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## *Journeys to the Other Side of the Navel*

1. Take 500 milligrams of flesh.
2. Cut the flesh into smaller pieces and place them into a mortar. Add 2000microlitres of extraction buffer and grind with a pestle thoroughly to crush the cells and release the DNA.
3. Transfer the resulting paste and buffer to a 1.5ml microtube.
4. Centrifuge the tube for 5min at high speed in a micro-centrifuge to sediment the debris.
5. Transfer 300microlitres of the supernatant to a fresh micro tube.
6. Add 800microlitres of cold ethanol by carefully layering it on top of the supernatant.
7. Dip the glass pipette up and down in the microtube, gently mixing the alcohol with the supernatant. The DNA will precipitate as a white stringy mass which adheres to the glass rod. One base pair, the basic unit, of the DNA molecule that you see, is only  $3.34 \times 10^{-4}$  microns long.<sup>i</sup>

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### *Micro Power: 'The Century of the Small'*

“Who knows, perhaps that's what the twenty-first century has in store for us. The dismantling of the Big. Big bombs, big dams, big ideologies, big contradictions, big countries, big wars, big heroes, big mistakes. Perhaps it will be the Century of the Small.” Arundhati Roy<sup>ii</sup>

Within the grand narrative of globalisation and empire the “micro-physics”<sup>iii</sup> of power propagate and begin to function in a much finer mesh than ever before. As the philosophers Foucault and Agamben have both illustrated, the very fact of being alive is now the site for sovereign mechanisms of discipline and control. This is exemplified in the post September 11 proliferation of biometric identification techniques<sup>iv</sup> which map the micro differences of living systems into the macro control of population flow across borders. In the related field of information technology, minaturisation is the name of the game due to an inverse relation between the size of the hardware and the speed at which it processes information. At the same time, recombinant DNA techniques and stem cell research present the ability to fundamentally alter the potentiality of life through technical interventions at the micro scale and beyond. I think that Arundhati Roy is right in suggesting that it will be a ‘Century of the Small’, but I think that it is wrong to imagine that these small things will not have a big effect.

Small contradictions, small mistakes. These are the territory of an industry which operates at the level of the gene and the protein molecule. Small shifts in the definition of life, small adjustments at the periphery of death. The transformation that gathers force. I wish here to engage with the indeterminate zone between life and non-life as it is constituted on a micro scale. What is this life world within us? Uncanny negotiations at the boundaries of life gather affective power as they are amplified to the macro level. Biological artworks are able to insert themselves into the process of amplification: a small intervention whose affect is effective in exposing the politics of the living.

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### *Micro Shifts: Umwelt and the Uncanny*

To work with living processes at the micro scale engenders an embodied understanding of the intricacies of life. When working with tissue culture or recombinant DNA engineering, one becomes aware of the extremely contingent relation between life and non-life - minute attention to detail is necessary, as a tiny mistake will mean contamination or failure. To perform a DNA extraction seems, given this ability to manipulate the contemporary 'essence of life', something a kin to modern-day sorcery. To see moving cells under the microscope is to feel, like so many others before, wonder - and to wonder about the nature of life. The life that we all take for granted is made strange. The process of making art that engages with life necessarily encounters the strange and paradoxical relation between the living and the non-living. As artists engaging with biotechnologies, it is our role to negotiate this ethically uncertain territory of the indeterminate and unfamiliar, to pro-actively make strange in order to initiate a moment of contemplation about contemporary relations between technology and life.

“For Freud, the uncanny derives its terror not from something external, alien, or unknown but--on the contrary--from something strangely familiar which defeats our efforts to separate ourselves from it.”<sup>v</sup>

“Man is... the uncanniest of the uncanny” Heidegger<sup>vi</sup>

In the situation of 'making strange' the idea of the uncanny is a useful one with which to understand the affective power of 'biotech art'. Freud discussed a number of instances that come together to create the feeling of the uncanny, a particular subset of which Catherine Waldby has singled out as being:

“instances where life and death exist in an ambiguous mixture. Such instances include 'doubts whether an apparently animate being is really alive; or conversely, whether a lifeless object might not be in fact animate'; the figure of the double, which is both 'an energetic denial of the power of death' and a harbinger of death.”<sup>vii</sup>

