(RE)embodying Biotechnology:

Towards the Democratization of Biotechnology Through Embodied Art Practices

Jennifer Willet

A Thesis

In the Humanities Program

Presented in Partial Fulfillment of the Requirements

For the Degree of Doctor of Philosophy at

Concordia University

Montreal, Quebec, Canada

September 2009

Your file Votre référence
ISBN: 978-0-494-63385-4
Our file Notre référence
ISBN: 978-0-494-63385-4

ABSTRACT

(RE)embodying Biotechnology: Towards the Democratization of Biotechnology Through Embodied Art Practices.

Jennifer Willet, Ph.D.
Concordia University, 2009

Contemporary discourse surrounding biotechnology places great emphasis on digital metaphors in describing the biological sciences. In these discourses it is as if mankind's 'cumulative' technology – *computation* – performs the ultimate science, the dominion of man over nature through the application of numeric code to living organism. This general application of computational models to instances of biotechnology provides a sterilizing affect, removing all that is wet, bloody, unruly, and animal, from mass imaginations of the biotech future. As I argue this vision of biotechnology (as it is presented to non-specialists) may serve to nullify public engagement in the complex ethical dilemmas that arise from engaging in technologies of the body.

(RE)embodying Biotechnology focuses on reuniting notions of embodiment with the language, analysis, practice, and representation of contemporary biotechnologies. With a social and political mandate that advocates informed public discourse, *(RE)embodying Biotechnology* complicates, rather than simplify our understanding of the biotech field. Methodologically, I propose artistic means for non-specialists to engage in biotechnology as an embodied practice through

the mobilization of a 'critical participatory methodology'. *(RE)embodying Biotechnology* is a research / creation thesis; comprised of the documentation of a body of work and a text that reflects on how artistic engagement in the biotechnological field may allow for non-specialists to engage critically with evolving biotechnologies.

Insert Signature Page Here

Acknowledgements

I wish to thank numerous individuals who have contributed to my research with *BIOTEKNICA*, and the completion of my thesis *(RE)embodying Biotechnology*. I wish to first to express my gratitude to Shawn Bailey (Jason Knight) for his immeasurable investment in our long and transformative collaboration. I am grateful to Oron Catts and Ionat Zurr their collaborative efforts, as well as for providing *BIOTEKNICA* with our first wet biological art experiences, a beautiful and painful induction into the specialist class. I wish to also express my gratitude to so many artists, scientists, and theorists in the bioart community who have opened their hearts and labs, and practices, to my investigations: Adam Zaretsky, Kira O'Reilly, Marta de Menezes, George Gessert, Guy Ben-Ary, Dr. Suzanne Anker, Polona Tratnik, Kathy High, Dr. Stuart Bunt, Jane Coakley, Gary Cass, Dr. Stuart Hodgetts, Dr. Robert Zwijnenberg, Dr. Miriam van Rijsingen, Dr. Anne Kienhuis, Tagny Duff and Marie Pier Boucher. I wish to express my sincere thanks to those individuals who worked directly on a variety of projects: David Jhave Johnston, David Bouchard, Tagny Duff, Edgar Perez, James McDougall, Anil Ragubance, Kevin Finlayson, Christian Kuras, Yen-Chao Lin, and Emily Wonder.

I am especially grateful to Dr. Kim Sawchuk for her unending contributions and mentorship through the difficult maze of completing a doctoral degree. Without her, this thesis would not be completed today. More importantly I am grateful for

her stewardship towards an evolved academic and intellectual maturity that marks the beginning of a life long process. I wish to also express my appreciation to my committee: Dr. Catherine Russell, Dr. Ernestine Daubner, Dr. Sha Xin Wei, Dr. Shannon Bell, Dr. Dennis Murphy, as well as Dr. James Jans, and Dr. Bina Freiwald for their patience, feedback and support.

I wish to thank the agencies and organizations that supported this work including: The Social Science and Humanities Research Council of Canada, HEXAGRAM, The Canada Council for The Arts, Conseil des arts et des lettres du Québec, Programme Québec Multimédia Jeunesse, SymbioticA, the School of Anatomy and Human Biology at The University of Western Australia, The Banff Centre for the Arts, Concordia University (Studio Arts, and Humanities PhD Program: Interdisciplinary Studies in Society and Culture), The Art and Genomics Centre at The University of Leiden, and The School of Visual Arts at The University of Windsor.

