interpretations, and definitely the most post-anthropocentric perspective of the HeLa cell line's existence, comes from a scientist, Leigh Van Valen. While many artists, as I have said, comment directly or indirectly on the taxonomical crisis which is the characteristic of the post-modern and post-biological era, Van Valen suggests controversially to his peers that the HeLa cell line is an embodiment of a new taxonomical branch (a semi-living one) – it is a new species of its kind. Due to its ability to replicate indefinitely, and its non-human chromosome number, Leigh Van Valen controversially described HeLa as an example of the contemporary creation of a new species, *Helacyton gartleri*, named after Stanley M. Gartler, whom Van Valen credits with discovering ‘the remarkable success of this species’. His argument for speciation depends on three points:

- The chromosomal incompatibility of HeLa cells with humans, which makes them non-human.
- Their ecological niche, which may be technologically dependent, but we can assert that many species, including humans to a large extent, are by now technologically dependent.
- Their ability to persist and expand well beyond the intentions and imaginations of human cultivators.

HeLa cell lines are considered by the scientific community as weeds, as they grow fast and contaminate other niches (the sweet revenge of Henrietta Lacks?). HeLa cell lines have now became a different species that do not adhere to our humanistic taxonomical system; they can be seen as precursor of a new order, almost as the new liminal, somewhat monstrous, beings.

Bioteknica began as a fictitious virtual corporation, generating designer monstrous organisms on demand. Bioteknica artists Willet and Bailey were especially interested in the irrational and grotesque, for which virtual specimens were modelled on the teratoma. Teratoma is a type of germ cell tumour (an irrational growth) that may contain several different types of tissue, such as hair, muscle, and bone. The word teratoma comes from Greek and means ‘monstrous tumour’. Ironically, Bioteknica is interested in artificially re-engineering an irrational growth.

> In BIOTEKNICA the user (through a series of commands and choices) produces and reproduces cloned and genetically engineered specimens in a virtual environment. It generates two-dimensional images and three-dimensional prototypes of fictitious organisms. Additionally, and more importantly, BIOTEKNICA is a critical device that simultaneously collects and reproduces accurate information surrounding biotechnology in a virtual environment, while at the same time making well-informed critical and artistic comment on the societal, scientific, and political ramifications of these technologies.[ccxcv]

In 2003, Oron Catts and myself attended a European media conference in Germany, where Bioteknica presented their virtual teratomas using graphic and web techniques. We dared them, on that occasion, ‘put their money where there mouth is’; to come and observe as well as grow ‘real’ cancerous cells (and obviously to realise, that the wet stuff is visually much less spectacular then their virtual entities).

Willet and Baily have said: ‘Initially virtual, our organisms are now under laboratory development using living tissue. BIOTEKNICA both embraces and critiques biotechnology, considering the contradictions and complexities that these technologies offer the future of humanity'.[ccxcvi] They continue: 'Now, we are engaged in an interdisciplinary critical participatory relationship with evolving biotechnologies'.

Bioteknica, as a result of its declaration to re-engineer the irrational growth, embodies the anthropocentric human (and artist) who wishes to control and engineer its environment and herself as a form of control. Ironically, this is in a sense also the paradox embedded in the attempt of this chapter to force the above artistic expressions into a more coherent taxonomy, which will take a form that will make sense to us, humans (and specifically art historians…).

A more radical and defined political agenda is the core of the engagement of the Critical Art Ensemble (CAE) with tissue art. Tissue as a model for the whole and more specifically the human organism is their tactic. CAE is a collective of artists exploring the intersections between art, technology, radical politics and critical theory.

> CAE's practice is about the process of resistance, about creating works and events which reveal and challenge the authoritarian underpinnings of pancapitalism and Western culture. CAE makes events using combinations of traditional and participatory theatre, lecture, dialogue and the written text – events that demonstrate the necessity of this challenge.[ccxcvii]

The working title for their research project in SymbioticA 2007 was *Burning Bodies*:

> This project examines and documents the effects of phosphorus and low intensity radiation on cell structure. The product of the process will be an installation featuring a series of slides (in the microscopy sense of the term) projected from a video microscope and video of the production process intercut with the project's relationship to the wars in Iraq and Lebanon. Ultimately, it's an antiwar project concerned with the use of illegal weapons in the Middle East. The metaphorical value of hot or slow decay of living matter enveloped in a militarised environment is fairly obvious. However, people should also be able to visit horrible effects of war in a manner that does not fall into the standard affect of the war documentary image which should enable viewers to reflect upon the situation from within a different mode of consciousness. We hope to contribute to creating a different kind of affect about the war.[ccxcviii]

CAE art tends to follow more of a didactic approach in which the tissue is used as a medium to transfer a clear political agenda concerning human politics. The tissue stands as a signifier of the whole human body.

While CAE (and there are more applications of such artist research) subjected tissue cultures to different conditions and different substances and chemicals as a model for the whole organism – mainly human – condition, the following artworks treat the tissue as a non-human instrument.

The author was closely involved in the development of the *Fish & Chips* project which then evolved into *MEART – the Semi-Living Artist*, under the banner of the SymbioticA Research Group. In this project notions of sentience and creativity were investigated by recording signals from fish neurons (*Fish & Chips*) and embryonic rat cortical neurons (*MEART*). The readings were translated via a computer algorithm into art producing modules that are then stimulated back to the neurons. We referred to 'it' as a Semi-Living artist, ironically imposing the humanistic term 'art' onto disassociated neural tissue. This work was inspired and developed alongside Steve Potter's (2002) neuroscience research into learning behaviours of mammalian neurons in-vitro cultured over a multi electrode array. These non-invasive electrodes allow the recording from, and stimulation of, cultured neurons for days or even weeks. Neural activity from the cultured neurons was interfaced using custom software that operated a robotic arm that produced drawings. The artists were interested to see if the emergent behaviour can be perceived as creative. In one of the configurations of *MEART*, visitor's portraits were photographed and this information was used as the basis for stimulating the neurons. The images were reduced to 60 pixels, corresponding to the 60 electrodes of the multi electrode array, and the level of activity in these 60 regions of the culture determined the movements of the arm.

The project embodies Haraway's notion of the cyborg as 'a cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as a creature of fiction…Contemporary science fiction is full of cyborgs – creatures simultaneously animal and machine, who populate worlds ambiguously natural and crafted.'[ccxcix]

MEART’s strength is in its irony; questioning ideas of learning behaviour, art and human control over an animal/machine hybrid.

This project is very challenging on the ethical level as the use of neural cultures that receive inputs and produce outputs can be seen as the most problematic in the context of semi-living artistic entities. In our society, mistreatment of organisms equipped with a central nervous system is considered to be cruel, while the same treatment to an organism that does not have a central nervous system will not usually raise concerns. Furthermore, we now believe that the concept of self and consciousness emerge in the neurons. What happens when we take the neurons out of the organism, culture them and obtain their responses to stimulation we provide? How many neurons do we have to culture in order to create a conscious, sentient semi-living being?

Tissue as an instrument (an evocative instrument) is presented in BioKino’s *Living Screen* artwork:

> …the possibilities of developing an apparatus (‘The Bio-Projector’) that will allow a series of self created Nano-Movies to be projected through a microscope onto one single cell or living cell tissues is explored. The Nano-Movies specifically relate to different film theories ranging from the Lacanian inflections of Slavoj Zizek, to the phenomenological interpretations of Vivian Sobchack, through to the corrosive impact of Gilles Deleuze.[ccc]

The tissue as a medium is being used within the discourse of film theory.

A further instrumentalisation of tissue is apparent in a project that is design oriented rather than artistic, and which offers a potential consumer product, *Biojewellery*. The *Biojewellery* project, inspired by the work of TC&A, stemmed from research by two design students in the Royal College of Art, London.

> The project is seeking couples who want to donate their bone cells – a couple having their wisdom teeth removed would be ideal. …The couple's cells will be grown at Guy's Hospital and finished bone tissue will be taken to a studio at the Royal College of Art to be used in the design of a pair of rings. Following consultation with the couple, the bone will be combined with traditional precious metals so that each has a ring made with the tissue of their partner.

The designers assert that:

> Whilst each participant of Biojewellery has their own set of concerns, we are not producing objects of direct protest but pieces of information that will hopefully provoke unexpected and diverse responses. Our interest is in the complex relationship between the production and value of the biojewellery, the couple as both owner and donor, and the ways in which the jewellery and couple are perceived by a larger audience.[ccci]

Anna Munster's response to this approach is critical:

> ‘Biojewellery’, by way of contrast, invokes the power vested in avant-garde art to provoke audience reaction and yet claims that this will lead to more open-ended investigation of biotechnologies than the scenarios provided by the media, which frequently endow biotechnologies with fear. Rather than raising questions about what either science or art is doing in, or contributing to, the realm of living things, the ‘biojewellery’ project fashions an unusual and beautiful object out of the cloistered realm of experimental science. Although perhaps slightly unusual, I want to suggest that this instance of art-science collaboration does not push any aesthetic or cultural envelopes and falls into the trap of aestheticizing science.[cccii]

The difference with the last project described is the transition from an art object to a consumer product. Hence a straightforward and openly declared intention to instrumentalise the medium of tissue in order to create consumer products. As with many artists working with emerging technologies as a way of critiquing the same technologies, they also present the possibility of their (the technologies’) domestication and use/exploitation in realms beyond what they were originally aimed for. This paradox is evident in the work of the TC&A artists who, on one hand, critique life’s instrumentalisation in their discourse about the semi-living entities, and at the same time make the technologies available to everyone through training and SymbioticA’s workshops. While hoping to create a post-anthropocentric vision we also create a new class of object/subject for human exploitation. Nevertheless, through these experimental situations created by TC&A installations and in SymbioticA, new and alternative lives created by the bio-tech project are being explored and questioned, as well as their taxonomical position within the life continuum.

Concluding notes:

Through this survey of some of the artists working with living tissue as a medium I have outlined the variety of approaches and agendas contributing to the use of living tissue as a medium for artistic expression that challenge existing taxonomies. From extension of the human artist's body, political statements, spiritual journey or instrumentalised tissue (to the extent of making tissue as a product for human consumption), these are all expressions which utilise the medium of tissue. What is the hallmark of the TC&A project (as well as some of the associated works described above), besides its pioneering status, is its desire to break free from the 'I', the human, into a post-anthropocentric condition. This is not so much an expression of some utopian desire, but more a reflection of a taxonomical crisis driven by the recognition that humans are part of nature and dependent on it.

As part of our work in the TC&A project we present (differently to 'Art Orienté objet'), a thoroughly secular vision which explores the organic material in relation to the socio-economic fabric it exists and evolved within. We avoid terms of magic and the sublime as they are somewhat escapist strategies that deliberately obscure rather than illuminate the investigation of the current instrumentilisation of life. Also, unlike many of the artists working with tissues, we have mostly shied away not only from our own bodies and other self personifers, but from the human body in general, as part of our post-anthropocentric strategy. Many of the artists who have worked with us using tissues as a medium came from the conventional modernist and post humanist perspective of the artist self and the artist body.

However, unlike some of the projects described which treat tissue as purely a tool, TC&A relates to these fragments as semi-beings. Therefore, there is the need to explore a new taxonomy (such as in the case of Van Vellen) which will accommodate entities which are partly alive and are not individual, gender, species, or age specific.

It is still an early stage to speculate on the most appropriate art historical narrative to attach to the evolving tissue art. The tendency, though, which I have emphasised through this chapter, is that the use of semi-living tissue as part of an artistic expression, is a useful and evocative way to question conventional notions of life (e.g. humanist thought) and search for a post-anthropocentric expression. Will there be a meaningful future where semi-living semi beings will become an integral part of our living and constructed environment? Will they become more ‘living’ as they increasingly become more complex and independent from the artificial environment? And are we increasingly becoming less ‘living’ (or more semi-living) as we become ever more dependent on the technology we create?

Chapter 7 –

Towards A New Class of Being: The Extended Body

The Extent of a Metaphor

As mentioned earlier, a rough estimate would put the biomass of living cells and tissues, which are disassociated from the original bodies that once hosted them, in the millions of tons. In addition, there are tons of fragments of bodies (cells, tissues, organs) that are maintained in suspended animation in cryogenic conditions. All of this biomass requires an intensive technological intervention to prevent transformation to a non-living state. This type of being (or semi-being/semi-living) does not fall under current biological or even cultural classifications. The notion of the Extended Body can be seen as a way to define this category of life, maintaining the need for classification, while at the same time attempting to destabilise some of the rooted perceptions of classification of living beings. Much of this living biological matter can, in theory, be co-cultured and fused (cell fusion), or share its sterile environment (to varying degrees of success). Age, gender, race, species, and location do not play the same roles in the Extended Body as in other living bodies. This means that, in theory, every tissue in every living being has the potential to become part of this collection of living fragments. The Extended Body can be seen as an amalgamation of the human extended phenotype and tissue life; the fragmented body that can only survive by technological means; a unified body for disembodied living fragments, and an ontological device, set to draw attention to the need for re-examining current taxonomies and hierarchical perceptions of life.

The Life of Parts – The Being of the Semi-Living

> The body cannot survive without organs and cells, but the latter two groups can survive without the body.[ccciii]

The development of tissue culture in the early part of the twentieth century brought about a new type of being that requires a different ontology and, by extension, a different taxonomy of life. These beings are fragments of bodies kept alive with the aid of a new kind of body – a techno-scientific one. In-vitro tissue culture evolved from being a research field in itself (1910-1950s) to a research tool (1950s to present day), and then to a means of production (1990s to present day). The 'population' of what can be referred to as partial life and semi-living entities proliferated to a vast amount of cells and tissues that are living and growing outside of the organisms from which they originated. These beings are rarely referred to as subjects; their existence (supported by the techno-scientific project) is indicative of the instrumentalism of life that manifests itself in utilitarian and economic value.

The traditional use of animal (human and non-human) cells and tissue cultures for research, diagnostic, and therapeutic (tissue engineering) ends is increasingly being surpassed by the use of cells and tissues for the production of biological agents (mainly antibodies). Antibody production is now being done in large-scale bioreactors, as 'demand for many antibodies is very intensive, leading companies to build more and larger manufacturing plants on the scale of tens of thousands of liters'.[ccciv] Other recent uses of tissue cultures include the attempts to grow tissue-engineered meat (sometimes wrongly referred to as violence-free meat), and the development of living toxicity sensors (Linda Griffith, MIT), experimental actuators,[cccv] complex research models, and art. Tissues are being catalogued and stored in tissue banks, zoos and museums. In addition, tissues, cells and organs are being harvested from recently dead and living donors for organ transplant, or are being stored in suspended animation in cryogenic conditions. Some of the cells and tissues are removed from the body, manipulated or only reproduced in culture, and then reintroduced into a body – not necessarily the original body or even the same species. Other semi-living entities can be found at the butcher's shop and on the side of the road (among other places) where living cells can exist in the bodies and parts of animals. Even without technological intervention these cells and tissues survive for hours and days after the organism is considered to be dead (meat).

The questions that arise from the existence of a large biomass consisting of living fragments of bodies are rarely addressed. And when this existence is discussed, it is almost exclusively in an anthropocentric manner. Examples are Andrews and Nelkin in *Body Bazaar* (2001), which explores the legal implications of tissue commodity[cccvi] and Waldby and Mitchell (2006) *Tissue Economies: Blood, Organs, and Cell Lines in Late Capitalism*, which investigates human tissue (predominantly blood) as a waste and as a gift in the context of the global economy.[cccvii] Squier (2004), [cccviii] is less anthropocentric as she discusses partial lives as 'themselves' and refers to them as 'liminal lives'. However, she also focuses on human tissue and human embryos and the beneficial or potentially hazardous effects of these liminal lives on human society. The latest publication by Landnecker (2007). *Culturing Life: How Cells Became Technologies*,[cccix] is yet another step towards the discussions of cells in culture and the history of that technology as well as how these in-vitro lives may reflect on the human condition.

In certain instances, the popular media does refer in a non-direct way to these partial lives as partial beings. A recent example can be found in a *New Scientist* article describing Griffith and Shuler's tissue chip hybrids (or Meta Chips). While Griffith states that 'our vision is building the human body on a chip', the article is titled, 'Dawn of the Zombies' since 'You can poke them, prod them and pump them full of drugs, and they'll never complain'.[cccx] All of the above examples fail to give an agency or even a proto-agency to the living fragments; these examples treat the semi-living as quasi-life at best and in most cases as equal to inert objects.

Thacker, however, goes further. He calls the semi-living 'actants'. He asks: 'Can there be a politics that effectively takes into account these nonhuman actants, entities that are much more than inert objects and yet much less than autonomous organisms? How can we keep from falling into the too easy habit of reducing all actants to agential origins (e.g., the notion that, yes, there are these nonhuman machines, but ultimately humans design and operate them)?'[cccxi] TC&A's Extended Body is a small step towards answering Thacker's question.

<u>The Metaphysical Question</u>

When tissue culture started at the beginning of the twentieth century, it required a new way of looking at the body as a community of discrete entities that can survive independently from the body.

The example of the beehive further illustrates the complications involved in ideas of individuality. A beehive can be seen as one organism, with the individual bees as organs / tissues / cells of that organism.[cccxii]. However, we do have the tendency, due to the morphology and behaviour of the individual bee (and due to our anthropomorphic tendencies), to perceive one bee as an independent organism.

If the body is a community of cells, how can one refer to the collection of cells that are growing outside the body? What is the ‘community’ to which they belong?
When cells and tissues are removed from the (context of the) host body and kept alive, they are also being stripped of many other aspects of what is perceived as a living individual. They are kept alive and grown in a technological environment that acts as a surrogate body in the most fundamental way, they represent the ultimate bare life (as discussed by Adele Senior[cccxiii] and Monika Bakke[cccxiv]). These cells and tissues change morphologically, functionally, and in relation to space/time. Most isolated cells and tissues can survive and grow alongside cells and tissues of different individuals, species and ‘generations’. In many cases, a fairly simple procedure will temporarily open up the cells and nuclei membranes to fuse two or more cells, creating a novel chimerical being that constitutes living parts of different individuals and species. In addition, important

ingredients in (mainly) the nutrients provided to cells and tissues are derived from other living beings. One such ingredient is foetal calf serum, which is widely used to feed cultures of many cell types and origins.