Freud names the automata as a prime example of this life/death ambiguity and also talks about the uncanny effect as being one of “intellectual indeterminacy” that “is often and easily produced by effacing the distinction between imagination and reality, such as when something we have hitherto regarded as imaginary appears before us in reality...”<sup>viii</sup>

Many of the pieces in Art of the Biotech Era function affectively by operating in this zone of the uncanny. Michalis Pichler's work 'Kuh' is framed as an experiment with the paradoxical mixture of life and death in imagery associated with the cow. Andre Brodyk describes his work, 'Glo@k Gene', in terms of an encounter between the animate and the inanimate, fiction and fact. Gina Czarnecki's work 'Infected' operates in the zone of the uncanny, with its presentation of an indeterminate body that is recognisably human, yet manipulated in such a way that it could not physically be so. The Tissue Culture and Art Project's collaboration with Stelarc on the semi-living quarter scale ear overtly works to create the uncanny affect of an object between life and death. 'The Pig Wings Project', a previous work by TC and A involving tiny wing shaped objects that were grown with pig bone marrow stem cells and then coated in gold to look like cheap jewellery, playfully reverses the uncanny relation between the imaginary and the real as a comment on the way in which the life sciences industry plays up to its affective power.<sup>ix</sup> Although Adam Zaretsky's work, 'The Brainus Analolly Complex', is framed in a humourous manner, it has a strangely disturbing quality as one contemplates the question posed:

"Please Vote...

- I would much rather lick the Brainus. An anus seeded with brain tissues is more lickable because....
- I would much rather lick the Analolly. A lollypop seeded with anal tissues is more lickable because...."

One realises that we are living in a time where the living and non-living aspects of everyday life are being blurred in ways never before imagined. Zaretsky's accompanying statement, regarding the eel involved in the process of making the work (and dinner), functions to highlight the intellectual indeterminacy operating in the relation between life and death by framing death as an imminent and, thus, immanent quality of life:

"I will ... try to welcome the hunger of the living consumers of my body (animal, vegetable, bacterial, insectoid, fruit or fungal) when they come to feast on my inevitable temporary-ness, my becoming food for others."<sup>x</sup>

Folding through this uncanny life/death paradox is the zone of translation between the sensory bandwidth of humans and other living phenomena. This translation is in itself a process by which life/death, living/non-living are defined and, as such, becomes part of the process of 'making strange'. At the beginning of the 20<sup>th</sup> Century a man by the name of Jakob Von Uexküll introduced the word *Umwelt* to designate the world which is particular to each organism by virtue of its specific sense capacities. "Each biological life-form, by reason of its distinctive bodily constitution (its 'biological heritage', as we may say), is suited only to certain parts and aspects of the vast physical universe."<sup>xi</sup> *Umwelt* is life as process with world. The life world of a human is determined by the bandwidth of its sensory capacities: audio frequencies 20 – 20,000Hz, volume above 20dB, light wavelengths between 400 and 700 nanometres, and so on. Each organism has, in this way, a specific sensory relation with physical phenomena that determines the objects of experience of that organism. These objects of experience may or may not be the same as those of other organisms. The world of the micro is outside our ability to sense and is, thus, not naturally part of our *Umwelt*. Translation technologies must be employed in order to bring it into our realm of experience. The micro is amplified to become part of the process with world in which our art is defined.

Amplification of the micro plays an important part in the uncanny functioning of a number of the works from 'Art of the Biotech Era'. George Gessert's 'The Family of Mark Tobey from Origin' is a work based on the amplification of genetic mutations. Similarly, the superweed project is a small package with an unassuming aesthetic which claims the potential to destroy the economic viability of GM canola crops through a process of selective breeding. Here the micro physics of life are strangely instituted within a macro economic politic. Brodyk's Glo@k amplifies the enagement of GFP and RFP genes in E. coli bacteria into a work pointing to the strange relations between the living and the non-living and the potentially huge ramifications of genetic engineering. The quarter scale ear amplifies individual cells of human skin simultaneously into an object of experience compatible with human sensory capacities and is a comment on the changing position of the living in the contemporary world. To 'make strange' with art, is to inject micro peturbations into the tightly coupled relation between life and world. It is to intervene at the micro scale in order that the uncanny paradadox of life is amplified in translation. The artist must engage with the indeterminate zone of the life/non-life relation at the micro level and with the technologies of translation and amplification that enable it to be perceived at a macro level. Concepts of *Umwelt* and the uncanny are, thus, necessarily intertwined in the process of making bioart.