I wish to thank my friends and family – Warren, Teala, Robin, Sarah, Josh, and Grant – for cheering me on, and giving me the time and circumstances to complete this task successfully. Lastly, I dedicate this thesis to the memory of my mother Cynny Willet who encouraged me from the very beginning to pursue my research, no matter how difficult or unusual it may be.

Table of Contents

List of Figures

1 | (RE)embodying Biotechnology: Introduction

> First day in the lab. Baptism by fire of sorts. We arrived in Australia two days ago. Still dizzy, jet lagged, and curiously upset by the location of the sun in the northern sky. Today we performed our first passaging on the 3T3 Mouse Fibroblast cell line. Cell lines are very special cells developed for research purposes. They are immortal. The telomeres have been chemically treated with an enzyme so that the cells do not age, they do not experience cell death, they are able to divide infinitely. Sound Familiar? Creating an infinite cell line sounds a lot like creating a cancerous cell line. What is the difference? Possibly in order to deem uncontrollable cellular division cancerous the cells must inhabit and jeopardize a host organism. I immediately begin referring to our cells as 'our little monsters'.[1]

In May 2004, I left my home and disabled cat in Montreal to travel to the opposite end of the earth (Perth, Australia) with my collaborator Shawn Bailey[2] as part of our ongoing *BIOTEKNICA* research to study mammalian tissue culture (TC) and tissue engineering (TE) protocols at The University of Western Australia. Over a period of three months, we gained proficiency in antiseptic technique, freezing,

---

[1] Jennifer Willet. *BIOTEKNICA | ORGANIC TISSUE PROTOTYPES | LABORATORY NOTES*, unpublished manuscript, 2004.

[2] Shawn Bailey now works under the name Jason Knight, though I refer to him as Shawn Bailey as this was his working name throughout the BIOTEKNICA project.

defrosting, feeding, and trypsinizing procedures — all working in chorus to support cellular life outside of the donor body. The skills we acquired during this time are rather basic in the specialized field of TC, which was established over a hundred years ago. However, what was unique about our first foray into the field was not the specialization of the knowledge obtained or the remote location of our instruction but instead the intentions, education, and background of ourselves, the willing students. We are artists. Together, we developed an interdisciplinary artist collective called *BIOTEKNICA*, investigating the ethics and aesthetics at the intersection of art and science. Our original training was in traditional forms of reproduction: printmaking, serigraphy, intaglio, lithography; these expanded to include digital imaging, internet authoring, installation and performance. In 2004, we went back to the classroom — this time to learn TC and TE techniques towards the production of contemporary art.

We served as Honorary Research Fellows at SymbioticA: The Art and Science Collaborative Research Laboratory, giving us the same status and level of access as visiting scientific researchers working in the School of Anatomy and Human Biology at the UWA. It was at this time that *(RE)Embodying Biotechnology* was conceived — at the edge of life-altering, art-denaturing instances of real, hands-on knowledge of biotechnological protocols from a non-specialist perspective. Here, for the first time, I experienced the instrumentalization of life as a scientific and technological tool and, simultaneously, as the object of scrutiny. I often look back at that time as an

induction — or a disillusionment — as it was the moment when the biosciences became a real embodied knowledge set rather than merely a textual topic of study. Though my research and production had centered on science, medicine, and the body for a decade, it was at SymbioticA that my work as an artist came to life.