It becomes obvious that the dissociated tissues and cells conform to a lowest common denominator – they are alive, they need technological support and they can coexist. Therefore, they form a kind of community. This community does not conform to common biological and cultural classifications and presents both an ontological and epistemological challenge: ontological because it calls into question the definition of being in a very basic and fundamental way; and epistemological because it questions our knowledge production from the perspective of a fragmented out-of-context collection of 'kind-of-alive' beings. It also reveals new perceptions with regard to the human position within the larger ecology.

Without being a vitalist, one begins to formulate ontological questions that need to be addressed:

- Does life have an intrinsic value that is different from the value of non-life?
- Is life different from non-life in that it is a subject rather then an object?
- Where does this 'haecceity' reside?[cccxv]
- Where can partial life and the semi-living be placed in the ontological and taxonomical charts?

- Do all fragments of one individual, although located in different geographical locations, still have the essence of this individual? Or are they all fragments of the same species?
- Is it the techno-scientific vessel that makes fragments a ‘one body/community’ and a ‘one being’?

Classification

The category of semi-living does not seem to exist or conform to either Linnaean taxonomy or molecular systematics (chemotaxonomy). The origin of most cells can be traced back to an organism that can be classified under these systems. Cells and tissue banks are still using this system to identity their ‘stock’ and sometimes even record the ethnicity of some human cell lines. There are cells in the collection that do not adhere to either Linnaean taxonomy or molecular systematics (chemotaxonomy), such as the McCoy cell line, which is classified as mouse cells even though the cells’ origin is identified as human.[cccxvi] In addition, the cell lines in the collection are actually sorted by unique names and catalogue numbers, partly because traditional taxonomies are not sufficient to deal with the collection.

Current taxonomy is rooted in eighteenth-century understandings of life and therefore carries some of the social values and scientific and ontological understandings of that time; for example, biblical understandings in which a species is defined according to morphological resemblance and ideas of speicies essenialism. Contemporary attempts at refining the system employ recombinant systematics based on data derived from DNA.

Besides enhancing current genohype,[cccxvii] this system excludes some of the more puzzling entities that exist today, such as chimeras, which have a few types of tissues with different DNA; or those semi-living entities that combine parts of living beings considered distinct in current taxonomies and are supported by technological means to maintain a form of life.

However, the concern of TC&A is the other ‘being’ that falls in between categories of the system of taxonomy, whether based on sexual selection or recombinant systematics – that of the Extended Body. We argue for a consideration of quasi-beings that are not animal (including human) as well as not fully living. These quasi-beings are liminal lives that are growing larger in population and in significance. These semi-living entities can convey to us new understandings of life and our own position within the fabric of living and non-living environments.

Humans and Animals Compared

In the dominant discourse exploring the human position within the living world, humans are compared and contrasted with other animals. This already takes a ‘speciesist’ position as a starting point for interweaving humans in the ecological fabric. We are suggesting that, rather than falling back on familiar arguments, we should adopt a new and fresh perspective that will force us to re-examine our position within a taxonomy that is increasingly dissolved, fragmented, and inadequate.

We may want to begin taxonomising humans together with other animals (as humans are animals) and look for another mirror image for comparison and contrast; a broken mirror image that is not necessarily so much like us, but can be, literally, part of us.

In order to explain this position I would like to investigate Heidegger's division of the world into three ontological positions – objects (such as stones) as wordless; animals as 'poor in the world'; and humans as world-forming.[cccxviii] I do not intend to provide an analysis of Heidegger's philosophy (I am far from qualified for such an enormous task) but rather to use Heidegger's concept as an aid for establishing a new position from which we can explore the different beings and semi-beings in the world.

Heidegger believes that animals have radically different modes of being in the world than humans. Animals lack the ability to perceive other entities in the world as beings (but they are capable of instinctive comprehensions of textures, scent, colors etc.). As a result of this lack, animals do not perceive themselves as beings either. Therefore they are 'in poverty' in the world (Heidegger did not attach any evaluation to such a position). Humans, in contrast, can perceive beings as well as comprehend their own 'being-ness'.

Heidegger's arguments are based on the latest discoveries in the life sciences of his time. The empirical evidence for his philosophical argument mainly is the work of the zoologists Emanuel Radl and Jakob von Uexküll on bees.

The Bee Experiment

As previously discussed, bees can be seen as part of a super organism (the colony / the community) rather than an individual being. Cells were not just named after the beehive but can be seen as analogous to the bee (as part of a community, according to Huxley). Therefore the bee experiment described in the following can be seen as an appropriate approach to exploring the position of the Extended Body. We should note, however, that there is some danger in applying Wilson's concept of socio-biology, where he equates the construct of the social insect (colony) to human society. (This comparison is reductionist and may lead to ideological propagation.) However, as a thought experiment, one can look at metaphorical relationships between cells and bodies (i.e., Huxley's community) and between humans and their extended phenotype (society, culture, technology).

A bee can be seen as part of an organism (the colony / the community) rather than as an individual being. However, some scientific experiments have demonstrated that the worker bee is not indifferent to the scent and colour of the flower from which it receives nourishment. The bee sucks nectar from a flower with some particular traits (such as scent and colour) and flies off. Most people will understand the latter as a conscious action performed by the bee once it realises that the flower does not hold any more nectar. Heidegger, however, questioned whether the reason why the bee stops sucking and flies off is in fact the bee's comprehension of the fact that nectar is no longer present and available. Heidegger believed that the bee lacked any ability to be aware of the absence of nectar as such.

To support his argument, Heidegger outlines an experiment in which a bee was placed in front of a bowl filled with more honey than it could consume at once. The bee began to suck the honey and, at a certain point, stopped and flew off (leaving some honey in the bowl). According to Heidegger, this behaviour could be wrongly interpreted as the bee recognising that it could not suck the whole amount of honey and therefore stopping. In another experiment, it was observed that if the bee abdomen is carefully cut away while the bee is sucking honey, the bee will continue to do so, regardless of the amount its body can accumulate (even when honey begins dripping out of the bee). This experiment led Heidegger to assert that the bee lacks the cognitive ability to conceive the existence of honey and is only acting instinctively (almost mechanically?).

This thesis does not intend to discuss the flaws of the experiment or the fact that Heidegger carelessly jumps to conclusions. After all, the bee was stripped of its natural context and placed into a techno-scientific one – a bowl with a large amount of honey. The bee was also physically 'reduced' through the removal of its abdomen and was therefore coping with an extreme and unfamiliar situation. To explain the behaviour of the bee, without any consideration for agency, is not necessarily the right approach for we can never know what the bee is actually "thinking". Paradoxically, one could argue that the bee may have been 'consciously' behaving this way because of the stressful circumstances – in order to defy them.

There are arguments that humans may exhibit similar behaviour when they are interfered with both physically or emotionally (one just needs to look at our Western obesity problem to realise that some of us have lost our ability to know when it is time to stop consuming).

We would argue that this experiment did not prove in any way that animals have no agency as such; one also cannot conclude that they are different from humans on the basis of this specific experiment. It may very well be that the bee can perceive other beings as such. In turn, our own ‘animality constraints’ may diminish our capability of perceiving other beings as beings (such as Heidegger's ability to perceive a bee as a being that is able to perceive other beings as such).

If we trace back the analogy between cells and a beehive, we can understand one bee as a whole organism or as an organ in the organism / colony forming an ‘individual body’. In other words, experimentation performed on a single bee can be compared to experimentation with tissue cells in a Petri dish. Taken from the context of the bee-colony, the bee will behave in unusual ways, just like cells removed from the body. The bee can be seen as part of an extended body. Humans will also behave strangely when removed from their community.

Our argument addresses notions of different scales of size, time etc., as well as different sensual perceptions (visuals, sound, smell or texture) that are determined by our biological makeup. All ‘beings’ are constructed according to variables of these parameters. Furthermore, beings can exist within beings, parallel to other beings, engulfing other beings, partly immersed in other beings etc. and not be aware of such ‘beingness’.

The Extended Body is a construct that may enable us to question the classification of the world according to humans, animals and non-living entities and look at the semi-livings that are located in between human/animal (cells of humans and animals fused together), human/object (a tissue-engineered construct consisting of human cells) and animal/object (a tissue-engineered construct consisting of animal cells) etc. Furthermore, these semi-livings can fall into any of these categories and still not conform to any one of our understandings of these categories.

We are all in some way an Extended Body – or the Extended Body is an apt metaphor for all life, dependent on the techno-scientific project in order to extend our survival. Fragments of our bodies are potentially becoming part of the Extended Body and fusing with other semi-living beings. The Extended Body engulfs all these cells, tissues of organs that are stripped off or removed from their host bodies – cells, tissues and organs without a ‘natural’ body – and are destined to be kept alive and often even proliferate in a new body that is techno-scientific. These bits of flesh can physically grow in different configurations, together or dismembered, regardless of their original host species, race, sex etc. This ability to co-culture, and in some cases even to hybridise, stems from the context into which the fragments are introduced. Hence, they are stripped from a body with an immune system and are introduced into a new ‘body’ yet to be defined as a specific ‘being’ that will not reject any foreign agent who/which may want to become part of it.

The Extended Body Point of View

The flexibility and versatility (even vulnerability) of the Extended Body ‘opens up’ a niche for new semi-living beings. It is our intent to take the ‘point of view’ of the Extended Body in order to examine new taxonomies and our new relations with the living and semi-living world around us from a fresh perspective.

As discussed earlier, Honor Fell (1900–1986), one of the pioneers in the field of tissue culture, encouraged her colleagues to adopt what she referred to as ‘the tissue culture point of view’[cccxix] as a way to understand better the processes and needs of cells in vitro. In TC&A, we are trying to expand this non-anthropocentric aspiration to a somewhat more complex ‘entity’, which is not human and not non-human, but rather a semi-living being. This way we hope to open up a fresh perspective from which to discuss humans’ relations to other beings.

Our position may be somewhat reductionist, though arguably not as reductionist as taking the DNA or the code point of view (the non-living / information-based point of view). We are taking a position that is reductionist with regard to the complexity of the living being; however, this reduction to a more visceral point of view enables, at least from a symbolic perspective, the engagement with different complexities, which are defining notions of living, non-living, species, race, gender, the individual, as well as the I (Am I a discrete being? Am I an accumulation of all my cells and the other organisms I've evolved from? As well as those who are embedded in my body such as bacteria, ams, viruses etc?).

As human ability to preserve ecological conditions for their survival is questionable, so is the fate of the Extended Body that is dependent on human care for its survival. The Extended Body is an extension of our own (or other living) body that takes the definition and perceptions of what a body is in different and alternative directions. The Extended Body is growing in size, presence, complexity, and versatility and can be a point of departure for addressing our limitations in the understanding of ourselves as an integral part of the ever transforming ecology.

Conclusion – The Ecology of Parts

The questions this thesis addresses are ontological/epistemological ones: What/who are the Semi Livings? How does their 'being' reflect on our understandings of life? What is their effect in our/human society? By their nature, these questions raise ethical and political considerations. They are also necessarily speculative questions as they point towards a phenomenon which is still evolving and in a process of becoming. We do not yet have the privilege of retrospective contemplation, but only contemporary fragmented anecdotes to illustrate and speculate upon. Furthermore, following the methodology of experiential participation, I am deeply embedded in the 'experiment' I am outlining and discussing.

Therefore, rather than discovering concrete answers to the questions above, I have suggested some strong tendencies towards a future in which Semi-Livings or partially living entities are taking on an integral and growing part in our made environment and this thesis is a further articulation of their problematic classification and positioning in our perceptions of and relations to life.

Personal story 1

'I just do eyes...just eyes...just genetic design, just eyes. You Nexus, huh? I design your eyes.'[cccxx]

Day 1:

Buzzing to get access to the laboratory in the Lions Eye Institute; the door opens and we are entering the corridor that leads to our designated bench in the lab. It is late morning and today we are going to learn, using our 'wet hands', how to isolate cells from a primary source. Until today we have mainly practised in sterilisation methods and basic tissue culture techniques with cells already isolated; cells in a dish – an extreme abstraction of a once living, bleeding animal.

Together with Brian, a PhD science student who will accompany us throughout the process, we dress in white laboratory coats. Together we walk through the corridor again and towards the large cold room. We open the large heavy metal door, and switch on the light. Brian asks us to take out the brown cardboard box from the bottom shelf and carry it with us back to the laboratory. It smells funny.

Back in the lab, we open the box to face a chaos of white fur stained with red blood. It takes us few seconds to adjust and compose and see what we look at: a pile of tens of half heads of white fluffy rabbits. Brian explains to us that the rabbits were slaughtered (or in the scientific jargon – 'sacrified') in the morning for gourmet food purposes. The brains were delivered to a neuroscience laboratory, while the rest of the heads were kept in the cold room, and we are going to derive living cells from the eyes of these dead heads.

First we 'pop' the eyes out and cut the optic nerve which attached them to the skull. Then we cut the excess skin with fine scissors and put the eyes into a 50 ml tube that is filled with nutrient media and a high concentration of antibiotics (to reduce chances of contamination by bacteria). The tube with the eyes is then positioned in the fridge until the following day.

Before putting the test tube into the fridge, Brian holds the test tube in front of us; the red pale eyes are 'looking' at us. 'I just do eyes…', he says with a funny smile. Immediately we share a bond among us as we all know exactly who Brian is quoting – the Hannibal Chew character from the film *Blade Runner*, who engineers the eyes for the androids. We all share the same association and quirky humour…and glimpse into a biologically engineered future.

Day 2:

We ring the bell in request to open the security door; once it opens we quickly walk along the corridor towards the lab. We open the fridge door and hold up the tube with the eyes. The eyes are still there as if looking at us, fragments of a once living body. Are they alive? Semi-living?

Working with fragments, with cells, we now have to work in sterile conditions as the original body and its immune system are detached. Dressed in lab coats and gloves, under the sterile hood we carefully cut around the eye iris. It is a tricky procedure as the round shape and smooth texture of the eye makes it difficult to hold. The cut needs to be gentle and precise to avoid puncturing the eyeball. If you do it right, the eye cornea is exposed. On the cornea there is a thin layer of epidermal tissue. This is what we need.

The small piece of tissue is then transferred to a six-well dish with nutrient media, and is put into the incubator. The cells, which are still alive, will proliferate and grow. We extended the life of parts of the rabbit more than 24 hours after its 'death'. We then made them into semi-living entities.

There is no conclusion, given the indeterminate nature of the project (as outlined above), and so a good way to conclude is with an account of the most recent TC&A project: *NoArk* (2007).

NoArk

[Figure 16]

NoArk explores the taxonomical crisis that is presented by life forms created through biotechnology. More specifically, NoArk considers the problematic position of the semi-livings in scientific as well as popular taxonomies, as the semi-living do not adhere to Linnaeian or molecular taxonomy, or to our popular understandings of a being.

NoArk is an experimental vessel designed to maintain and grow a mass of living cells and tissues that originated from a number of different organisms. This vessel serves as a surrogate body for the collection of living fragments, and is a tangible as well as symbolic 'craft' for observing and understanding a biology that combines the familiar with the other.

To create *NoArk* we used cellular stock taken from tissue banks, laboratories, museums and other collections. *NoArk* contains a chimerical 'blob' made out of modified living fragments of a number of different organisms, and lives in a techno-scientific body. In a sense, we have made a unified collection of unclassifiable sub-organisms.

Figure 16

We deliberately chose cell lines which by their definition present a paradoxical classification. For BEAP 2007 we cultured McCoy cell line (discussed above) over polymers aboard *NoArk*. Little descriptive information about the origin of the McCoy cells appears in the literature. 'The cells were reported to have originated from the synovial fluid in the knee joint of a patient suffering from degenerative arthritis. In 1965, scientists showed that McCoy cells are indeed human cells. However, another sub-line was, in fact, of mouse origin and possessed marker chromosomes characteristic of strain L mouse fibroblasts. McCoy cells, presumed to be human, but which actually are mouse cells, have been disseminated from laboratory to laboratory throughout the world.'[cccxxi]

In contrast to classical methodologies of collection, categorisation and display that are seen in natural history museums, contemporary biological research is focused around manipulation and hybridisation, and rarely takes a public form. The new sites for the collection of specimens of 'neo-organisms' are the life science/engineering laboratory, the research hospital, the biotech industry, and increasingly among artists and amateurs/hobbyists.

The specimens of neo-organisms and sub-organisms are catalogued and collected systematically, in tissue banks, research institutes and the patent office. However, most of these systems have little connection to natural history taxonomy. The appearance of these specimens in the public arena is more akin to the cabinet of curiosities than to the natural history museum. Like the cabinet of curiosities that preceded the natural history museum's refined taxonomy, we hope that *NoArk* is a symbolic precursor to a new way of approaching 'made' nature.

In the thesis I have referred to the collections of cells which already can be weighed in tons and are spread in laboratories, museums, zoos, and lately in some galleries, around the world, as the Extended Body. The new Extended Body ecology, consisting of a variety of semi-livings and partial life makes some of our traditional classification systems redundant while introducing new ontologies and epistemologies and calling for ethical re-consideration. These new sets of considerations enable a speculative vision towards a post-anthropocentric perspective.

As advocated by Monika Bakke, in a somewhat extreme way, the *zoe* (as opposed to the *bio*) offers new and alternative ways of perceiving the world and the changing hierarchy among its living and semi-living species:

> Currently, it is the bio-power of *zoe* that attracts so much attention. On the one hand it is an object of desire of anthropocentrically oriented transhumanists and neo-liberal humanists who tend to instrumentalise and commercialise it. On the other hand, post-anthropocentric thinkers focusing on pre-human and non-human aspects of *zoe* point out the necessity of considering subject as ecological entity.