Art dealing with biotechnology is a micro event that creates waves in the fabric of life. Works in 'Art of the Biotech Era' operate physically at the micro scale. They play with the disjunction between the size of the micro event and its potentially huge ramifications: a call to pay greater attention to detail - life is at stake. Work is created with a sense of the uncanny in a strategy of 'making strange' that enables art to function as a spur to ethical debate. Micro works engage the productive synthesis of translation to the macro. They effect themselves within this translation process in order to question the ethics of relations that go into the production of new types of bodies - "living and non-living, molecular [and] macro, individual [and] social."<sup>xii</sup> Thus, the *Umwelt* and the uncanny fold together in an affective coupling that brings the process of living into question. The next two sections of this paper take a closer look at translation technologies and the operation of the indeterminate relations between life and non-life being extended at the intersection of the biotech and nanotech industries.

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### *Micro Translations: Envisioning Potential*

Techniques for translating the realms beyond the low bandwidth human capacity to sense have been, and continue to be, instrumental in defining boundaries in the borderland between the living and the non-living. The micro relations between imaging phenomena and living processes are fundamental to the macro understanding of the relationship between phenomena and life. The uncanny incorporation of the non-living in the living is the process by which an organism's *Umwelt* is constituted and also the means by which translation between life worlds is effected. Thus, concepts of matter, life and generation have shifted in tandem with the progression of scientific imaging techniques.

## Microscopy

“If there is such a thing as progress, then, it is surely manifested in increasing accuracy of measurement. Increased accuracy extends man’s knowledge of the world and discovers subtleties that could never even be dreamt of in the armchair.” Turner<sup>xiii</sup>

This quote, taken from an article entitled ‘The Microscope as a Technical Frontier in Science’, expresses the familiar Cartesian idea of a world rendered comprehensible through measurement, of which the ‘subtleties discovered’ are merely the finer details. The measurement of the micro domain, in this case, enables a closer approximation to an external reality. What actually occurs, however, is the appearance of a fundamental indeterminacy at the micro scale that is not able to be resolved through more accurate measurement but, rather, operates as an essential defining feature of the world. The invention and development of the microscope through the 17<sup>th</sup> and 18<sup>th</sup> centuries functioned to amplify this indeterminacy in a number of debates about the nature of life and generation.

“With the invention of the microscope at the beginning of the seventeenth century, it became possible to take a first glimpse at the previously invisible world of microscopic life. A bewildering array of new structures appeared before the astonished eyes of the first microscopists.”<sup>xiv</sup>

Such micro phenomena were initially understood to be part of a structural continuum between life and non-life and, as such, were construed as a vindication of the spontaneous generation theory of life.

“Nature proceeds little by little from lifeless thing to animal life, so that it is impossible to determine either the exact line of demarcation, or on which side of the line an intermediate form should lie.” Aristotle<sup>xv</sup>

This theory, which was originally espoused by Aristotle, held that life was able to form spontaneously out of matter. The opposing theory held that life and matter were two distinctly different domains which did not intermingle. This debate was connected to a general divide between the preformationist and epigenesis theories of animal reproduction. The preformationists believed that the embryo pre-existed in micro form either in the fathers’ semen or the mothers’ uterus before conception “Most also thought that all embryos had been formed by God at the Creation and encased within one another to await their future appointed time of development.”<sup>xvi</sup> In this instance it was seen that the coming together of the male and female elements merely stimulated the growth of the preformed embryo. Epigenesists, on the other hand, although differing in their explanations, believed that life could be generated from the gradual self-organisation of matter. Many experiments were carried out on the newly discovered microorganisms by advocates of both sides of this debate to claim support for their particular theories.