Biotechnology is arguably the most significant technological development of our time. Historically, humankind has harnessed the ability to produce and reproduce (in an industrial sense), as well as simulate (with computation), but with biotechnology we are able to breed, and indeed to birth, generational life forms that serve as tools and subjects — creating living, embodied technologies that, in turn, interact with and alter our bodies and the planet's ecology. We see ourselves facing an alarming threshold where humanity, as we understand it today, will be irrevocably changed by the technological trajectories that we choose. Biotechnology and, more specifically, projected cloning technologies are imagined as a kind of Pandora's box. Paradoxically, these technologies offer great humanitarian potential, particularly in the health care sector, yet simultaneously they ensure a societal leap into a vast and possibly devastating unknown. In *The Biotech Century*, Jeremy Rifkin states that "The biotechnology revolution *will* affect each of us more directly, forcefully, and intimately than any other technology revolution in history."[3] With such focus placed on predictions and forecasts (the hype and hysteria) surrounding biotechnology, we often

[3] Jeremy Rifkin, *The Biotech Century: Harnessing the Gene and Remaking the World*, (New York: Tharcher/Putnam, 1998), p. 236.

overlook the bio-manipulations and bio-invasions of the physical and social body occurring each and every day. In vitro fertilization, plant hybridization, pasteurization, antibiotics, vaccines, and genetic testing, to name only a few, are all established and integrated technologies that alter corporeal existence in our society. Arguably, there is no impending biotechnological threshold — or, if there is, it has already been crossed. Quietly, and without pomp or circumstance, we have slipped into the biotech future.

We are already immersed as a species, society, and ecology, in harnessing the natural world towards human ends. This process of life manipulation goes back thousands of years — humans have long been breeding, planting, culling, and affecting life forms towards survival and aesthetic ends. This process is easy to imagine as a one-way manipulation, particularly given our anthropocentric view that human beings are simply influencing the environment around us to suit our needs. However, I prefer to see this relationship as reciprocal; humanity is a component of the very ecology we intend to harness. In fact, I would argue that this process of manipulating our ecology (and, by extension, ourselves) is not restricted to the human race, although we understand biotechnology as inherently a cultural and unnatural act. If we distance our analysis from the specificities of this particular incursion, we can interpret biotechnology as an evolved relationship between species and environment: one of ecology. I am reminded of Richard Lewontin's description of a cyclical ecology:

> Every species, not only Homo Sapiens, is in the process of destroying its own environment by using resources that are in short supply and transforming them into a form that cannot be used again by the individuals of the species. ... But every act of consumption is also an act of production. That is, living systems are the transformers of materials, taking in matter and energy in one form and passing it out in another that will be a resource for consumption for another species.[4]

This life-manipulating drive has grown exponentially in the last hundred years. In this time, we have identified the constituent parts of life (atoms, cells, DNA) and manipulated these parts to the extent that organic chemistry and microbiology are no longer observational but experimental sciences. In his detailed investigation *The Uses of Life: A History of Biotechnology*, Robert Bud outlines, in great detail, a lineage of life manipulation, from the inception of agriculture to contemporary genetic manipulations. He provides a common definition of biotechnology; it is "...the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services."[5] Bud marks the 1980s as the birth of our contemporary conception of biotechnology, one dominated by genetics and genomics with great emphasis on the commercialization potential of these fields. He states, "Practically the entire period covered by this book so far could be considered as the 'prehistory' of

---

[4] Richard Lewontin, *The Triple Helix: Gene, Organism, and Environment*, Cambridge: Harvard University Press, 2000. P.55.

[5] Robert Bud, *The Uses of Life: A History of Biotechnology*, Cambridge: Cambridge University Press, 1993. P.1.

biotechnology, for only in the 1980s did biotechnology acquire internationally recognized significance. Certainly, it was then that the subject became an economic category, with careful measurements of national investments and outputs."[6]

This incarnation of biotechnology as an economic entity draws my attention as an artist and activist to the field. On a fundamental level, I find it very disconcerting for life to be conceived of and mobilized as a commodity. Certainly, my concern for this situation is inherently flawed and hypocritical, as the commodification of life is as old as the economy itself. In addition, I have benefited directly from this basic premise, as has everyone else on this planet. Animal husbandry (to obtain food, byproducts, and domestic pets) is an industry deeply entrenched in our civilization and an excellent example of accepted life commodification. My fear in regard to biotechnology is more specific. I worry about allowing economic gain to determine the research trajectories, applications, and outcomes of this revolutionary means of harnessing generational life with little consideration of the long-term biological implications. Though subject to alarmist language, and espousing a didactic rejection of all things biotechnological, Jeremy Rifkin would certainly agree:

> Several of the largest life science companies are extending their commercial activities to virtually every bio-industrial field. ... The increasing consolidation of control is alarming, especially considering that

[6] Robert Bud, *The Uses of Life: A History of Biotechnology*, Cambridge: Cambridge University Press, 1993. p.189.