> One of the most daring alternatives to the humanist and transhumanist attitudes to *zoe* comes from the new materialist vitalism inspired by Deleuze that is non-essentialist and anti-teleological hence radically postanthropocentric.[cccxxii]

As opposed to the enthusiastic and somewhat deterministic position taken by Bakke in relation to the evolving concept of post-anthropocentrism, my recurring use of the term post-anthropocentric is open-ended and exploratory. More than anything it reflects the need to find an alternative to the conventional dialectic of anthropocentric versus anti-anthropocentric discourses. It is a paradoxical and somewhat futile attempt, as it voices the need to find a 'language' that is not limited by purely human concerns, yet it is an important, if somewhat optimistic, approach that starts to envision an ontology and epistemology of hybrids which defy human classifications of being and being alive. The semi-livings and partial life are these post-anthropocentric entities which are partly us and partly the other and in the process of becoming 'themselves'. Bakke writes:

> Postanthropocentric attitudes seems to be spreading really quickly especially in academia and the art world but anywhere else it is still rather an uncommon and marginalized condition evoking lots of hostility as it brings a radical reformulation of the notion of subject, at the same time it offers a reformulation of the notion of life itself. However, this new awareness emerging vis-à-vis the techno-scientific novelties produces the effect of vertigo as it subverts the stability and balance of the anthropocentric subject. Yet, I argue, this vertigo is only a temporary symptom of a highly desired and invigorating shift from the

> anthropocentric stupor of the subject to the much needed flexible subjectivity operating in the mode of continuity and symbiosis.[cccxxiii]

While Bekke's version of post-anthropocentric attitudes is utopian, I question such optimism. Post-anthropocentric attitudes might offer alternative hierarchies and new configurations of relations, but by giving subjectivity to the *zoe* life forms it tends to eradicate the agency of the *bios* (if we are to follow Bekke's dialectic). One should always ask where the victims are positioned in the evolving new hierarchy.

<u>From 'Hatcheries' for premature humans to 'Vessels' of sub-life:</u>

The introduction to this thesis opens with the story of how the technology which enabled better rates of survival for premature human babies was introduced to the United States. These neonatal incubators were introduced to society through alternative means in the form of entertainment shows in fairgrounds. The incubator's design was intended to enable a better view for the spectator who paid approximately 25 cents to be able to view this 'wonder'. One of the reasons for that, I speculated, was that this new technology, even if scientific or biomedical, problematises conventional notions of life. Also, the transformation of birth from the realm of 'women's secret business' into the patriarchal realm through the use of technology, gained the 'seal of approval' from the scientific community by transferring it back into the hospitals. It seems that new ideas first need to be socially, culturally and personally articulated before becoming transparent and 'neutral' and therefore open to industrialisation.

The incubator for premature human babies was a device that enabled the ‘passage’ of the infant from an ambiguous zone into becoming a person. While in this ‘passage zone’ the premature baby had to be articulated. The premature baby, at the time became a ‘thing’, a freak, a ‘semi-being’ (neither human nor animal); an object/subject that could be put on display as a curiosity, until it became ‘normalised’ and ‘approved’ by the patriarchal techno-scientific project and was assimilated into the classification of life as a human being. In the case of the semi-livings this is even more problematic as they are not only liminal in the sense of being ‘on the edge of life’ (hence the in-between zone of the pre-life on its way to become fully living human organism), but rather they are liminal in many other profound respects – they are hybrids of species, age, morphology, race, sex, normal/cancerous and more. Furthermore, as demonstrated through this thesis and mainly by the artistic engagement with living tissues by the Tissue Culture & Art Project, these semi-living entities are not necessarily in the process of becoming something else but rather slowly gaining semi-agency as they are.

In the first chapter I established the basic questions asked in this study and their ontological, scientific and artistic contexts. The chapter outlines the natural and technologically-mediated occurrence of biological (rather than symbolic/representational or conceptual) hybrid beings ranging from the level of the organism (i.e. a mule) to the level of the DNA (i.e. transgenic animals as part of the pharmaceuticals industry as well as the arts). I concentrate my argument on the level of cellular hybrids as they challenge many aspects of our conventional understandings of life. Beside the fact that they are hybrids created by technology rather than evolutionary process (sexual selection and mutation) [cccxxiv], they pose an even larger 'threat' to many of the basic assumptions that frame Western thought. Because the status of these hybrids as beings is not clear by the standards of current thinking, they offer us a porthole onto new discourses. This set up the main thesis of this dissertation: the experimental development at the biological level of such hybrid semi-lives provides a potent arena and indeed means for artists who wish to push at the limits of those assumptions that frame our understanding and conception of what life is.

In this chapter I also discuss the increasing interest in recent years among artists (as well as curators, galleries and the media) in the use of animals and animal themes. I argue that this is in the main a result of artists reflecting on a void caused by the biotech revolution and the creation of new living and semi-living entities that are yet to classified. In other words, artists are seeking meanings out of pointing to the gap created between our cultural understandings of life to what we know about life through science and what we can do to life through our developing biotechnologies.

These biological and artistic developments are the context of fundamental questions posed by TC&A, and are the principal subject of the thesis: can we create a tangible yet symbolic gesture (or a conceptual prototype) towards some thing/one that is exemplary of the flux of the life continuum? A partially living, with some kind of agency (an actant[cccxxv]) that consists of different parts of (what we tend to perceive as) different species and individual beings, but is yet to be classified as a new species or a new animal;[cccxxvi] an entity that constantly defies definition or conventional categorisation, and will continually remind us that we are part of some thing or system that we cannot fully comprehend. A prime goal of the Extended Body concept of the TC&A project is to examine such an entity and the ontological problems (amongst others) it raises.

In chapter two I identify, outline and examine a history of partial life. I present an intriguing though unresolved history of the field of tissue culture and tissue engineering that was never separated from its researchers' attempts to articulate the 'nature' of cells in vitro, their position within the life continuum and in relation to humans. All, eugenic, secular, vitalist, anthropocentric and anti-anthropocentric narratives, were developed to explain what it may mean once humanity realises that fragments of bodies can be sustained and grown outside and independent of their host bodies.

This short history emphasises two narratives. One is concerned with the shifting perceptions and the use of metaphors to explain the 'nature' of fragments of life. The other narrative is concerned with the position of fragments of bodies within the life continuum and in relation to the bodies they were derived from as well as the new techno-scientific body they have been delivered to.

I argue that following the developments in regenerative medicine and in parallel with the unfulfilled promises of the human genome project, there has been a return to the metaphors that dominated during the development of cell theory. Metaphors of community (nation/state) and shared labour as opposed to the contemporary prevalence of metaphors of life as information – as manifested by emphasis on life as a DNA code. I do not suggest that either one of the metaphors is better than the other but rather direct the discussion towards contextualising these metaphors within a larger frame. Life as a code (or the central dogma) may have functioned to enable the transition from the information revolution to the biotechnological one while keeping the economical status quo (as thoroughly discussed in chapter four). However, the communal metaphors may have led Alexis Carrel, one of the pioneers in tissue culture techniques in the early twentieth century, to his eugenic beliefs. Life in vitro led Carrel to speculate on the benefits of eradicating the supposedly inferior sections of society for the betterment of the superior parts.

The other narrative outlined in the history of partial life discusses the position of fragments of bodies within the life continuum and in relation to the bodies they were derived from, as well as the new techno-scientific body they have been delivered to. I discuss the vision of Honor Fell, who, in complete contradiction to her predecessors in the early twentieth century, was more interested in the new understandings that stem from life in vitro as they apply to the co-existence and inclusion of different species, ages, sexes and races when grown in a dish. I introduce Fell's concept of the 'tissue culture point of view' as a precursor to exercising what I refer to as a 'post-anthropocentric point of view'.

I have demonstrated, giving examples from scientific writing as well as media and fiction texts at the time (mainly Huxley's 'The Tissue Culture King'), how life in vitro ignited the imagination of many people at the time regarding its possibilities as well as a point of reflection on one's own body and society as a body. Social metaphors (as already identified by Canguilhem) always lurked behind the field. As is later demonstrated, in chapters four and five, the social metaphors of cell theory, with all the problems they evoke, were then replaced with no less problematic metaphors of life as information and code. While the former tended to be anthropomorphic the latter tends to be simplistic and reductionist. Both can be used to serve and justify different and sometimes contradicting ideologies. The limits of both show yet again how 'life' is still a mystery to us, and how our taxonomies over determine and limit, as much as enable, our knowledge of the world.

I include the artistic work of TC&A as part of this history, following the work of pioneers such as Joseph Vacanti in the field of tissue engineering. What I have wanted to emphasise, beyond avoiding the art/science divide, is how TC&A has promoted the idea of treating the tissue constructs not as body replacement parts or even tools, but rather as semi-living beings or at least forms who/which can stand as themselves and gain semi-recognition and semi-agency to the extent that there is a call to look at them as a new species altogether.[cccxxvii]

The strategy of my argument is to look at different life or sub-life forms not from the usual reference point of the human – how they can be put to the service of humans; how they are affecting humans etc. – but rather to try and explore them in terms of their own existence. Such anti-anthropocentric arguments usually employed the 'other' animal to articulate a point of difference from the anthropocentric perspective. However, I use a different 'other' that cannot be gendered, sexualised, or even individualised.

Nevertheless, it can consist of parts of us and other animals, and just like us, it is subjected to the conditions of the techno-scientific project and is dependent on it for its survival.

In chapter three I examine the ethical questions raised by the existence of the extended body, but more particularly I have looked at the ethical questions raised by growing/constructing semi-living entities for artistic expression. These questions, I argue, expose a paradoxical position. On one hand there is the attempt to break down speciesism and make humans part of a broader continuum. On the other hand, human artists are using (abusing?) a more privileged position to technically manipulate an aesthetic experiment with other (semi) life forms. This paradox is partially resolved by the realisation that humans are part of the continuum of life. This is not to suggest the equality or sameness of life and non-life. On the contrary, the projects expose the complexities of life and the continuum between life and non-life to which humans intimately belong.

I argue that only when artists use semi-livings for what seems to be a frivolous purpose can a true ethical discussion begin, as in this context there is no scope for the utilitarian arguments governing bio-medical, agriculture or defence discourses.

Personal Story 2

'Fairy tale dreams come true as princes and princesses, heroes and villains meet Guests in enchanted lands.'[cccxxviii]

Oron Catts and I were invited to a poster presentation at the Third Biennial Meeting of the Tissue Engineering Society, 30 November–3December 2000, in Orlando, Florida. As it was organised by Dr Joseph Vacanti, we were wondering whether the choice of the land of Mickey Mouse by the creator of the Eared Mouse was not accidental.

Day 1:

We arrive from Boston to Florida a day early as we are curious about the Disney World, a place we have heard about but never experienced. Our colleague, Boris, a heart surgeon, is joining us for the trip.

Breakfast is served early morning in our resort. In the spirit of the American dream we are confronted with a large selection of meat, eggs, cereal and other food items. We must exercise our right to choose. This becomes even more complicated as Mickey and Goofy are approaching our table with more food on trays for our selection. We already feel that the experience is concerned mainly with excessiveness.

Excess of food leads to excess of tissue…

Long and lasting queues for bigger, brighter, scarier themed rides. Joining Oron and Boris on the ride tested my fears…I scream hysterically on every ride, whether it is a train ride of 200 kph upside down, or a toddler's ET bicycle drive of 10 km at 20 cm off the ground.

Dr. Vacanti confessed to us that his favourite ride is the ‘It is a Small World’ ride: in which one sits in a boat-like carriage which slowly takes you on a ride across the American version of other cultures as demonstrated by small figures who dance and sing in high pitched voices. I remember *The Simpsons* episode in which Lisa is forced to drink from the artificial water on which the boat is sliding only to experience what seemed to be an LSD trip.

Walt Disney characters are smiling to you everywhere, trying to sell you stuff. Kids are crying, parents are shouting, cameras are everywhere. It is time to go back to the hotel.

Day 2:

The day of the conference. Many people mostly dressed in suits. Name and affiliations budges are attached. We are part of Harvard Medical School and people are checking whether we are familiar to them. After all it is the Disney world of tissue engineering; all the people we have read about are here.

Poster session is at midday. We hang our poster: ‘The use of tissue engineering as a medium for artistic expression’,[cccxxix] which reads:

Introduction:

‘Tissue engineering holds much promise for improving the quality of human life. However, tissue engineering for artistic purposes has largely been overlooked…’

Case Study:

'Semi Living Worry Dolls…'

Methods and Materials:

'Our worry dolls were handcrafted from biodegradable polymers, PGA mesh, P4HB, PLGA and various surgical sutures…'

Results:

'Preliminary tissue-engineered art has been successfully produced. Under laboratory conditions, a close to confluent layer of smooth muscle cells was achieved on the worry dolls in approximately three weeks. Most of these worry dolls maintained their structural integrity during exhibition.'

Conclusion:

'Our sculptures have been met with varied reaction. The general reaction has been one of immense curiosity surrounding the objects themselves, the production process, and the futuristic implications. For many people, our art challenges them to examine their perception of the boundary between living and inanimate. We have been able to engage the public with our art by providing informative and contextual explanations, and by the use of humour.'

To one side of our poster, which was illustrated with colourful images of the worry dolls, there was a poster titled, 'Bioresorbable carriers for subchondral anchoring of tissue-engineered cartilage in articular defects', while opposite to us was a poster describing the use of tissue engineering techniques for penis enlargement.

Reactions to our poster ranged from visible rage (This is not science! This poster degrades the field of tissue engineering!) to genuine interest. One scientist even confessed to us that he himself created sculptures of different animals using tissues while testing new biomaterials.

In the evening cocktail, networking with the scientists around me I was not sure anymore what I found more ethically appropriate; making them (the scientists) outraged about our artistic work or making them respond enthusiastically to the possibilities that this kind of work raises.

'This is an intervention', I told myself, 'Make them (as much as yourself) feel a slightly more informed hypocrite…'.

Chapter three outlines the different ethical frameworks that are used to explore the relations of humans with the rest of the animal kingdom as well as beyond. I outline the hypocrisies humans exercise towards their living and non-living environment, which we abuse and depend on. I suggest that the semi-livings, if exercising the 'tissue culture point of view', enable us to push our ethical goalposts as they are multi-species, multi-gendered, multi-aged etc., and therefore we cannot employ our conventional ethical frameworks and are forced to configure new ones; which may be more post-anthropocentric?

Chapter four examines the importance of wet engagement with the life sciences for better understanding the complexities of life as well as for the contemporary framing of mis/understandings and mis/uses of biological metaphors. I argued that for the non-scientist the “wet” experience in the laboratory involving some degree of life manipulation can be seen not only as an ethical conduct but also as a political act. As political act, it goes beyond the democratisation of the technology to the actual act of breaking down dominant discourses, dogmas and metaphors to reveal new understandings of life and the power structure it operates within. This experiential engagement can sometimes reveal that criticism levelled against some biological art is embedded within the dominant dogma.

Chapter five follows this argument and extends it to question the role of the critical artist who works with the technologies she criticises and operates within an institution which is subject to certain regulations. The chapter is also a critique of ‘genohype’, or the gene-mania that occurred following the Human Genome Project media blitz.

I discuss the different methods that can be employed and their limitations, drawing on a personal experience in which the TC&A project *Pig Wings* became scrutinised for its political content. Again, rather than giving specific answers, I demonstrated the self awareness an artist must constantly employ to play with and upon the potential of her work to be used in contradiction to her intentions.

Chapter six examines the growing number of artists using tissues and cells for their artistic expression. Although I present a somewhat eclectic collection of expressions, motivations and intentions in the use of tissue as art, I point towards a tendency by the artists to view the semi-livings not only as a legitimate and powerful living medium, but also as beings with semi-agency that can articulate new understandings of ourselves becoming hybrids with other animals/machines, dependent on the techno-scientific project for our survival, and therefore becoming more post-anthropocentric.

Chapter seven examines again the metaphor of the extended body and its embodiment with living tissue as an artistic expression. It is an exploration of the Extended Body point of view which suggests, through the TC&A project of the victimless utopia, a future which is non-utopian/ non-dystopian but rather ironic, as, while humans have created technological semi-beings as a form of control over life, at the same time, like their creations, they have become dependent on these technologies.

Adopting the suggestion of Van Valen and Maiorana[cccxxx] of treating the HeLa cell line as a new species, based on its unique genotype and niche specification, one is left not only with the question of fragmentation and classification, but also with a paradox: If *Helacyton gartleri* is a new species, how long will it stay a pure and fixed entity if it was ever such an entity before? When will it mutate to yet another one and how can we begin the enormous and self defining task of classifying all the different and ever changing and growing semi-livings around the world?

Through this dissertation I have not only described the evolving discourses of the TC&A project, but also suggested alternative scenarios for a future in which partially living entities prolifiate. TC&A has affected and changed perceptions about life, art and the hierarchy of living systems.

The term semi-living and TC&A discourses have penetrated in different forms into a wide variety of niches from the art world, humanities, and the scientific and commercial worlds. The semi-living are growing in presence and in agency. They are multi-potent in meanings and possibilities; they are part of us and independent of us; they can give us a fragmented glimpse into a post-anthropocentric future.