Anna Munster describes the baroque scientific image as a consciously constructed artefact in which the layering of diagram and conjecture and an active performativity of light and perspective is inscribed.<sup>xvii</sup> Shifting the virtual image of the lens, focusing in on potential life,

on life's potential. Robert Hooke's *Micropgraphia* (1665) with its detailed illustrations of phenomena sighted under the microscope was an important milestone in microscopy. However, "[i]n his book Hooke points out how difficult it is to be sure of the true shape of an object, 'the same object seeming quite differing in one position to the light, from what it really is, and may be discovered in another'. He claimed that he had repeatedly examined his specimens before drawing what he thought were the real shapes."<sup>xviii</sup> Likewise Marcello Malpighi's illustrations detailing the microscopic developments of a chick embryo were used to support the preformationist project despite the fact that "Malpighi never argued for the presence of embryos before fertilisation .. and in fact reported that one can see nothing in the unfertilised egg.." <sup>xix</sup> Thus, just as there is an indeterminacy in the relationship between matter and life so there is an indeterminacy in the history of microscopic translations which underpin the debate over which point and from what life begins.

The indeterminacy surrounding the microscopic observations of the 17<sup>th</sup> and 18<sup>th</sup> centuries continues in various forms up to the present day. The debate between epigenesis and preformationism continued into an epistemological divide between embryology and genetics, and is expressed now in the ethical positioning over stem cell research. Early supporters of the cell as "the fundamental unit of inheritance"<sup>xx</sup> and of its nuclear chromosomes as the determinants of embryological development were accused by other scientists of re-instituting a type of preformationism, a perspective which at this time was considered simplistic and scientifically dubious. However, with the discovery of DNA as the unit of genetic inheritance the idea of a human essence replicating itself through time had once again gained the upper hand in the popular scientific imagination. Today, the stem cell debate functions at the divide between an emphasis on potential life or life as potential. Between matter in the epigenetic tradition that could, given the right environment, become life and matter that is already a life with potential and rights.

## **Ultrasound**

As the indeterminate zone between life and non-life defines the crisis at the centre of the debate over abortion and the reproductive and biotechnology industries, other forms of translation to the human sensory bandwidth become critical. Although there are many such forms of translation, the predominant imaging technique used to chart the process of human reproduction is ultrasound. Like the microscope and diagram, ultrasonic imaging, is inscribed with a particular type of performativity. Ultrasound is a micro phenomenon defined as; sound which is beyond the human capacity to hear. Ultrasonic wavelengths used in medical imaging are anywhere between 344 and 22 microns long.<sup>xxi</sup> Ultrasonic imaging operates by mapping micro differences in time into boundaries of flesh. A transducer sends out pulses of ultrasound and measures the delay of the reflections. Images of the surfaces which reflect the sound are constructed from the difference times recorded between the signal pulse and echo. Points of differential signal permeability are constructed in dialogue between the computer and the medical practitioner as boundaries forming an identity.

"What exactly does a pregnant woman see when she has a sonogram? For high-risk pregnancies, vaginal transducers manipulated by highly trained sonographers can produce uncannily detailed images of eight week old fetuses. Routine examinations in

an obstetrician's office, however, may show a fan shaped blur with a dark, undifferentiated bean which the mother is told is her growing fetus."<sup>xxii</sup>

Thus, the relation between ultrasonic phenomena, the living matter of examination and the interpretative translation of an imaging practitioner is crucial in the delineation of boundaries between the living and the non-living.

The increasing use of medical ultrasound over the past three decades has made the grainy image of a gestating fetus commonplace and this image is deeply implicated in the uncanny paradox of death in life / life in death.

"Before ultrasound there was no way to see eggs, a developing embryo, or a fetus at an early stage of development. Gynecologists and obstetricians were apt to regard the developing fetus as some kind of uterine tumor."<sup>xxiii</sup>

This new image of life where before there was indeterminacy has been used by opponents on both sides of the abortion debate as ammunition in the attempt to understand matter as potential life or as life with potential and rights.