TC&A's most recent work (at the time of writing), aboard the *NoArk* vessel,as described earlier includes a fully functioning techno-scientific body – a bioreactor and collection of (semi)living fragments of different bodies above a collection of dead and preserved animals. The movement of the Noark vessel (over a turntable) corresponds to the movement of the bioreactor and maintains a constant the movement of the vessel – while the dead specimens are only rotating along one axis, the semi-artificial abstracted life is moving along two axes and also changing over the fourth dimension of time. This is also to symbolize the current situation of our changing perceptions and developing understandings about life and our position within its gradients. As argues by Bakke; this 'unpreccedented situation of not knowing one's location in respect to other life forms is destabilizing and yet desirable.'[cccxxxi] Such a state, in which human abilities to manipulate and to certain extent create new living and semi-living entities, and furthermore when the definition and understandings of the term life is going through significant changes, can be seen as a reflection as well as a porthole to new views of the world. This thesis, through its exploration of partial life describes the ways in which the development of tissue culture techniques, the metaphors and arguments they generated, and then the artsworks they have inspired in recent times , have opened the door to a more post-anthropocentric view of the world in which the human and the other animal are all seen part of an ecological continuum; from living to semi-living; an extended body created and dependent on the techno-scientific project which it formed and is being formed by .

- **Appendix 1**

PARTIAL LIST OF TEXTS WRITTEN AND/OR CITING ABOUT THE WORK OF THE TISSUE CULTURE & ART PROJECT:

1. Andrews B. Lori, Art as a Public Policy Medium, in *Signes of Life:Bioart and Beyond*, Eduardo Kac Editor. The MIT press 2006 pp.125-150.
2. Andrews B. Lori, Tissue Culture: The line between art and science blurs when two artists hang cells in galleries, in *The Journal of Life Sciences*, September 2007 pp.68-73.
3. Anker Suzanne, Nelkin Dorothy, *The Molecular Gaze: Art in the Genetic Age* CSHL Press 2004.
4. Animal Studies Group, *Killing Animals* University of Illinois Press, 2006
5. Ascott Roy, Interactive Art: Doorway in the Post-Biological Culture, in *BioMediale: Contemporary Society and Genomic Culture* Dmitry Bulatov Editor. Published by The National Centre for Contemporary Arts (Kaliningrad Branch, Russia) 2004, pp.200-215.
6. Bakke Monika, Zoe-philic Desires: Wet media art and beyond, Parallex, 2008, vol. 14, no. 3, 21-34.
7. Bullen E.; Robb S.; Kenway J., Creative destruction': knowledge economy policy and the future of the arts and humanities in the academy Source: *Journal of Education Policy*, Volume 19, Number 1, January 2004 , pp. 3-22(20) Routledge, part of the Taylor & Francis Group.

8. Catts Oron The Art of the Semi-Living in *Live: Art and Performance*, Tate Publishing 2004.

9. Clarke E. Braddock Sarah and O'Mahoney, *Techno Textiles 2: Revolutionary Fabrics for Fashion and Design* Thames and Hudson 2005.

10. Cooper Melinda,Tissue Culture Art – Relics, Living Dolls and Meat in *Art in the Biotech Era,* Melentie Pandilovski Editor, Experimental Art Foundation Press: Adelaide Australia 2008 pp.140-147.

11. Dollens Dennis, *Digital-Botanic Architecture: D-B-A* SITES Books, 2005.

12. Ede Sian, *Art & Science* B Taurus Publisher:London 2005.

    Edelman P.D., McFarland D.C., Mironov V.A., Matheny J.G. In Vitro-Cultured Meat Production in *Tissue Engineering*. May 1, 2005, 11(5-6): 659-662. doi:10.1089/ten.2005.11.659.

13. Eamonn Kelly, *Powerful Times: Rising To the Challenge of Our Uncertain World* Wharton School Publishing, 2005.

14. Fischer M J Michael, *Emergent Forms of Life and the Anthropological Voice* Duke University Press 2005.

15. Houser Jens, *Tactical Biopolitics Art, Activism, and Technoscience*, Beatriz da Costa and Kavita Philip Editors, The MIT Press 2008

16. Houser Jens, *Behind the Animal, the Man: the relationship to animals in art biotech*, in Publications de L'Universite de Pau, Bernard LaFargue Editor 2005.

17. Hauser Jens, Biotechnology as Mediality: Strategies of organic media art, *Performance Research*, 11:4 (2006): 129–136.

18. Hauser Jens, Bios, Techne, Logos: A Timely Art Career, *Revista Digital Universitaria*, 8:1 (2007) p.2.

19. Ingraham Catherine, *Architecture, Animal, Human: The Asymmetrical Condition* Routledge, 2006.

20. King A Elaine & Levin Gail *Ethics and the Visual Arts* Allworth Communications, Inc., 2006

21. Lachaud Jean-Marc, *Art et politique* L'Harmattan, 2006.

22. Langford Martha Editor, Eyes and Skin/Gaze and Touch in *Image and Imagination* Mcgill-Queen's University Press 2006.

23. Lee Suzzane, Preez du Warrenand Jones Thornton Nick, *Fashioning the Future: Tomorrow's Wardrobe*, Thames and Hudson 2005.

24. Leopoldseder Hannes, Schöpf Christine, Stocker Gerfried *Ars Electronica, 1979-2004: The Network for Art, Technology and Society: The First 25 years= 25 Jahre Netzwerk für Kunst, Technologie und Gesellschaft* Hatje Cantz, 2005.

25. Munster Anna, *Materializing New Media: Embodiment in Information Aesthetics*, UPNE, 2006

26. Munster Anna, Bioaesthetics as Bioethics in in *Art in the Biotech Era,* Melentie Pandilovski Editor, Experimental Art Foundation Press: Adelaide Australia 2008 pp.14-21.

27. Poissant Louise & Daubner Ernestine, *Art et Biotechnologies* Presses de l'Universite du Quebec 2005.

28. Powell Dave, Chimera Contemporary: The Enduring Art of the Composite Beast, in *Leonardo* Vol. 37, No. 4, Pages 332-340 2004.

29. Reichle Ingeborg, *Kunst Aus Dem Labor,* SpringerWien: New York 2004.

30. Seiler H. Lauren, What Are We? The Social Construction of the Human Biological Self *Journal for the Theory of Social Behaviour*, Volume 37 Issue 3, Pages 243 – 277 2007.

31. Senior Adele, In the Face of the Victims: confronting the Other in the Tissue Culture and Art Project, in *sk-interfaces: exploring borders – creating membranes in art, technology and society*, Jens Houser Editor, FACT & Liverpool University Press: UK 2008 pp.76-82.

32. Senior Adele, Towards a (Semi-)Discourse of the Semi-Living; The Undecidability of a Life Exposed to Death, *Technoetic Arts: A Journal of Speculative Research*, 5:2 (2007) 97–111.

33. Stocker Gerfried, Schöpf Christine Editors, *Ars Electronica 2007: Cyberart*, Hatje Cantz 2007.

34. Stocker Gerfried, Schöpf Christine Editors, *Hybrid Living in Paradox: Hybrid - Living in Paradox* Hatje Cantz 2005.

35. Sutton Damian, Brind Susan, McKenzie Ray, *The State of the Real: Aesthetics in the Digital Age* I.B.Tauris, 2007.

36. Tofts Darren, *Interzone,* Craftsman House: An imprint of Thames & Hudson Australia Pty, Ltd. 2005.

37. Wilson Stephen, *Information arts: Intersections of Art, Science and Technology,* The MIT Press: Cambridge Massachusetts, London England 2002.

The Tissue Culture & Art work has been featured in numerous media articles, radio and television shows. To mention just few of these outlets – Nature Magazine, The New York Times, The Washington Post, Time Magazine, the Economist, Art World, ZDF Television, BBC Television, PBS Television and many more.

Appendix 2

CHRONOLOGICAL LIST AND DESCRIPTION OF WORK OF THE TISSUE CULTURE & ART PROJECT DISCUSSED IN THE THESIS

1. *Tissue Culture & Art – Stage One*

Perth Institute of Contemporary Arts (PICA), Western Australia, 1998

Tissue culture (epidermal cells and fibroblast, primary culture and cell line) was grown over three-dimensional glass structures. The glass structures, which we designed, took the form of human made technological artefacts, i.e. a bomb, a cogwheel, a spiral, a squeezer. The semi-living structures were photographed, using different biological techniques. The images were than digitised and some of them were further manipulated.

The exhibition also presented the *Hamsa* image. This image, from Jewish culture, is of a hand shape with an eye (usually referred to as *Hamsa*) which is suppose to protect from the evil eye. In order to create this image, tissue (primary rabbit's fibroblast cells) was grown over a readymade glass structure. The glass structure was bought at the holy gravesite of Rabbi Shimon bar Yochai in Israel

The exhibition consisted of the two-dimensional and backlit images as well as the glass structures with fixed (dead) tissue.

Catalogue of exhibition: ISBN: 1-875386-33-5

2. *The Stone Age of Biology*

Perth International Arts Festival, Scitech Discovery Centre, Western Australia, 1999

Muscle (mouse) and nerve (fish) tissue was grown over hydrogels P(HEMA) in the shape of miniaturised prehistoric stone artefacts. The prehistoric stone artefacts were borrowed from the Western Australian Museum. They were scanned in three dimensions using a touch sense scanner. The virtual object was then reduced in size and plotted onto modelling wax. A mould was made out of silicon which enabled the formation of a hydrogel mould.

The exhibition consisted of the two-dimensional and backlit images as well as the hydrogels and the other artefacts produced in the process of creating the semi-living stone tools (i.e. wax moulds, silicon moulds etc.).

The concept of the exhibition is described in the following extract from the Exhibition brouchure:

> The evolution of technology ushered a number of major developments. These developments changed the perception of humans toward their environment. One of the very first of these changes was the realisation that stones can be chipped to form functional tools. Only the humans that could build a mental three-dimensional representation of a finished tool and who had the cognitive ability to plan ahead and manually construct the tools could survive the game of natural selection. For them

nature became a resource for raw materials for tools production. This mental shift separated humans from nature for the first time, and we never looked back…

We are now, for the first time, treating living nature (including ourselves) as a resource for new biological tools that will be part of our manufactured environment. What kind of mental shift we will go through? How will we treat our biological bodies? How will we perceive manufactured living matter? How much technology will invade the body and how much of the body will invade technology?

The Stone Age of Biology can be seen as the lines on the walls of our new cave. The development of stone tools transformed hominoids from being 'intellectual apes' to what we are now. The mental shift that made the apes toolmakers is now being repeated. The development of biological tools will change us in ways that we cannot imagine.

3. *Semi-Living Worry Dolls: Tissue Culture & Art(ificial) Wombs*

Debuted in *Next Sex Festival*, *Ars Electronica*, Linz, Austria, 2000.

Tissue from McCoy cell line was grown over biodegradable polymers (PLGA P4HB) hand-crafted to the shape of small dolls.

This was the first time TC&A was able to present live semi-living sculptures in the gallery space. For that, a laboratory was constructed inside the gallery. The laboratory was a square shape and made out of clear vinyl so that the interior of the laboratory and its operators were visually exposed. The semi-living Worry Dolls were grown inside a micro gravity bioreactor, positioned inside the laboratory and facing the audience.

Beside the laboratory, people could type into a computer their worries addressed to the dolls (as well as read other people worries). This feature exists in all *Semi-Living Worry Dolls* installations around the world, as well as online at http://www.tca.uwa.edu.au/ars/main_frames.html.

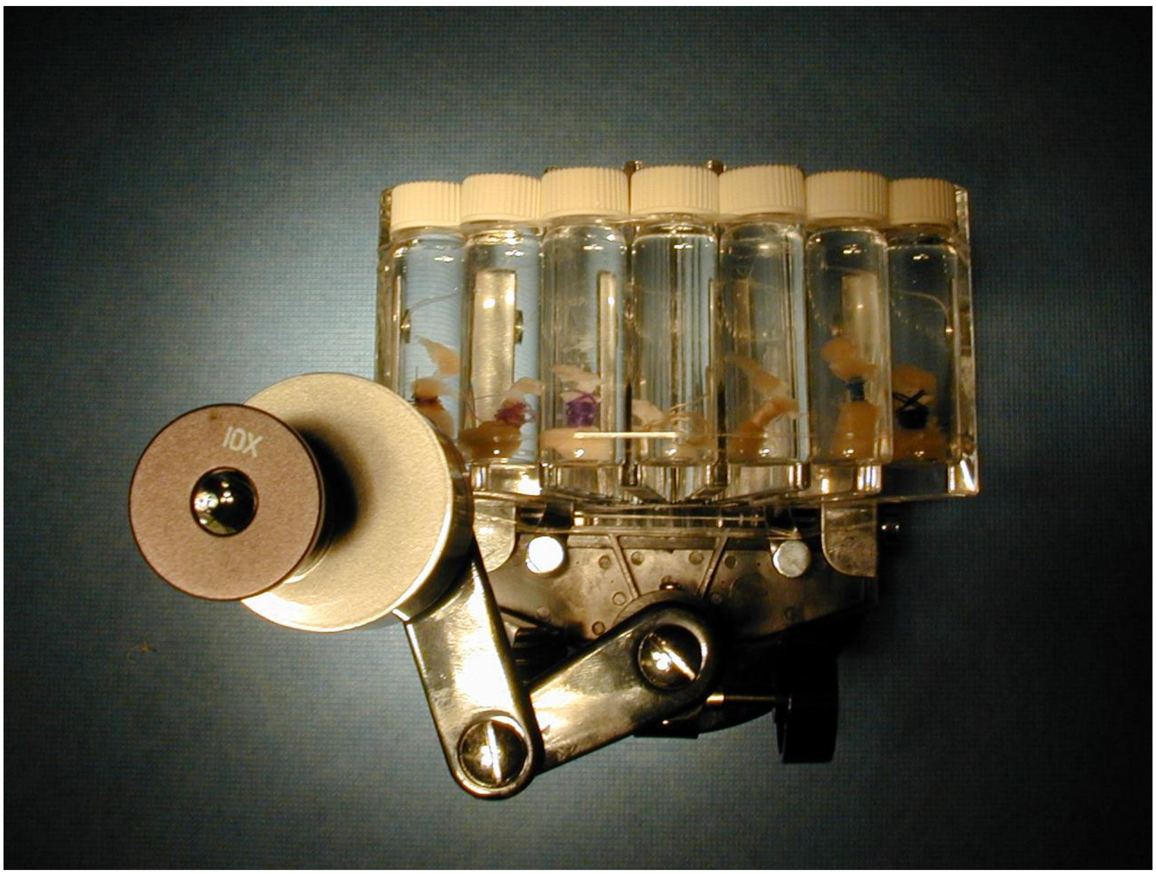


Figure 18

4. Pig Wings

The Pig Wings project was developed in 2000-2001 during a residency in the Tissue Engineering and Organ Fabrication Laboratory in Massachusetts General Hospital, Harvard Medical School.

In the *Pig Wings* project three sets of wings made out of pig mesenchymal cells (bone marrow stem cells) were grown over/into biodegradable/bioabsorbable polymers (PGA, P4HB). The wings size is 4cm x 2cm x 0.5cm each, and they were grown for approximately nine months. The original wings are coated with gold and kept in jewellery boxes.

The project was originally developed for a commission by the Wellcome Trust (which was rejected, see chapter five). It was first shown as part of the *Converge* exhibition at the Adelaide Biennial of Australian Art, 2002, and recently in the Design and Elastic Mind Exhibtion at the Museum of Modern Art, New York 2008.

***5.* The Victimless Utopia Series (includes: *Disembodied Cuisine 2003; The Remains of Disembodied Cuisine 2004; Victimless Leather: A Prototype of Stitch-less Jacket grown in a Technoscientific 'Body' 2004; DIY De-victimizer 2006*)**

Tissue culture technology seems to promise us (among many other things) an illusion of a victimless utopia. TC&A argues that this technologically mediated victimless utopia is but a transformation of explicit violence into a hidden implicit one on a much greater scale. As urban Western culture seems to find it hard to stomach images of real violence (as opposed to cinematic and constructed simulated violence) its obsession with ever growing meat consumption has inevitably created increasing amounts of victims from the natural environment to other animals and humans. There is a shift from ‘the red in tooth and claw’ of nature to a mediated nature. The victims are pushed further away; they still exist, but are much more implicit. For example, parts of the living are fragmented and taken away from the context of the host body (and the mere act of fragmentation is violent) and are introduced to a technological mediation that further ‘abstracts’ their livingness. By creating a new class of Semi-Being, which is dependent on our technology for survival, we are also creating a new class for exploitation.

5.1 Disembodied Cuisine

L’Art Biotech exhibition, Nantes, France 2003

This installation was based on research in the Tissue Engineering and Organ Fabrication Laboratory in Massachusetts General Hospital, Harvard Medical School, in 2000–2001. In this project Semi-Living food was grown. The first steak was made out of pre-natal sheep cells (skeletal muscle). Cells were harvested as part of research into tissue engineering techniques in utero. The steak was grown from an animal that was not yet born.

For *Disembodied Cuisine*, we grew *Xenopus laevis* cell line (XTC) over biopolymer for food consumption. The semi-living frog steak was grown for more than two months and was consumed as food by the artists and eight other volunteers by the end of the exhibition.

From the catalogue:

> Some might say that the ultimate way of treating living systems is by consuming them for food. Throughout history humans have practised some kind of division among living entities that are categorized as food or others (such as pets, ornaments, work etc.). These divisions are not always clear, and we must practise some kind of hypocrisy in order to be able to love and respect living things as well as to eat them. Dogs are an example of such confusion; in some cultures they are 'man's best friend' (pets), in others they are ornaments and being selectively bred for aesthetic qualities. Dogs, in other cultures, are being eaten. Peter Singer refers to such division as: Speciesism in Practice – Animals as food.[cccxxxii] As human society becomes urban and direct relations to what is considered to be 'wild nature' weaken, this behavior is being further questioned. Furthermore, as our understanding of life increases, we employ different attitudes and hypocrisies to be able to continue this need to simultaneously cherish and kill living systems while employing some kind of value based hierarchy (sometimes rigid/sometimes arbitrary) among the different living systems. (After all, vegetables are also living systems). We recently heard a story from Jason Davidson, an Australian aboriginal artist, who documented his hunting trips as a way to explain the functions of internal organs to his community. He presented one of these videos to a white urban audience. In this video he showed a wild water buffalo that been hunted and cut open for the dual purpose of food and education. One of the viewers could not hide her disapproval and accused him of being cruel while suggesting that he should go

to the supermarket and get his meat there. This epitomizes the hypocrisy of the western urban society in relation to meat consumption. These neatly packed parcels of meat on the supermarket shelf bear very little reference to its source. Is hunting (for food) an animal that had a good life in the wild much crueler than buying meat in the supermarket, meat that was produced by growing animals in crammed industrial farms?