"...why not, some legal scholars have suggested mandate that every abortion seeker see a sonogram of her fetus? ... The assumption here is, of course, that no woman could see a sonogram and go ahead with an abortion... However, it seems equally likely that if the sonogram showed a defective fetus, any women who had not considered abortion would procede to have one."<sup>xxiv</sup>

Ultrasonic imaging is a technology that amplifies micro differences in the reflection of sound and thickness of flesh to a liberal discourse of rights, from intimate relations between movement and matter to decisions about life and death.

## **Quantum Dots**

A life developed in the perspective and diagram and a life defined in terms of surface and boundary. What translation technologies are emerging now, in tandem with new issues surrounding the boundary between life and death, the living and the non-living? Quantum dots are tiny semi-conductor crystals that contain only between one hundred to one thousand atoms. Because these dots are so small they display particular behaviors that do not exist in larger crystals. Of most interest to biological imaging is their ability to emit light at specific frequencies depending on size, and for different sizes of dot to fluoresce in response to a single light frequency.

"Biologists have long been eager to probe living cells in full colour over extended periods of time. Such a technique could reveal the complex processes that take place in all living organisms in unprecedented detail, such as the development of embryos. Existing imaging techniques use natural molecules that fluoresce... However, each dye emits light over a wide range of wavelengths, which means that their spectra overlap. This makes it difficult to use more than three dyes at a time in order to tag

and image different biological molecules simultaneously. The fluorescence of dyes also tends to fade away quickly over time.”<sup>xxv</sup>

In the past the problem with this technology has been that the outside coating of the dots is hydrophobic, which means that they cannot be used in wet biological environments. However, recent developments have overcome this problem by inserting the dot into a phospholipid surround that is the same as the basic structure of a cell membrane. It is then possible to connect the dots to fragments of DNA which are able to attach themselves to the DNA of a target molecule. The development of a frog embryo has been imaged *in vivo* using this technology (without the DNA targeting) in combination with timelapse microscopy.

“The researchers made several key observations. Upon cell division, the fluorescent particles appeared to be solely distributed to the offspring of the injected parent cell, and did not diffuse out of the cell. The path taken by a fluorescent cell could therefore be traced back to the cell that was first injected. The researchers also found that all embryonic cell types can be stained...”<sup>xxvi</sup>

Image and body speak as one. A potential image, an image co-becoming with life itself. A process of becoming which inscribes the differences of a constantly shifting identity. An image that is implicated in the micro transformations of matter becoming life through connection to a fragment of essential code. The image of the embryo is in symbiotic relation with its *Umwelt*. The genesis of an identity is amplified into an uncanny entanglement of matter, image and life. The more the imaging techniques by which we seek to understand life and its generation become implicated in living processes, the more they determine the way we are able to understand the boundary between life and non-life. The image is constructed by its particular affinity to life and life forms itself in an inverse relation to image. So we have an indeterminacy created not by lack of detail but, rather, within the technology of detail itself.

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### *Micro Transductions: The New Indeterminacy*

“... [N]anoscience and nanotechnology will change the nature of almost every human made object in the next century.”<sup>xxvii</sup> Beyond our capacity to sense, intimate transductions between matter and life generate and sustain new forms of being. Quantum dot imaging is one of many new technologies working with biomimetic devices. Others include biopolymers created to become part of the living system they inhabit and technologies that utilise biological molecules themselves as building components. The highly developed molecular functioning of living systems is being used to construct systems that exhibit much of the self-sustaining functionality of life.

“The unique properties of DNA are set to turn the building block of life into one of the most sought-after materials in the nano-scale construction industry. DNA is a wonderful material with which to build. It can act as a molecular glue or as the fuel for molecular engines. It can be made into rigid girders and tiles, and can also be used to design complex structures capable of self-assembly. DNA nanostructures can act as

parallel computers, as "scaffolds" in protein-crystallography experiments and may soon form support structures in 3D molecular electronic circuits. The remarkable properties of DNA that allow it to be used as bricks, mortar and fuel could even lead to molecular assembly lines with conveyor belts that play an active role in the construction process."<sup>xxviii</sup>

Besides being a beautiful example of the profoundly mechanist paradigm at work in contemporary scientific discourse, the description of the self-replicating and multi-potent nature of the DNA molecule is of particular interest.<sup>xxix</sup> The fundamental preformationist unit of heredity is understood here as a self-organising process of matter. .... It is this "immanent power of self-organisation"<sup>xxx</sup> that is being sought after in the nanotech industries.