In 'Disembodied Cuisine' we grow frog skeletal muscle over biopolymers for potential food consumption. A biopsy is being taken from an animal which lives in the gallery alongside the growing 'steak'. This installation culminates in a 'feast'. We also culture plant tissue as a 'side dish'.

This piece deals with one of the most common zones of interaction between humans and other living systems and will probe the apparent uneasiness people feel when someone 'messes' with their food. Here the relationships with the Semi-Living are that of consumption and exploitation, however, it is important to note that it is about 'victimless' meat consumption. As the cells from the biopsy proliferate, the 'steak' in-vitro continues to grow and expand. Hence the source – the animal from which the cells were taken – is healing. Potentially, this work presents a future in which there will be meat (or protein rich food) for vegetarians, and the killing and suffering of animals destined for food consumption will be reduced. Furthermore, ecological and economical problems associated with the food industry (growing grains to feed the animals and keeping them in economically rationalized conditions) can be reduced dramatically. However, by growing our food we create a new class of exploitation – that of the Semi-Living.

One of the students in the Vivoart class, offered by SymbioticA, the Art & Science Collaborative Research Laboratory, is a vegan who believes in minimizing harm to animals. She has offered a new twist to human confusion between living system and 'meat'. Recently she had the urge to eat meat (an 'evolutionary' desire for protein rich food? the thrill of the hunt? or is it just an aesthetic desire for a different taste and texture of the food we decide to consume?). The craving for meat and the belief in not eating other species found an outlet based on the idea of Semi-Living food; she could suggest taking a biopsy of her own cells, rather than inflicting physical and psychological stress (even if temporary) on another animal. In this way we could grow steaks made of her own flesh. The questions we are pondering are not whether it is against nature (we are a long way away from nature for a long time and humans have practised cannibalism before), nor if it is moral (it is done with the full consent from an aware adult), but rather questions of bio-safety and furthermore, the rhetoric that will be used by our society to deal with such a concept.

5.2 The Remains of Disembodied Cuisine 2004

In this installation are presented the remains – the pieces people spat out – of the semi-living frog steak grown and feasted on as part of *Disembodied Cuisine* installation, at *L'Art Biotech* exhibition, Le Lieu Unique, France 2003. The installation also includes the video film, *Pictures at an exhibition: Disembodied Cuisine by the Tissue Culture and Art Project* by Jens Hauser.[cccxxxiii]

5.3 Victimless Leather: A Prototype of Stitch-less Jacket grown in a Technoscientific 'Body'

The Space Between Exhibition, John Curtin Gallery, Perth, Western Australia, 2004

The 'victimless leather' is grown from immortalised cell lines which are cultured and form a living layer of tissue supported by a biodegradable polymer matrix in the form of a miniature stitch-less coat-like shape. The victimless leather is grown inside a custom made perfusion chamber (inspired by the organ perfusion pump originally designed by Alexis Carrel and Charles Lindbergh). It is an automatic dripping system which drips into the polymers and feeds the cells. The *Victimless Leather* project is concerned with growing living tissue into a leather-like material.

From the catalogue:

> Humans, the naked/nude apes, have been covering their fragile bodies/skins to protect themselves from the external environment. This humble act for survival has developed into a complex social ritual which transformed the concept of a 'Garment' into an evocative object that cannot be taken on its face value. Garments became an expressive tool to project one's identity, social class, political stand and so on. Garments are humans' fabrication and can be explored as a tangible example of humans' treatment of the Other.

By growing Victimless Leather, the Tissue Culture & Art (TC&A) Project is further problematising the concept of garment by making it Semi-Living.

The Victimless Leather is grown out of immortalised cell lines which [are] cultured and form a living layer of tissue supported by a biodegradable polymer matrix in a form of miniature stitch-less coat-like shape. The Victimless Leather project [is] concerned with growing living tissue into a leather like material.

This artistic grown garment will confront people with the moral implications of wearing parts of dead animals for protective and aesthetic reasons and will further confront notions of relationships with living systems manipulated or otherwise. An actualized possibility of wearing ‘leather' without killing an animal is offered as a starting point for cultural discussion.

Our intention is not to provide yet another consumer product but rather to raise questions about our exploitation of other living beings. We see our role as artists as one in which we are providing tangible example of possible futures, and research the potential affects of these new forms on our cultural perceptions of life. It is not our role to provide people with goods for their daily use. We would like our work to be seen in this cultural context, and not in a commercial context.

As part of the TC&A project we are artistically exploring and provoking notions relating to human conduct with other living systems, or to the Other. This particular project will deconstruct our cultural meaning of clothes as a second skin by materialising it and displaying it as an art object.

This piece also presents an ambiguous and somewhat ironic take into the technological price our society will need to pay for achieving ‘a victimless utopia’.

5.4 DIY De-victimizer 2006 (Performance)

Dies De Bioarte 06, Barcelona, Spain, 2006

DIY De-Victimizer explores the hypocrisies involved in human relationships with other living and partially living systems by taking the paradoxes and ironies involved in the production of a victimless utopia to somewhat extreme levels of absurdity.

The DIY DVK was used in a performative installation that experimented with bringing back to life (literally) parts of meats. Attempts were made to reverse the 'destructive' effects of human technology by 're-life-ing' its victims. The audience was also invited to take an active role in the experiment by assisting in caring for the fragments of life and making different ethical decisions with regard to these fragments' eventual fate.

Figure 19

6. Extra Ear – ¼ Scale (in collaboration with Stelarc)

In this collaboration, a quarter-scale replica of the ear of the performance artist Stelarc was grown using human and other animal cells. The ear was cultured in a rotating micro-gravity bioreactor which allows the cells to grow in three dimensions.

Extra Ear – ¼ Scale is about two collaborative concerns. The project represents a recognisable human part. However, it is being presented as partial life and brings into question the notions of the wholeness of the body. It is also confronts broader cultural perceptions of 'life' given our increasing ability to manipulate living systems. TC&A are dealing with the ethical and perceptual issues stemming from the realisation that living tissue can be sustained, grown, and is able to function outside the body. Stelarc, ultimately, is concerned with the attachment of the ear to the body as a soft prosthesis.

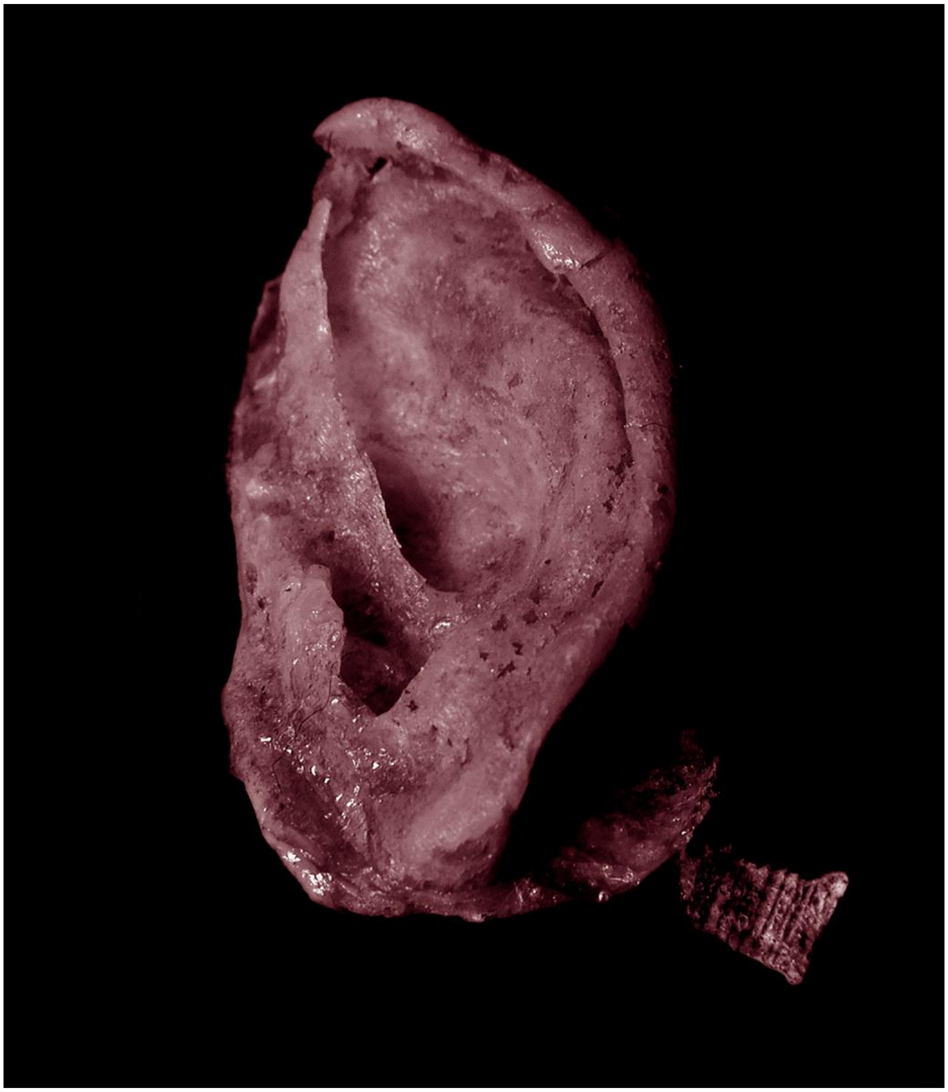


Figure 20

7. Doll G

This project is an elaboration on *The Semi-Living Worry Dolls: Tissue Culture & Art(ificial) Wombs* that was first presented at Ars Electronica 2000 in Linz, Austria. Fittingly, 'Doll G' appeared at the *Ars Electronica* Festival in Linz in September 2007.

The Semi-Living Worry Dolls were the first tissue-engineered sculptures to be presented alive in a gallery context. In that piece, seven tissue-engineered sculptures based on the Guatemalan Worry Dolls Legend were constructed and were given alphabetical names from A to H, avoiding the name 'Doll G'. one of the main reasons for this action was TC&A continous counter balance position to Genohype (see chapter 5 and 6). Seven years later, Doll G was resurrected in order to engage with its slow death. The media were human and mouse cells, biodegradable/bioabsorbable polymers, custom designed perfusion pump, and glassware.

As the Semi-Living Worry Dolls are supposed to solve people's worries, TC&A wanted to express its worry and growing concern regarding the persistence of genohype, the almost universal perception that modern biology (and sometimes life itself) deals only with the molecular level of the genetic code. The popular assumption is that the code is life and life is information. TC&A hopes Semi-Living Doll G will help remove this misconception, as literally it presented as dying.

8. NoArk

NoArk is a research project exploring the taxonomical crisis that is presented by life forms created through biotechnology.

Appendix 3

List of TC&A Project Installations and Exhibitions

- **Victimless Leather - A Prototype of Stitch-less Jacket grown in a Technoscientific 'Body',** Skin Deep Exhibition, The National Glass Museum, Netherlands. April 2008.
- **Pig Wings** & **Victimless Leather - A Prototype of Stitch-less Jacket grown in a Technoscientific 'Body'***, Design and the Elastic Mind* Exhibition, MoMA New York, February 2008.
- **NoArk**, *ARCO 2008*, Madrid, Spain, February 2008.
- **Victimless Leather- A Prototype of Stitch-less Jacket grown in a Technoscientific 'Body'***, Sk-interface* Exhibition, FACT, Liverpool UK, January 2008.
- **The Semi-Living Worry Dolls,** *Fuse* Exhibition, Jam Gallery Adelaide, January 2008.
- **NoArk,** *Biotechnique* Exhibition, Yerba Buena Center for the Arts, San Francisco, November 2008
- **NoArk,** *Still Living* Exhibition, Biennale for Electronic Arts, Perth, Western Australia, September 2007.
- **The slow death of a Semi-Living Worry Doll G: An irreversible performative execution,** *Ars Electronica* Festival, Linz, Austria, September 2007.
- **Victimless Leather- A Prototype of Stitch-less Jacket grown in a Technoscientific 'Body'***, Our Cyborg Future?* Dott 07Discovery Museum, Newcastle UK, August 2007.
- **Victimless Leather- A Prototype of Stitch-less Jacket grown in a Technoscientific 'Body'***,*Holon Centre for Digital Arts, Israel, February–March 2007.
- **The Pig Wings Project**, Australia-Asia Foundation, Gallery A4, Sydney NSW. February–March 2007.
- **Taratological Prototypes**, ZeroOne/ISEA06, in collaboration with Bioteknica, San Jose. 2006.

- **Pig Wings** and **Remains of Disembodied Cuisine**, *Strange Attractors: charm between Art and Science*, Zendai Museum of Modern Art, Shanghai, China, 2006.
- **Victimless Leather- A Prototype of Stitch-less Jacket grown in a Technoscientific 'Body'**, Ontario Science Centre, Toronto, May 2006.
- **The Remains of Disembodied Cuisine** as part of *AV06*, Middelsborough, UK March 2006.
- **The DIY De-victimizer Kit Mark One (DVK m1)**, *Días de Bioarte '06*, Centre d'Art Santa Mònica, Barcelona, Spain, February 2006.
- **LifeBoat** as part of the *Touch Me* Festival, Zagreb, Croatia, September 2005.
- **The Remains of Disembodied Cuisine** as part of *Put on your Blue Genes*, NGBK Gallery, Berlin, August 2005.
- **The Semi-Living Worry Dolls,** Archibald Arts Gallery, New York, July 2005.
- **The Remains of Disembodied Cuisine** as part of *Today in Paradise***,** Götenberg New Media Arts Festival, Sweden, March 2005.
- **The Pig Wings Project** as part of *Organismos: esto es vida*, Central Plaza de Catalunya Barcelona, Spain, January 2005.
- **The Pig Wings**, Madrid, Spain, June–September 2004.
- **LifeBoat**, ISEA, Helsinki, Finland August 2004.
- **Victimless Leather- A Prototype of Stitch-less Jacket grown in a Technoscientific 'Body'**, *Space Between* Exhibition, John Curtin Gallery, Perth, Western Australia April–June 2004.
- **Extra Ear - ¼ Scale** in collaboration with Stelarc, *Art in the Biotech Era*, Adelaide International Arts Festival, South Australia, February–March 2004.
- **The Remains of Disembodied Cuisine,** part of *Spike*, UTS, Sydney, February–March 2004.
- **Extra Ear ¼ Scale** (Installation and Performance), The National Review of Live Art, Midland, Western Australia. October 2003.
- **Extra Ear ¼ Scale,** National Gallery of Victoria, Melbourne, Australia, September 2003.

- **MEART – The Semi-Living Artist,** *ArtBot*, New York, August 2003.
- **Extra Ear ¼ Scale**, Kapelica Gallery, Ljubljana, Slovenia, May 2003.
- **The Pig Wings Project**, DeCordova Museum Lincoln (Boston), MA, part of the Boston *CyberArts* Festival, 8 March–25May 2003.
- **Disembodied Cuisine** and **The Tissue Culture & Art(ificial) Womb,** *L'Art Biotech* group exhibition of biological art, la lieu unique, Nantes, France, 14 March – 4 May 2003.
- *Biofeel* Exhibition, Biennale of Electronic Arts, Perth Institute of Contemporary Arts, Perth, Western Australia 2002. Curator and also participating artist.
- **Pig Wings**, *ConVerge*, Adelaide Biennale of Australian Arts, Art Gallery of South Australia, 1 March–25 April 2002.
- **The Tissue Culture & Art(ificial) Womb III**, *Unmediated Vision*, Salina Art Center, Kansas, USA, 26 January–30 March 2002.
- **Fish & Chips,** *Takeover*, Ars Electronica, Linz, Austria, September 2001.
- **The Tissue Culture & Art(ificial) Womb III,** *Transhuman*, Kenderdine Gallery, University of Saskatchewan, Canada, 10 September – 21 October 2001.
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- **The Tissue Culture & Art(ificial) Womb,** *The Next Sex*, Ars Electronica, Linz, Austria, September 2000.
- **The Stone Age of Biology**, Perth International Arts Festival 2000, Scitech Discovery Centre, February 2000.
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- *Art and Science* a group exhibition with the Department of Anatomy and Human Biology, University of Western Australia, at the Lawrence Wilson Gallery, UWA, Perth, Western Australia,1998.
- *The Tissue Culture & Art Project – Stage One* at Perth Institute of Contemporary Art, Western Australia, 1998.

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with an eye which is supposed to protect from the evil eye. Dimensions of original: 1.5 cm x 1.5 cm x 0.5 cm. From *The Tissue Culture & Art Project – Stage One*, Perth Institute of Contemporary Art, 1998.

9. *Spear*, The Tissue Culture & Art Project. Muscle primary tissue grown over P(H)ema hydrogel. From *The Stone Age of Biology* Exhibition, Scitech Discovery Centre, the Perth International Arts Festival, 2000.
10. *Spear II*, The Tissue Culture & Art Project. Muscle primary tissue grown over P(H)ema hydrogel. From *The Stone Age of Biology* Exhibition, Scitech Discovery Centre, the Perth International Arts Festival, 2000.
11. *Nature?* Marta de Menezes
12. Tissue Engineered Steak No.1 2000, A study for *Disembodied Cuisine*, The Tissue Culture & Art Project. Pre-natal sheep skeletal muscle and degradable PGA polymer scaffold.
13. Who Plays God in the 21st Century? 'Signers are all part of a coalition of more than 60 non-profit organizations that favor democratic, localized, ecologically sound alternatives to current practices and policies. This advertisement is # 1 in Genetically Engineering series…'. Turning Point Project (www.turnpoint.org).
14. *Pig Wings*, The Tissue Culture & Art Project. Pig mesenchymal cells (bone marrow stem cells) and biodegradable/bioabsorbable polymers (PGA, P4HB) Dimension of original: 4 cm x 2 cm x 0.5 cm each, 2000–2001.
15. *inthewrongplaceness*, Kira O'Reilly. Photography: Manuel Vason. HOME, London. January 2005.

16. *on and on while you're gone...*, Alicia King. Medium: glass, resin, human tissue (HeLa cell line), rubber. Photography: Amy Spiers, 2006.
17. *NoArk*, The Tissue Culture & Art Project (Oron Catts & Ionat Zurr). Vessel design in collaboration with Marcus Canning, 2007.
18. *Semi-Living Dolls Display*, The Tissue Culture & Art Project, 2000.
19. *DIY De-Victimiser I*, The Tissue Culture & Art Project. Performance, *Dìas de Bioarte '06*, Centre d'Art Santa Mònica, Barcelona, 2006.
20. *Extra Ear – ¼ Scale*, The Tissue Culture & Art Project (Oron Catts & Ionat Zurr) in collaboration with Stelarc, 2003. Biodegradable polymer and human chondrocytes cells. Dimension of original: 3 cm x 1.5 cm x 1.5 cm.

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[i] SymbioticA became a State Centre of Excellence for Biological Arts this year, 2008.

[ii] Dr Lawrence M. Gartner and Dr Carol B. Gartner, *The Care of Premature Infants: Historical Perspective in Neonatal Intensive Care*, NEONATAL INTENSIVE CARE - A HISTORY OF EXCELLENCE, A Symposium Commemorating Child Health Day Sponsored by the National Institute of Child Health and Human Development. Originally presented October 7, 1985, National Institutes of Health Bethesda, Maryland NIH Publication No. 92-2786, October 1992. U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, Public Health Service National Institutes of Health. P.4 .http://www.neonatology.org/classics/nic.nih1985.pdf

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viii A. J. Liebling, A Patron of the Preemies The New Yorker, June 3, 1939, pages 20-24.

ix Magdalena Mazurak, Malgorzata Czyżewska, Incubator Doctor and the Dionne Quintuplets: on the Phenomenon of Exhibiting Premature Infants, History of Medicine, 2006, 43, 2, 313–316.

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[xiv] Steve Baker, Philosophy in the Wild? Kac and Derrida on Animals and Responsibility, *New Formations*, 49 (2003), Lawrence and Wishart, pp. 91-98(8)

[xv] Jens Hauser, Biotechnology as Mediality: Strategies of organic media art, *Performance Research*, 11:4 (2006): 129–136.

[xvi] http://www.genomicart.org/gessert.htm. (last accsess May 2008)

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[xix] Jens Hauser, Bios, Techne, Logos: A Timely Art Career, *Revista Digital Universitaria*, 8:1 (2007) p.2 (English translation was given to IZ by the author prior to publication).

[xx] De Menezes writes: ‘In NATURE? I created live butterflies with wing patterns never seen before in nature. I achieved this 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 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 do not have the intention of enhancing in any way nature's design. Nor do I intend to make something already beautiful even more beautiful. I simply aim 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.' http://www.martademenezes.com/.

xxihttp://www.viewingspace.com/genetics_culture/pages_genetics_culture/gc_w03/davis_microvenus.htm.

xxii Jens Hauser Ed., Art Biotech, Clueb Publishing, Italy 2007

xxiii Translated to English by George Gessert 2008.

xxiv An interesting example of embedding BioArt in the historical context of human technological evolution was presented in the exhibition Biotechnique, curated by Phil Ross, at the Yerba Buena Center for the Arts (YBCA), San Francisco, in November 2007 (TC&A showed the piece *NoArk* in this exhibition). In this exhibition, contemporary artworks were presented alongside other contemporary and historical examples of human activities with life manipulation, such as historic viticultural tools and artifacts from the Artesa Winery/Condorniu family in Spain Napa and an Aqua Forest Aquarium in the Takashi Amano style, to state of the art microfluids devices from the Quake group at the Stanford University Clark Center (for more, see the *Biotechnique* catalogue, edited by Philip Ross, YBCA, 2007). Ross is exploring the containers or vessels in which these biotechnologies appear as a device to explore the larger philosophical, ethical and aesthetical implications of human activity with life as a material: ‘Shown alongside these artworks are artifacts made by industrial technologists, ecological researchers, and biological engineers. These hybrid objects, from sheltering vessels to semi-living diagnostic tools being developed in Silicon Valley, provide context for the artworks and further explore the increasingly fuzzy line between the technological and the natural’ (from the curatorial statement).

xxv Examples of post anthropocentric artistic expression are large and are by no mean excluded to the contemporary phenomenon of Bioart. Historical movements such as Eco Art and Environmental Art have been exploring issues concerning the human position as part of its environment. Prominent examples includs Robert Smithson Spiral Jetty (1970) as well as Andy Goldsworthy work.

xxvi To read more about tissues in these contexts:

Dorothy Nelkin and Lori Andrews, *Body Bazaar: The Market for Human Tissue in the Biotechnology Age*, Crown Publishers, 2001.

Susan Merrill Squier, *Babies in Bottles: Twentieth-Century Visions of Reproductive Technology*, New Brunswick: Rutgers University Press, 1994.

Catherine Waldby & Robert Mitchel, *Tissue Economies: Blood, Organs, and Cell Lines in Late Capitalism*, Durham NC: Duke University Press, 2006.

Hannah Landecker, *Culturing Life: How Cells Became Technologies*, Cambridge MA: Harvard University Press, 2007.

[xxvii] A term used by Susan M. Squier in her book *Liminal Lives: Imagining the Human at the Frontiers of Biomedicine***,** Durham NC: Duke University Press, 2004.

[xxviii] We are now referring to this external/container body as the 'epi body': 'Historical and recent developments in the life sciences have created new forms of life that challenge perceived boundaries of what is considered to be "alive". Terms, and the actualities they represent, such as pre-mature life, liminal life, bare life, and semi-living are becoming more prevalent, and populate a greater place in the life to non-life continuum. What is common to all of these life-states is the need for another kind of body – an Epi-Body of sorts, to mediate their existence. These cases demonstrate how vitality should be discussed not only in relation to life and death, but also in relation to the techno-scientific "Epi-Body" which sustains and articulates it. Furthermore, these "Epi-Bodies" can represent a class of death-resisting machines.' (from abstract of a paper to be presented by TC&A at the conference 'Society Literature Science Art' in Berlin in 2008).

[xxix] For more, see Oron Catts and Ionat Zurr, Growing Semi-Living Sculptures, *Leonardo* 35:4 (2002) 365-370.

[xxx] In recent years, the definition of tissue engineering is expanding beyond its 'classical' role (or better put – its promise) as the field to grow body spare parts. Rather, the field engulfs areas of stem cell research, therapeutic cloning, pharmaceutical production of antibodies and other industrial products, as well as food production and more.

[xxxi] Eugene Thacker, *The Global Genome: Biotechnology, Politics, and Culture*, Cambridge MA: MIT Press, 2005, p.309.

[xxxii] Stephen Wilson, *Information Arts: Intersections of Art, Science, and Technology*, Cambridge MA: MIT Press, 2002.

[xxxiii] http://www.symbiotica.uwa.edu.au.

[xxxiv] Adele Senior, Towards a (Semi-)Discourse of the Semi-Living; The Undecidability of a Life Exposed to Death, *Technoetic Arts: A Journal of Speculative Research*, 5:2 (2007) 97–111.

[xxxv] Ibid. p. 102.

[xxxvi] Ibid. p. 102.

[xxxvii] Ibid. p.110.

[xxxviii] The only exception to this rule is the anomaly of the symbiotic flatworms which ‘are such good providers that the worms have atrophied mouths; the close-mouthed green worms “sunbathe” rather than seek food, and the endosymbiotic algae even recycle the worm’s uric acid waste into food’ (L. Margulis and D. Sagan, *What is Life?*, Berkeley and Los Angeles CA: University of California Press, 2000, p.120).

[xxxix] ‘It is widely believed that 2000 million years ago the cyanobacteria – oxygen eliminating photosynthetic prokaryotes that used to be called blue-green algae...effected one of the greatest changes this planet has ever known: the increase in concentration of atmospheric oxygen from far less than 1% to about 20%. Without this concentration of oxygen, people and other animals would have never evolved’ (L.Margulis and V.S. Karlene, *Five Kingdoms*, 2nd edition. W. H. Freeman Publisher, 1988, p.28.

[xl] K.D. Thornton, The Aesthetics of Cruelty vs. the Aesthetics of Empathy, in O. Catts (ed.), *The Aesthetics of Care*, 2nd edition, Perth, Western Australia: SymbioticA Press, 2004, p.17.

[xli] Ibid. p.15.

[xlii] For more, see Georgio Agamben, *The Open: Man and Animal*, Stanford CA: Stanford University Press, 2004.

[xliii] Adele Senior, Lanccastar University, is making a link between the TC&A work and Agamben writings through proposing 'a genealogy of the Semi-Living using a figure of Roman archaic law, homo sacer (sacred man) who shares with the Semi-Living a "life exposed to death"' (Senior, Towards a (Semi-)Discourse of the Semi-Living).

[xliv] http://encyclopedia.thefreedictionary.com/Individual+(disambiguation).

[xlv] http://medical-dictionary.thefreedictionary.com/Species+(biology).

[xlvi] The assault on the individual person as a discrete entity is manifested in many other ways and one example is the mental condition of schizophrenia.

[xlvii] As defined by Bruno Latour in *Pandora's Hope: Essays on the Reality of Science Studies*, Cambridge MA: Harvard University Press, 1999.

[xlviii] An exception is Leign M. Van Valen and Virginia C. Maiorana, HeLa, a new microbial species. *Evolutionary Theory*, 10 (1991) 71–74. In this paper the authors propose to classify the HeLa cell line as a new species. This paper will be discussed further in a later stage of the thesis.

[xlix] Marc Ereshefsky, *The Poverty of the Linnaean Hierarchy*, Cambridge University Press, 2001.

[l] Cited in: http://www.ucmp.berkeley.edu/history/linnaeus.html.

[li] Ibid.

[lii] H.G. Wells, The Limits of Individual Plasticity, in R. M. Philmus and D. Y. Hughes (eds), *H. G. Wells: Early writings in science and science fiction*, Berkeley CA: University of California Press, 1975, p.36.

[liii] Ibid. pp. 36-39.

[liv] http://news.bbc.co.uk/1/hi/sci/tech/889951.stm.

[lv] Eugene Thacker, *The Global Genome: Biotechnology, Politics and Culture*, Cambridge MA: MIT Press, 2005, p.334.

[lvi] Richard Dawkins, *The Selfish Gene*, Oxford University Press, 1976.

[lvii] Some experiments are dated as early as 1668. for a web based list of Transplant time line – xenotrasplane, see: http://www.medhunters.com/articles/transplantTimelineXeno.html

[lviii] David K. C. Cooper and Robet P. Lanza, *Xeno: the promise of transplanting animal organs into humans*, Oxford University Press, 2000, p.24.

[lix] David Hamilton, *The Monkey Gland Affair* **(**Chatto & Windus: London) 1986.

[lx] http://www.eliocaccavale.com/utilitypets.html.

[lxi] H. Landecker, *Building 'A new type of body in which to grow a cell': Tissue Culture at the Rockefeller Institute, 1910-1914,* Rockefeller University Centennial, NY, November 2000.

[lxii] For more, see David M. Friedman, *The Immortalists: Charles Lindbergh, Dr. Alexis Carrel, and Their Daring Quest to Live Forever,* New York: HarperCollins Publishers, 2007.

[lxiii] Eduard Uhlenhuth, Changes in pigment epithelium cells and iris pigment cells of *Rana pipiens* induced by changes in environmental conditions. *Journal of Experimental Medicine*, 24 (1916) 689–699 at p.690.

[lxiv] http://medical-dictionary.thefreedictionary.com/cell+fusion.

[lxv] http://www.medterms.com/script/main/art.asp?articlekey=32440.

[lxvi] Henry Harris, Roots: Cell Fusion, *BioEssays*, 2:4 (2005) 176-179.

[lxvii] Thomas Lewis, cited in Harris, Roots: Cell fusion.

[lxviii] Ibid. p.178.

[lxix] M. R. Davey, R. H. Clothier, M. Balls and E. C. Cocking, An ultrastructural study of the fusion of cultured amphibian cells with higher plant protoplasts, *Protoplasma*, 96:1-2 (1978) 157–172.

[lxx] *Nature*, vol. 445, issue no. 7123, 4 January 2007, at http://www.nature.com/nature/journal/v445/n7123/full/445001a.html.

[lxxi] ‘We are currently conducting fundamental studies characterizing cell dynamics and liver-specific gene expression as a function of several system parameters, and using and modifying the system for a range of applications including prediction of drug toxicity, evaluation of liver responses to environmental toxins, and models of cancer metastasis.’ (http://web.mit.edu/lgglab/research/index.html).

[lxxii] Muscle-Powered MEMS Structures: ‘We have created a self-assembly system for muscle cells on MEMS devices … PNI subsequently dissolves in the culture medium to release assembled tissues, enabling their freedom to contract… Since all types of cells and MEMS structures may be integrated, this system is highly versatile and represents a significant advance in the science and engineering of cell and tissue mechanics’.

[lxxiii] Van Valen and Maiorana, HeLa, a new microbial species.

[lxxiv] H. G. Wells, Julian Huxley & G. P. Wells, *The Science of Life: A Summary of Contemporary Knowledge about Life and its Possibilities*. London: Amalgamated Press, 1929, Vol.1, p.29.

[lxxv]Thacker, *The Global Genome*, p.309.

[lxxvi] Philip R. White, *The Cultivation of Animal and Plant Cells*, New York: The Ronald Press, 1963.

[lxxvii] François Delaporte (ed.), *A Vital Rationalist: Selected Writings from Georges Canguilhem*, New York: Zone Books, 1994, p.162.

[lxxviii] Wells, Huxley & Wells, *The Science of Life*, p.26.

[lxxix] Ibid. p.27.

[lxxx] Theodore Schwann (1839) cited in White, *Cultivation of Animal and Plant Cells*, pp.188–190.

[lxxxi] Wilhelm Roux Über die Entwicklungsmechanik der Organismen (1890)

[lxxxii] Jorge R. Pasqualini, Robert and Scholler Hormones, *Fetal Pathophysiology* (Informa Health Care: 1992) p. 602.

[lxxxiii] Ross Harrison, The Outgrowth of the Nerve Fiber as a Mode of Protoplasmic Movement,. *Journal of Experimental Zoology* 1910, 9:787–846.

[lxxxiv] For more see, H.L. Landecker, New Times for Biology: Nerve Cultures and the Advent of Cellular Life in Vitro. *Studies in History and Philosophy of Biological and Biomedical Sciences*, 33 (2002) 567–760.

[lxxxv] ibid

[lxxxvi] Ross Harrison, The life of tissues outside the organism from the embryological standpoint. *Transactions of the Congress of American Physicians and Surgeons*, 9 (1913) 63–75.

[lxxxvii] Eduard Uhlenhuth, Changes in pigment epithelium cells and iris pigment cells of *Rana pipiens* induced by changes in environmental conditions, *Journal of Experimental Medicine*, 24 (1916) 689–699 at p.690.

[lxxxviii] Ibid.

[lxxxix] Ibid.

[xc] In 1953 surgeon John H. Gibbon developed this idea further by introducing the heart-lung machine for open heart surgery.

[xci] Alexis Carrel & Charles Lindbergh, *The Culture of Organs*, Hoeber, NY 1938.

[xcii] Alexis Carrel, *Man, the Unknown*, Harper & Bros: NY 1935.

[xciii] 'Those who have murdered, robbed ..., kidnapped children, despoiled the poor of their savings, misled the public in important matters, should be humanely and economically disposed of in small euthanasic institutions supplied with proper gases. A similar treatment could be advantageously applied to the insane, guilty of criminal acts.' (Carrel, *Man, the Unknown* 1935, pp 290-291).

[xciv] A Carrel, *Man, the Unknown* (New York: Harper & Row, 1935), p. 299.

[xcv] Hannah Landecker, Building a New Type of Body in Which to Grow a Cell: The Origins of Tissue Culture. *Creating a Tradition of Biomedical Research: Contributions to the History of the Rockefeller University* (2004): pp.151-174.

[xcvi] Philip R. White,*The Cultivation of Animal and Plant Cells* NY: The Ronald Press Co. 1954.

[xcvii] Hannah Landecker, Building a New Type of Body in Which to Grow a Cell, pp.151-174.

[xcviii] Alexis Carrel, A Carrel, *Man, the Unknown* (New York: Harper & Row, 1935).

[xcix] Bill Davidson, Probing the Secret of Life, *Collier's Weekly*, 14 May 1954, p. 81. Quoted in Landecker, Building a New Type of Body in Which to Grow a Cell, 151-174.

[c] Ibid.

[ci] *Daily Express*, 21 July 1924, p.3, cited in Squier, *Babies in Bottles*, p.210.

[cii] Susan Hitchcock Tyler, *Frankenstein: A Cultural History*, W.W. Norton & Company, NY 2007, p. 134.

[ciii] Ibid. pp. 133-4.

[civ] Susan M. Squier, Life and Death at Strangeways: The tissue culture point of view, in P. Brodwin (ed.), *Biotechnology and Culture: Bodies, Anxieties, Ethics (Theories of Contemporary Culture)*, pp. 27-57, Bloomington, IN: Indiana University Press, 2000, p.31.

[cv] Ibid

[cvi] Ibid. p.33.