The French philosopher of science Gilbert Simondon calls this self organising process, in which life is defined, transduction. "Information as he understands it involves an irreducible element of 'disparation' – 'noise', 'fluctuation' or 'disequilibrium'. ...[H]e argues that a morphogenetic field is able to constitute itself in so far as it incorporates this irreducible element of fluctuation within its own internal structures – or rather, in so far as it is able to organise itself in and through the channeling of this fluctuation."<sup>xxxi</sup> In a similar way, Avery explains how the potential of life to exist as a self-organising structure is dependant on its ability to operate in a thermodynamic fluctuation between positive and negative entropy. Life, then, is always something that is in-formation. It is process with world. It is *Umwelt*. The essential nature of life is never consolidated in an actuality, but rather, it operates in its own existential paradox. Life is indeterminacy. Life at its most vital is absolutely uncanny.

In 1971 theoretical biologists Maturana and Varela came up with the term autopoiesis "to designate the organisation of a minimal living system." In a paper entitled *The Biology of Intentionality*, Varela defines an autopoietic system as "one that continuously produces the components that specify it, while at the same time realising it (the system) as a concrete unity in space and time, which makes the network of production components possible." In another work, Varela has argued that autocatalytic chemical systems such as reverse micelles "can come close to the mark for being a minimal autopoietic system."<sup>xxxii</sup> A micelle is defined as "[a] spherical arrangement of organic molecules in water solution clustered so that their hydrophobic parts are buried inside the sphere and their hydrophilic parts are on the surface of the sphere and in contact with water."<sup>xxxiii</sup> The cell membrane like surround encapsulating the quantum dots was a micelle. "Research over the past several decades has demonstrated that [reverse micelles] - small droplets of water in oil - can be used as the site for growth of metals, semiconductors, minerals, polymers and biomimetic materials."<sup>xxxiv</sup> Thus, what begins to emerge is a process of mutuality between life and non-life. A language of molecular complementarity in which components of living systems become a template for non-living products and non-living systems act as a template for a process of organisation in which a life is defined. So we have a previously unimagined extension of the relationship between life and non-life. The micro *Umwelt* of the self-constituting life process is bound up with a synthetic double. The molecular complement which defines the world of the micro life form is constituted in symbiosis with an artificial quasi-life. Freuds automaton is manifested as a micro chimera instituted in the process of living.

The reciprocal engagement of matter and life is also an evolutionary process. The scientific search for the origin of life is fuelled by the theory of spontaneous generation - by what means was matter gradually able to become life? What is interesting about the intersection of biotechnology and nanotechnology, is that this evolutionary continuum between life and non-life is being diachronically reintroduced and integrated back into relations which determine life. Melinda Cooper has suggested that stem cell research presents a novel perspective on the Aristotelean continuity, in which the totipotent stem cell is sustained as absolute potential with no ability to die.<sup>xxxv</sup> In the case of the biotech/nanotech interface we have, not an isolated stem cell with absolute potentiality, but rather, a quasi-life, which, by virtue of its interiority to a life, has the ability to die.

“Bodies are alive because their transductive constitution occurs on the interior as well as the exterior. With non-living elements it occurs only on the exterior.”<sup>xxxvi</sup>

DNA tagged quantum dot micelles or biopolymers, which are designed to integrate seamlessly into biological systems, become part of this living interior. Non-living components which lock into their living complement are instantiated back into the interiority of a corporeal life. Thus, a prosthetic amplification of the interplay between life and non-life exists within us and through us as the constitutive state of being alive.

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### *Micro Culture: Art and Life*

Art itself is a moment of transduction between the living and the non-living the micro and the macro. A living body is sensually, materially continuous with a work of art. It engages in a productive synthesis with the work that generates more than the sum of its parts. Art forms continuously at the interface between matter and life, and so, amplifies its own becoming.