[cvii] Ibid. p.44.

[cviii] Ibid. p.45.

[cix] Ibid. p.57

[cx] Oron Catts & Ionat Zurr, Gowing Semi-Living Sculptures, Leonardo Magazine, MIT Press, Issue 35:4, August 2002, p. 368.

[cxi] The text attached to a box containing Guatemalan Worry Dolls that was bought by us in a gift shop in Boston, USA, in 2000.

[cxii] Wells, Huxley & Wells, *The Science of Life*, p.29.

[cxiii] H.G. Wells, The Limits of Individual Plasticity, in R. M. Philmus & D. Y Hughes (eds), *H. G. Wells: Early writings in science and science fiction*, Berkeley, CA: University of California Press 1975, pp. 36–39.

[cxiv] Brian Stabelford, Biotechnology and Utopia in Barbara Goodwin Ed. *The Philosophy of Utopia*, GB: Frank Cass & Co Ltd., 2001, pp.189- 195.

[cxv] Julian Huxley, The Tissue Culture King, in Groff Conklin (ed.), *Great Science Fiction by Scientists*, New York: Collier Books NY, 1962, pp. 147 – 170.

[cxvi] Ibid. p.155.

[cxvii] Ibid. p.156.

[cxviii] Ibid. p.155.

[cxix] Ibid. p.157.

[cxx] Ibid. p.161.

[cxxi]Ibid. p.160.

[cxxii] Ibid. pp.158–159.

[cxxiii] Ibid. p.159.

[cxxiv] Robert Lanza, Robert Langer and Joseph P. Vacanti (eds), *Principles of Tissue Engineering*, 2nd edition, San Diego, SF: Academic Press, 2000, p.xxxv.

[cxxv] Eugene Thacker, The Thickness of Tissue Engineering, in Gerfried Stocker and Christine Schopf (eds.), *Life Science: Ars Electronica 99*, Springer, 1999, p.183.

[cxxvi] Lanza, Langer and Vacanti, *Principles of Tissue Engineering*, p.3.

[cxxvii] Charles Vacanti, Tissue Engineering, Embryonic Stem Cells might not be the way to go, *The Scientist*, vol. 18, issue 22 (2004).

[cxxviii] http://www.businessweek.com/1998/30/b3588008.htm.

[cxxix] 'In the late 1970s, they (Jay Vacanti and Robert Langar) had worked in the laboratory of Dr. Judah Folkman, the pioneering researcher who seeks to kill cancerous tumors by cutting off their blood supply. The flip side to Folkman's work was encouraging blood vessels to grow in new tissue.' (Jeffery Krasner, The Replacements, *Boston Sunday Globe*, 11 March 2001 p. D4).

[cxxx] Joseph P. Vacanti, quoted in Pepita Smyth, Organs on Demand, *The West Australian*, 30 October 2000, p. 15.

[cxxxi] Thacker, p. 186.

[cxxxii] Krasner, The Replacements, p. D4. This reference is also A reference to the Mouse with the Ear as the 'poster boy' for the field of tissue engineering in Krasner, The Replacements, p. D4.

[cxxxiii] Robert P. Lanza, Robert Langar and Joseph Vacanti, *Principles of Tissue Engineering,* 2nd Ed. (San

Diego, CA: Academic Press, 1997) p. 4.

[cxxxiv] http://biomicro.mit.edu/research/griffith.html.

[cxxxv] http://news.bbc.co.uk/1/hi/sci/tech/4181197.stm.

[cxxxvi] http://www.louisville.edu/hsc/medmag/ss01/atala.html.

[cxxxvii] http://www.newscientist.com/article.ns?id=dn3672.

[cxxxviii] More in Oron Catts, *Growing Custom Grown Living Surfaces*. Honours thesis, Design Degree in Curtin University, Western Australia 1995.

[cxxxix] White R Philip, *The Cultivation of Animal and Plant Cells*, New York: The Ronald Press, 1963.

[cxl] Steve Grand, *Creation: life and how to make it*, Phoenix, 2001, pp. 6–7.

[cxli] Steve Grand, *Creation, Life and How to Make it*, 2001 p.160

[cxlii] Ibid. pp.166–167.

[cxliii] For example: Marc Quinn, *DNA Portrait of Sir John Sulston* at the National Portrait Gallery in London (2001) or the MRI self -portrait by Australian Justin Cooper titled *Rapt* (1998).

[cxliv] A term coined by Sherry Turkle, Abby Rockefeller Mauzé Professor of the Social Studies of Science and Technology in the Program in Science, Technology, and Society at MIT and the Director of the MIT Initiative on Technology and Self, a centre of research and reflection on the evolving connections between people and artifacts in the co-construction of identity (http://web.mit.edu/sturkle/techself). Turkle explores, from a psychoanalytical perspective among other approaches, the relations humans form with objects that are 'sort of alive', 'seems to us to be alive', such as computers and E-toys. For more, see her book, *The Second Self: Computers and the Human Spirit* (London: Granada, 1984). Turkle has invited us on a few occasions discuss with her class issues of Self and Identity in relation to our 'Semi-Living' sculptures.

[cxlv] Jens Hauser, Genes, Geneies, Genes, in *L'Art Biotech Catalogue*, Trézélan, France: Filigranes Editions, 2003, p. 9 (translation by Jens Hauser).

[cxlvi] Examples can be found in the fields of transgenic and xenotransplantation where non-human animals genes, cells, tissues and even organs are being inserted or transplanted into humans and vice versa either to create 'better' compatibility between humans and other animals for the purpose of transplantation or for the investigation of diseases and possible treatments for human diseases. See, for example, 'Humanised' organs can be grown in animals, *New Scientist,* 17 December 2003. http://www.newscientist.com/article/dn4492-humanised-organs-can-be-grown-in-animals.html.

[cxlvii] George Gessert, Notes on the Art of Plant Breeding, *L'Art Biotech Catalogue*, p.47.

[cxlviii] Peter Singer, *Writings on an Ethical Life*, Fourth Estate (NY: HarperCollins), 2002, p.35.

[cxlix] Ibid.

[cl] Personal communication, a conversation held with Singer during his visit to SymbioticA, School of Anatomy and Human Biology, The University of Western Australia in 2002.

[cli] For more, see Sylvia Pagan, Growing Human Organs on the Farm, *New Scientist* 20/27 December 2003, pp. 4–5.

[clii] Tom Regan, *All that Dwell Therein: Animal Rights and Environmental Ethics*, Berkeley CA: University of California Press, 1982, p.58.

[cliii] Ibid. p. 55.

[cliv] Singer Peter, *Writings on an Ethical Life*, p.27.

[clv] The Australian Health and Medical Research Council (NHMRC) published in 1999 *The National Statement on Ethical Conduct in Research Involving Humans*, see p.57, http://www.nhmrc.gov.au/publications/pdf/e35.pdf.

[clvi] Marta de Menezes, The Artificial Natural: Manipulating Butterfly Wing Patterns for Artistic Purposes, *Leonardo*, 36:1 (2003) p. 29-32.

[clvii] Ibid. p. 31.

[clviii] There is an extensive list of Butterfly symbolism, for example, on http://www.insects.org/ed4/symbol_list1.html.

[clix] A ‘Remote Control Roach’ was developed by Shimoyama’s micro-robotics team and biologists at Tsukuba University, Japan: http://www.intercorr.com/roach.htm.

[clx] Oron Catts, Biofeel Curator Statement, *BEAP 2000 Catalogue*, John Curtin Gallery, Western Australia, 2002, ISBN 1 740667 157 0.

[clxi] Winston Churchill, 50 Years Hence, *Popular Mechanics*, March 1932.

[clxii] 'Skum-skimming wasn't hard to learn. You got up at dawn. You gulped a breakfast sliced not long ago from Chicken Little and washed it down with Coffiest. You put on your coveralls and took the cargo net up to your tier. In blazing noon from sunrise to sunset you walked your acres of shallow tanks crusted with algae. If you walked slowly, every thirty seconds or so you spotted a patch at maturity, bursting with yummy carbohydrates. You skimmed the patch with your skimmer and slung it down the well, where it would be baled, or processed into glucose to feed Chicken Little, who would be sliced and packed to feed people from Baffinland to Little America.' (Frederik Pohl and C.M. Kornbluth, *The Space Merchants*, NY: St. Martin's Press, 1952).

[clxiii] See the New Harvest website, http://www.new-harvest.org/.

[clxiv] http://www.tca.uwa.edu.au/vl/vl.html.

[clxv] http://invitromeat.org/content/view/15/34/

[clxvi] Alexander Madrigal, 'Scientists Flesh Out Plans to Grow (and Sell) Test Tube Meat' *Wired Magazine* on line 04.11.08

[clxvii] From an interview with Oron Catts: http://www.sbs.com.au/blogarticle/107961/the-taste-of-test-tube-meat June 2008.

[clxviii] For more, see http://www.fishandchips.uwa.edu.au.

[clxix] For more: http://www.neuro.gatech.edu/groups/potter/index.html

[clxx] For example: 'A rat is drawing this stuff? A dead rat? Lots of dead rats? Oh, Gross.' In Michelle Delio, The Robot Won't Bite You, Dear, *Wired News*, 16 July 2003.

[clxxi] J. Q. Trojanowski, J. R. Mantione, J. H. Lee, D. P. Seid, T. You, L. J. Inge and V. M. Lee, Neurons derived from human teratocarcinoma cell line, established molecular and

structural polarity following transplantation into the rodent brain, *Experimental Neurology*, 122:2 (1993) 283–294.

[clxxii] Stelarc, *Clamenger Contemporary Art Award Catalogue*, National Gallery of Victoria, Melbourne, Australia, September 2003, p. 30.

[clxxiii] The 2006 project in which an ear-shaped object was embedded under Stelarc's skin, on his arm, had no involvement by TC&A. I would like to emphasise that TC&A is not interested in implanting either objects or, more importantly, semi-livings, into anyone's body, but rather using the aid of an artificial technological body.

[clxxiv] Human Ethics Committee, Research Ethics, Research Services, The University of Western Australia. Project No. 0813, September 2003.

[clxxv] Ibid.

[clxxvi] Ibid.

[clxxvii] Cited in Monika Bakke, Zoe-philic Desires: Wet Media art and beyond, in Parallax, 2008 vol. 14 no. 3, pp.21-34.

[clxxviii] Ibid .p. 23

[clxxix] Petran Kockelkoren talks about the role that artists have always played in technological mediation, by appropriating new technologies in order to create a new visual language and the delivery of new meanings. He maintains that artistic engagement with new technologies created greater public acceptance and helped to domesticate these new technologies. By that he questions the notions of the autonomy of the artists and their practice. He does, however, also claim that the whole of human existence is mediated by technologies: 'People are "naturally artificial"…Technology cannot alienate people from their naturalness, because they are already alienated by virtue of their very

condition. Language, technology and art teach people how to articulate and even celebrate their ineradicable alienation.' (Petran Kockelkoren, *Technology: Art, Fairground and Theatre*, Rotterdam: NAi Publishers, 2003, p. 27). Human existence is and always been mediate by artificial constructs from language to all modes of technology. As new ways of seeing and interacting with the world around us develop so do the forms that mediate between humans and 'nature' (for more, see Kockelkoren, *Technology: Art, Fairground and Theatre*).

[clxxx] Cited in Denis Noble, *The Music of Life: Biology Beyond the Genome*, Oxford University Press, 2006, pp.3–6.

[clxxxi] A term coined by Neil Holtzman to describe the discourse of exaggerated claims and overstatements concerning DNA and the Human Genome Project, in Neil Holtzman, Are Genetic Tests Adequately Regulated? *Science*, 286 (1999), 4539.

[clxxxii] Report from the Wellcome Trust Biomedical Ethics Summer School, St Anne's College, Oxford, September 2005, cited in *CSS & CSEC Conference: Getting Underneath the Fact*

[clxxxiii] Carol Gigliotti, Leonardo's Choice: The ethics of artists working with genetic technologies, *AI and Society*, 20:1 (2006) *Special Issue: Genetic Technologies and Animals*. For the whole issue, see http://www.eciad.bc.ca/~gigliott/gtanimal/TOC.htm.

[clxxxiv] The *American Heritage Dictionary* defines Genetic as:

1. a. Of or relating to genetics or genes.

b. Affecting or determined by genes: genetic diseases.

2. Of, relating to, or influenced by the origin or development of something.

3. Linguistics. Of or relating to the relationship between or among languages that are descendants of the same protolanguage.

[clxxxv] For more, see Oron Catts and Ionat Zurr, Big Pigs, Small Wings: On Genohype and Artistic Autonomy, *Culture Machine* 7 (2005) *Biopolitics*, edited by Melinda Cooper, Andrew Goffey and Anna Munster (online), http://culturemachine.tees.ac.uk/Cmach/Backissues/j007/Articles/zurrcatts.htm.

[clxxxvi] Steve Baker and Carol Gigliotti, We have always been Transgenic: A Dialogue, *AI and Society*, 20:1 (2006) *Special Issue: Genetic Technologies and Animals*, pp.35-48

[clxxxvii] Ibid p.

[clxxxviii] Ibid.

[clxxxix] http://www.philross.org/.

[cxc] http://greenmuseum.org/artist_index.php?artist_id=19.

[cxci] SymbioticA resident 2007. ‘The art project revolves around interacting with birds at the bowers. There are three discrete but concurrent conceptual approaches in green, grey or dull silver. The first is to approach it by adopting an aesthetic standpoint of “interacting” or “have a conversation” with bowerbirds. The second is to undertake the process of science (as faithfully as possible) with a view to adding a small but accurate contribution to the knowledge of science. The third perspective is to undertake the process of science and use this performative experience as a material for artworks.’ (http://www.symbiotica.uwa.edu.au/residencies/residents2/perdita_phillips).

[cxcii] http://www.beap.org/2004/index.php?z=exhibitions/bio_arti&h=bio&h=bio.

[cxciii] http://www.contrib.andrew.cmu.edu/usr/pv28/rvid.html.

[cxciv] http://www.symbiotica.uwa.edu.au/residencies/residents2/paul_vanouse.

[cxcv] Noble, *The Music of Life*, p.21.

[cxcvi] Gigliotti, Leonardo's Choice.

[cxcvii] http://www.eceae.org/english/alternatives.html.

[cxcviii] http://www.peta.org/mc/factsheet_display.asp?ID=87.

[cxcix] Carol Gigliotti, Genetic Technologies and Animals, *AI and Society*, 20:1 (2006) *Special Issue: Genetic Technologies and Animals*..

[cc] Personal communication, letter from PETA, 10 February 2003.

[cci] 'Fetal calf serum (FCS)…is commonly used in cell and tissue cultures as a source of nutrients, hormones and growth factors. Many researchers, however, may not be aware of the ethical and scientific concerns regarding its use.

Methods of collection:

After slaughter and bleeding of the cow at an abattoir, the mother's uterus containing the calf fetus is removed during the evisceration process (removal of the mother's internal organs) and transferred to the blood collection room. A needle is then inserted between the fetus's ribs directly into its heart and the blood is vacuumed into a sterile collection bag. This process is aimed at minimising the risk of contamination of the serum with micro-organisms from the fetus and its environment. Only fetuses over the age of three months are used otherwise the heart is considered too small.

…Australian authorities have confirmed that fetuses here should have already died from anoxia prior to serum collection, however according to scientific literature this is not likely to be the case.

…It has been estimated that around half a million litres of raw FCS is produced each year worldwide which equates to the harvesting of more than one million bovine fetuses annually. Some sources have suggested that the actual figure may be closer to two million fetuses per year.' Personal communication, Chief Executive Officer of the Australian Association for Humane Research Inc. (AAIIR), 30 June 2006.

[ccii] http://www.new-harvest.org/default.php.

[cciii] An attachment to an email sent to TC&A, 12 December 2006 at 5:37 pm. The exhibition *Genesis, Life at the end of the information age* run in the Centraal Museum in the Netherlands from14 apr - 12 aug 2007

[cciv] Evelyn Fox-Keller, Beyond the Gene but Beneath the Skin, in Eva M. Neumann-Held and Christoph Rehmann-Sutter (eds), *Genes in Development. Re-reading the Molecular Paradigm.* US: Duke University Press, 2006, p.292.

[ccv] Denis, *The Music of Life*, pp.X-XI.

[ccvi] Fox-Keller, Beyond the Gene but Beneath the Skin, p.294.

[ccvii] Noble, *The Music of Life*, p.41.

[ccviii] Thacker, *The Global Genome*.

[ccix] Ibid. p.89.

[ccx] Thacker, *The Global Genome*.

[ccxi] Noble, *The Music of Life*, p.19.

[ccxii] Andrew Pollack, Custom-Made Microbes, at Your Service, *The New York Times*, 17 January 2006, http://www.nytimes.com/2006/01/17/science/17synt.html?emc=eta1.

[ccxiii] Gordana Vunjak-Novakovic, Transplants Made for Order, *The Scientist*, September 2006, http://www.the-scientist.com/article/daily/24539/.

[ccxiv] Haecceity (transliterated from the Latin *haecceitas*) is a term from medieval philosophy first coined by John Duns Scotus (c.1266–1308) which denotes the discrete

qualities, properties or characteristics of a thing which make it a particular thing. Haecceity is a person or object's 'thisness'. Charles Peirce later used the term as a non-descriptive reference to an individual. Writings of Charles S. Peirce: A Chronological Edition : 1884-1886**,** By Charles Sanders Peirce, Christian J. W. Kloesel, Max H, Indiana University Press,

[ccxv] Cited in Delaporte (ed.), *A Vital Rationalist: Selected Writings from Georges Canguilhem*, p.162.

[ccxvi] Ibid. p.169

[ccxvii] Fox-Keller: Beyond the Gene but Beneath the Skin, p.306.

[ccxviii] C. O'Leary, Gene Tests to Pick Junior Sports Stars, *The West Australian*, 23 November 2004, p. 1.

[ccxix] Holtzman, Are Genetic Tests Adequately Regulated?.

[ccxx] N. Brown, Hope Against Hype – Accountability in Biopasts, Presents and Futures, *Science Studies*, 16:2 (2003) pp. 3-21.

[ccxxi] For more see http://www.critical-art.net/biotech/cone/index.html.

See also Critical Art Ensemble, *Flesh Machine; Cyborgs, Designer Babies, Eugenic Consciousness*. New York: Autonomedia, 1998.

[ccxxii] S. Ross, (1994) in C. Court, Report calls for collaboration on genome research, *BMJ*, 308 (1994) 1123 (30 April 1994), http://bmj.bmjjournals.com/cgi/content/full/308/6937/1123.

[ccxxiii] The Joint Statement by President Clinton and Prime Minister Blair was released on 14 March 2000 and can be viewed online at http://clinton4.nara.gov/WH/EOP/OSTP/html/00314.html.

[ccxxiv] Comment by Dr Michael Dexter, Director of the Wellcome Trust, 26 June 2000, http://www.wellcome.ac.uk/doc_wtd002950.html.

[ccxxv] M. Morgan, The first draft of the Book of Humankind has been read (2000), http://www.sanger.ac.uk/HGP/draft2000/mainrelease.shtml.

[ccxxvi] GF *History of the Human Genome Project: The First Draft, June 2000* (2001), http://www.wellcome.ac.uk/en/genome/geneticsandsociety/hg13f010.html

[ccxxvii] Ibid.

[ccxxviii] O'Leary, Gene Tests to Pick Junior Sports Stars.

[ccxxix] Holtzman, Are Genetic Tests Adequately Regulated? p. 409.

[ccxxx] Ibid. p.409.

[ccxxxi] Ibid. p.410.

[ccxxxii] Brown, Hope Against Hype, p.14.

[ccxxxiii] Ibid. p.13.

[ccxxxiv] S. Anker and D. Nelkin, *The Molecular Gaze: Art in the Genetic Age*. New York: Cold Spring Harbor Laboratory Press, 2004, p. 95.

[ccxxxv] M. Fitzgerald, Giving (Real) Life to Art: Genetics and Tissue Culture find New Forms – and a New Audience, *Time Magazine*, no. 33, 23 August 2004, p. 66.

[ccxxxvi] For example, *BioDifference*, the exhibition we curated as part of the Biennale of Electronic Arts, Perth 2004. For more see http://lwgallery.uwa.edu.au/program/2004/BioDifference and http://www.beap.org.

[ccxxxvii] 'The nude mouse, a hairless mutant discovered in 1962, is immunodeficient, and thus does not reject tumor transplantations from other species' (B. Osburn, D. J. Klingborg, L. Hart, M. W. Wood, K. Berchhin, A. Dassler and Y. R. K. Kim, *The Mouse* *in Science, Cancer Research*, The UC Center for Animal Alternatives, School of Veterinary Medicine, University of California, Davis) 1996. http://www.vetmed.ucdavis.edu/Animal_Alternatives/cancer.htm.

[ccxxxviii] The term ‘meme’ was coined in 1976 by Richard Dawkins in his book, *The Selfish Gene*. In short, a meme is a self-propagating unit of cultural evolution analogous to the gene. Memes can represent parts of ideas, languages, tunes, designs, skills, moral and aesthetic values and anything else that is commonly learned and passed on to others as a unit. Like genes, memes can replicate and mutate.

[ccxxxix] For example, in 1995, Robert Langer and Joseph P. Vacanti wrote that in ten years they would be able to grow a fully functioning hand (Artificial Organs, *Scientific American*, September 1995, p. 100). In 2008 this dream is not even close to reality.

[ccxl] See Patricia Piccinini’s web site: http://www.patriciapiccinini.net/.

[ccxli] N. Jeremijenko, *A Response to Paradise Now* (2000) http://cat.nyu.edu/~nhj2/investnow/response.html.

[ccxlii] Jackie Stevens, The Industry Behind the Curtain (2000) at http://rtmark.com/rockwell.html, with the editorial comment, ‘Why are defense contractors suddenly sponsoring art about games (Shift-Ctrl)? Why are biotech companies suddenly sponsoring art about genes (Paradise Now)?’.

[ccxliii] Kockelkoren, *Technology: Art, Fairground and Theatre*, p. 106.

[ccxliv] Ibid. p.27.

[ccxlv] B. Groys, Art in the Age of Biopolitics, in D. Bulatov (ed.) *BioMediale: Contemporary Society and Genomic Culture*, The National Centre for Contemporary Arts, Kaliningrad, Russia, 2004, pp. 164 – 177. p.165.

[ccxlvi] D. Jones (2001) *'Working Drafts': art of the genome*

http://www.wellcome.ac.uk/en/genome/geneticsandsociety/hg16f003.html.

[ccxlvii] Groys, Art in the Age of Biopolitics, p. 177.

[ccxlviii] Kockelkoren, *Technology: Art, Fairground and Theatre*, p. 106.

[ccxlix] Dimitry Bultov (2002) *The Grecian Horse of Young Art*,

http://www.sitec.fr/users/akenatondocks/DOCKS-

datas_f/collect_f/auteurs_f/B_f/BULATOV_f/ACTIONBUL_F/BULATOV.htm.

[ccl] http://secondlife.com/whatis/.

[ccli] Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network Theory*,

Oxford University Press, 2005.

[cclii] Thacker, *The Global Genome*, p.309.

[ccliii] A prominent example of Baroque Modernism is the work of the French artist Orlan.

[ccliv] Steve Baker, *The Post Modern Animal*, London UK: Reaktion Books, 2000, p.19.

[cclv] Ibid. p. 54.

[cclvi] K.D. Thornton cited in Oron Catts (ed.), *The Aesthetics of Care*, p.16.

[cclvii] http://www.alamut.com/proj/97/longVoyage/genesisBarrier.html.

[cclviii] Ibid.

[cclix] http://www.apligraf.com/proddescrip.

[cclx] Natalie Jeremijenko, *Creative Biotechnology: A user's manual*, Locus + Publishing,

p.22.

[cclxi] Laval-Jeantet & Mangin, *Art Orienté Object*, CQFD 2002, p.93.

[cclxii] Anne Bonnin, cited in Laval-Jeantet & Mangin, *Art Orienté Object*, CQFD 2002,

p.7.

[cclxiii] This was in January 2008 while we were both exhibiting as part of the Sk-interfaces Exhibition, in the Foundation for Art Cultur and Technology, Liverpool UK.

[cclxiv] From Marion Laval-Jeanetet, The Fusional Haptics of Art Orient Object, in sk-interface: Exploring Boders – Creating Membranes in Art, Technology and Society, Jens Hauser De. FACT & Liverpool University Pres: Liverpool, p.94

[cclxv] AOO maintain to retrieve the original mouse with the ear on its back done by Vacanti. This claim is not based on any evidence as far as I am aware.

[cclxvi] From Marion Laval-Jeanetet, The Fusional Haptics of Art Orient Object, in *sk-interface: Exploring Boders – Creating Membranes in Art*, *Technology and Society*, Jens Hauser Ed. FACT & Liverpool University Pres: Liverpool, p.94 2008.

[cclxvii] ibid

cclxviii From O'Reilly, presentation in the SymbioticA BioDifference Conference, Perth Western Australia, 2004. Courtesy of the artist.

[cclxix] http://www.thisisliveart.co.uk/projects/past_projects/you_are_here_full.html.

[cclxx] From O'Reilly, presentation in the SymbioticA BioDifference Conference, Perth Western Australia 2004. Courtesy of the artist.

[cclxxi] Ibid.

[cclxxii] For more about Symbiotica and its academic programmes see: http://www.symbiotica.uwa.edu.au/educate.

[cclxxiii] http://www.theprogram.net.au/featuresSub.asp?id=3710&state=1.

[cclxxiv] 'I received ethics approval with UTAS through the previous SymbioticA approval, (along with Bioteknica, which came as sub-projects under Kirra's project). This was really important as it showed them a precedence of artist-lab relationships existing (as

I'm the first artist to have hands on Lab access at the Medical School), and my previous experience at SymbioticA had given me the all-clear for lab safety issues and tissue culture experience also. Without that SymbioticA approval it's really unlikely I would have received clearance I think.' From an email received on 28 May 2007.

[cclxxv] Email correspondence on 27 May 2007.

[cclxxvi] Ibid.

[cclxxvii] Ibid.

[cclxxviii] Ibid. Further, 'and resulted in an invitation to exhibit my work at the "Human Biotechnology and Public Trust Conference", held at Swinburne University, in late 2006 (Organised by the Centre for Law and Genetics). This also led to the publication of my work in the online journal *AJETS* (*Australian Journal for Emerging Technologies and Society*).'

[cclxxix] Ibid.

[cclxxx] http://www.lindenarts.org/show/2006/0818/king.html.

[cclxxxi] Email correspondence on the 27 May 2007.

[cclxxxii] Ibid.

[cclxxxiii] http://www.stelarc.va.com.au/.

[cclxxxiv] Laura Cinti's *Cactus* project (2002) is a prime example. 'The cactus project is a transgenic artwork involving the fusion of human genetic material into the cactus genome resulting in the cactus expressing human hair…[it] involved the use of the agrobacterium system introducing the keratin gene into the cells of the cactus. By taking advantage of the totipotency of plant cells, the transformed cells were used to regenerate genetically engineered transgenic cacti. The logistical challenge was having the keratin expressed in cactus cells morphologically similar to hair and for the cactus to produce it externally.' (http://www.lauracinti.com/).

The project, a hoax, was even featured as a 'credible' news item in the fairly credible magazine, *The New Scientist*, 24 February 2004 issue #2436.

[cclxxxv] http://www.ars-tratnik.si/37%20degree%20Celsius.htm.

[cclxxxvi] From Orlan proposal for a residency in SymbioticA 2007. SymbioticAarchive.

[cclxxxvii] For more about cell cataloguing, the systems and prices, see http://www.atcc.org/common/catalog/cellBiology/cellBiologyIndex.cfm.

[cclxxxviii] It is interesting to note that Reodica uses some of the TC&A terminology in the description of the work: in the web site she refers to the artistic tissue cultures as semi/living systems.

.[cclxxxviii] http://www.vivolabs.org/living_hymnext.html.

[cclxxxix] Her books include *Reading, Writing and Rewriting the Prostitute Body*,(Indiana University Press 1994). *Whore Carnival*, *Bad Attitude/s on Trial* (co-author), (Autonomedia/Semiotext 1995). and *Fast Feminism* (Autonomedia/Semiotext 2004).

[ccxc] From http://www.symbiotica.uwa.edu.au/residencies/residents2/shannon_bell.

[ccxci] http://www.eaf.asn.au/biotech/zaretsky01.html.

[ccxcii] *Moore* v. *Regents of the University of California* (51 Cal. 3d 120; 271 Cal. Rptr. 146; 793 P.2d 479.) from 1990. John Moore underwent treatment for hairy cell leukemia at the Medical Center of the University of California at Los Angeles under the supervision of Dr Golde. Moore's cancer was later developed into a cell line that was commercialised. The court ruled that Moore had no right to profits from the commercialisation of anything developed from his discarded body parts.

[ccxciii] This law is based on the law which prevents the legality of slavery. Hence, no human can own another human and therefore no human can own herself.

[ccxciv] From the artists' web site: http://members.westnet.com.au/moth/t_art/antext.htm.

[ccxcv]http://www.hexagram.ca/hexengine/projects.php?command=ViewProject&project_id=95&lang=en.

[ccxcvi] http://www.we-make-money-not-art.com/archives/2006/08/bioteknica-labo.php

[ccxcvii] http://greenmuseum.org/c/enterchange/artists/cae/.

[ccxcviii] From their proposal to SymbioticA (in SymbioticA archive).

[ccxcix] Donna Harraway, Simians, Cyborgs, and Women: The Reinvention of Nature, Routledge, 1991, p.194

[ccc] http://www.symbiotica.uwa.edu.au/residencies/residents2/biokino

[ccci] http://www.biojewellery.com/project1.html

[cccii] Anna Munster, 'Open bodies, closed cultures: bioart, the life sciences and the politics of intellectual property', paper given in SymbioticA Biotech Art Seminar, the Faculty of Creative Arts and the School of Biological Sciences, the University of Wollongong, 20 June 2005.

[ccciii] Roger Morton, in 'The Last Word' column in *New Scientist*, no. 2555, 10 June 2006, p.57. This quote is taken from Morton's response to the question, 'When an insect is changing inside its cocoon, and has turned to slush, is it alive? And if so, in what way is it alive?'. This is an interesting example, as we can categorise the insect in its cocoon stage as a semi-living. However, this case is different from other semi-living beings explored in this thesis, as the insect in cocoon stage is not in need of an artificial support mechanism to survive and transform to the 'fully living' state.

[cccciv] Drag Discovery and Development, http://www.dddmag.com/default.aspx.

[cccv] http://www-personal.umich.edu/~bobden/muscle_tissue_engineering.html.

[cccvi] Lori Andrews and Dorothy Nelkin, *Body Bazaar: The Market for Human Tissue in the Biotechnology Age*, New York: Crown Publishers, 2001.

[cccvii] C. Waldby and R. Mitchell, *Tissue Economies: Blood, Organs, and Cell Lines in Late Capitalism*, Durham, NC: Duke University Press, 2006.

[cccviii] S. M. Squier, *Liminal Lives: Imagining the Human at the Frontiers of Biomedicine*, Durham, NC: Duke University Press, 2004.

[cccix] Hannah Landecker, *Culturing Life: How Cells Became Technologies*, Harvard University Press, 2007.

[cccx] Robin Orwant, Dawn of the Zombies, *New Scientist*, no. 2553, 27 May 2006, p. 40.

[cccxi] Thacker, *The Global Genome*.

[cccxii] For more Wilson Edward O, *The Insect Societies,* New York: Harvard University Press, 1971.

[cccxiii] Senior, Towards a (Semi-)Discourse of the Semi-Living.

[cccxiv] Monika Bakke, ‘Zoe-Philia and the Predicament of Anthropocentrism’, paper given at the Mutamorphosis: Challenging Arts and Sciences conference, Prague, November 2007.

[cccxv] See above in note ccxi.

[cccxvi] http://www.atcc.org/common/catalog/numSearch/numResults.cfm?atccNum=CRL-1696. Little descriptive information about the origin of the McCoy cells appears in literature. They were first mentioned by Pomerat et al. [26143]. The cells were reported to have originated from the synovial fluid in the knee joint of a patient suffering from

degenerative arthritis. Around 1965, Defendi and colleagues showed that McCoy cells (designated McCoy A) were indeed human cells. However, another sub-line (designated McCoy B) was, in fact, of mouse origin and possessed marker chromosomes characteristic of strain L mouse fibroblasts. McCoy cells that are presumed to be human, but actually are mouse cells, have been disseminated from laboratory to laboratory throughout the world. Initial interest in McCoy cells followed the demonstration by Gordon and Quan [PubMed ID: 14268619] and Gordon et al. [PubMed ID: 4110420] that ionizing radiation (cobalt-60) greatly increased the susceptibility of McCoy cells to infection by chlamydia strains. A culture of the so-called McCoy cell line was received from the Center for Disease Control, Cell Culture Department, Atlanta, GA in March, 1984. Documentation of origin or passage history was not available. The cells have been used to propagate laboratory strains of the 15 recognized serotypes of *Chlamydia trachomatis*. The cell line has been satisfactory for chlamydia growth for at least 43 passages at ATCC. The cells are susceptible to chlamydia strains, and can be used to propagate chlamydia. Tested and found negative for ectromelia virus (mousepox). (McCoy and McCoy-Plovdiv cell lines in experimental and diagnostic practice – past, present and perspectives, *Journal of Culture Collections*, National Bank for Industrial Microorganisms and Cell Cultures, 4:1 (2005) 3-16).

[cccxvii] See Catts and Zurr, Big Pigs, Small Wings: On Genohype and Artistic Autonomy.

[cccxviii] Martin Heidegger, Translated by William McNeill and Nicholas Walker, *The Fundamental concepts of Metaphisics* Indiana University Press, 1995.

[cccxix] Cited in Squier, Life and Death at Strangeways.

[cccxx] Hannibal Chew, a character from the film *Blade Runner* (1982), directed by Ridley Scott. Based on the novel by Philip K. Dick, *Do Androids Dream of Electric Sheep* (1966).

[cccxxi] ATTC the Global Bioresource Center: http://www.atcc.org/common/catalog/numSearch/numResults.cfm?atccNum=CRL-1696.

[cccxxii] Ibid.

[cccxxiii] Ibid.

[cccxxiv] Human technology can be seen as an evolutionary process that made the technologically created hybrids as part of evolution. However, in this instance I mean by sexual selection.

[cccxxv] As defined by Bruno Latour in *Pandora's Hope: Essays on the Reality of Science Studies*, Harvard University Press, 1999.

[cccxxvi] An exception is the 1991 paper by Van Valen and Maiorana, HeLa, A new microbial species, in which they propose to classify a cell line as a new species. This paper will be discussed further in the conclusion.

[cccxxvii] Ibid.

[cccxxviii]

http://disneyworld.disney.go.com/wdw/experience/experienceLanding?id=CharacterExperiencePage

[cccxxix] *Tissue Engineering: The official journal of the Tissue Engineering Society*, 6:6 (2000) 697–000 at p.175.

[cccxxx] Van Valen and Maiorana, HeLa, a new microbial species.

[cccxxxi] Monika Bakke, Zoe-philic Desires: Wet media art and beyond, in *Parallax*, 2008, Vol 14, No. 3, p.32.

[cccxxxii] Peter Singer, *Practical Ethics*, New York: Cambridge University Press, 1993, p.62.

[cccxxxiii] Credit for the video are: Camera: Gérard Sergent

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