“At a very basic level, every technical mediation corporealises a living body or bodies. It... forms part of the iterative materialisation of the surfaces, limits and matter of bodies.”<sup>xxxvii</sup> MacKenzie

Art is a technique that sustains life between organisms and their world. It is an uncanny event that oscillates as life in process and is immanent in process with world. Art is a translation technology that foregrounds its own active performativity. Take Adam Zaretsky and Tanja Visosevic’s GLACK as an example:

“GLACK is a wet and fleshbound tour through the underside of your meatness. ... Shot with a long rubber endoscope, GLACK reminds us all that we are fleshy body pods.”

The image performs its compliment with life in order to demonstrate that we are organised matter. Matter organised in such a way that it is possible for us to die.

Bioart poses a micro/macro, life/death relation that travels in waves of matter moving. The force of bioart is an ethics of affect that functions through the micro physics of power to effect strange new ways of becoming life. It calls into question the operations of indeterminacy at play in the constitution of the human. The human is forced to acknowledge its properly contingent existence as a macro construction that is formed in translation from the micro. The human is thereby encouraged to give up its claim to superior status and engage in an ethical relation with its surround. Like art, biotechnologies also effect new relationships between matter and life, human and non-human. Bioart must function in rhythm with these techniques in order to pose a critical counterpoint to their operations.

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<sup>i</sup> This is my slightly altered version of the instructions written by Gary Cass in the work book for the Biotech and Art Workshop held at the Experimental Art Foundation in Adelaide, March 2004.

<sup>ii</sup> Roy

<sup>iii</sup> Michel Foucault uses this term in a number of his works including Discipline and Punish (1977).

<sup>iv</sup> "Under the US Enhanced Border Security and Visa Entry Reform Act of 2002, countries whose citizens enjoy visa-free travel to the United States must issue passports with biometric identifiers no later than October 26, 2004."

[http://www.theregister.co.uk/2003/07/22/us\\_names\\_the\\_day/](http://www.theregister.co.uk/2003/07/22/us_names_the_day/)

"Since January 31 [2002], asylum seekers in the UK have been issued with biometric cards holding family details, nationality, date of birth and other information.

[http://www.theregister.co.uk/2002/02/21/biometric\\_passports\\_for\\_brits\\_by/](http://www.theregister.co.uk/2002/02/21/biometric_passports_for_brits_by/)

<sup>v</sup> Morris

<sup>vi</sup> Heidegger p171

<sup>vii</sup> Waldby

<sup>viii</sup> Freud p398

<sup>ix</sup> The work was created for exhibit as part of a show to celebrate the apparent completion of the Human Genome Project but was not included in the final exhibition.

<sup>x</sup> The continuity that Zaretsky frames here between life, death, food (matter to be revitalised by its new incorporation) is one that I grapple with throughout. At what point in the cycle is matter dead, at what point is it non-living, pre-alive or post-dead? How alive does something have to be before it can be dead? These words play into the fundamental indeterminacy which is the subject of my paper. As a result there is a certain slippage between the terms non-life and death according to the context in which they are used.

<sup>xi</sup> Deely

<sup>xii</sup> Munster (2004)

<sup>xiii</sup> Turner p159

<sup>xiv</sup> Mazarello

<sup>xv</sup> Avery p1

<sup>xvi</sup> Roe p1. This theory was known as *emboitement*.

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- xvii Munster
- xviii Roe p3
- xix *ibid* p6
- xx Gilbert p6
- xxi Calculated according to “high frequencies in the range from 1 to 15 MHz are the norm” quoted from Cutnell, Johnson. *Physics, 3rd Edition*. New York: Wiley, 1995 in Elert, Glen.
- xxii Kelves p248
- xxiii Kelves p 247
- xxiv *ibid* p250
- xxv Bentoilla and Weiss
- xxvi *ibid*
- xxvii Parker
- xxviii Turberfield
- xxix Indeed PCR is one of the founders of the biotech nanotech combination.....
- xxx Cooper (2003) p11
- xxxi Cooper (2003) p19
- xxxii Varela pp5-6
- xxxiii Google search ‘define: micelle’ on the 10/04/04
- xxxiv Castagnola, Singh and Dutta.
- xxxv Cooper (2002) p91
- xxxvi MacKenzie p172
- xxxvii MacKenzie p85