> the biotech revolution will affect every aspect of our lives: the way we eat, the way we date and marry, the way we have our babies, the way our children are raised and educated, the way we work, the way we perceive the world around us and our place in it.[7]

The biotechnology we perpetuate today involves multifarious processes and orders of life. While my area of specialty is tissue culture and tissue engineering (a segment of regenerative medicine), but we can also look to fields such as in vitro fertilization, biological warfare, biometrics, genomics, and pharmacology in order to understand the far-reaching boundaries of contemporary biotechnology. With these advancements, we are manipulating manifold orders of life; plant, animal, human, partial-life[8] — cells, serums, bacteria, and plasmids — towards short-term economic gain. The market economy model, in a similar fashion as the scientific model, does not take into account those elements (such as irrationality or empathy) that reside outside of the systematic construct in which they are established and perpetuated. For example, human (or animal, plant, cell) indignity, pain, and suffering are not significant factors in reaching sound economic decisions. Also, if we look to more long-term considerations, economic gain is rarely judged against undefined ecological and humanitarian outcomes, as we clearly have little idea what will result from these invasive (and often

---

[7] Jeremy Rifkin, "The Biotech Century: Genetic Commerce and the Dawn of a New Era." from *LifeScience: Ars Electronica 99.* Stocker, Gerfried and Christine Schopf. Edits, New York: Springer-Verlang, 1999. p. 48.

[8] Oron Catts, and Ionat Zurr "Growing Semi-Living Sculptures" from *Leonardo Magazine*, MIT Press, Issue 35:4, August 2002, p. 366.

multigenerational) manipulations of the body. We seem to exhibit little foresight in imagining the possible ramifications of our biotechnological actions.

In addition to these general concerns linking life with economy, I am particularly focused on the lack of disclosure of biotechnological procedures and protocols to the general public. A culture of non-disclosure surrounds the biotechnological field, manifested by rampant over-specialization, instilled patent rights, and a competitive research community. Full communication of biotechnological procedures, protocols, and detailed risk-management reports is minimal. How can we, as a society, investigate, debate, and reach consensus about future biotechnological trajectories without full disclosure and general education? Or is it truly best to leave these decisions to businessmen, government officials, and scientists? It is my assertion that it is unethical to sever the general population from full knowledge of the products, legislation, and research that we are blindly and unconsciously supporting.

Both over-specialization in the field, and the dominance of economic interests in regards to biotechnology, contribute significantly to undermining public engagement in biotechnological research trajectories and debates. However, I see another important factor, that will serve as a central theme of *(RE)embodying Biotechnology*: the perpetuation of digital metaphors mobilized in the description and representation of biotechnology in public discourse. As I will outline in greater detail in chapter 3, I see a long trajectory of understanding, describing,

and mobilizing life based on metaphors generated by the latest technological revolution, be it the industrial revolution that spurred mechanistic models for conceiving of life as described by Lewontin:

> Such an analytic mode of understanding and study of biological systems, appropriate to a machine, is implied in the very word organism, first used in the eighteenth century. The analogy is between the living body and the musical instrument composed of separate parts that work together to produce a variety of final functions.[9]

Or perhaps the computational model that is applied in the description of all aspects of life, as elucidated by Gerfried Stocker:

> The post-human movement's pipe dream of soon being able to transform human beings into nomadic software entities takes an interesting turn in the emerging interpretation of the human body (or rather, all biological organisms) as wetware platform. Instead of the transformation of the human spirit into 0s and 1s, it is now the gigantic operation of the Human Genome Project which it is hoped will produce the decoding of the genome as the human operating system. And because we have learned so well over the long years of the digital information revolution to dress up everything in computer parlance, terminology like "the software of life" and

[9] Richard Lewontin, *The Triple Helix: Gene, Organism, and Environment*, Cambridge: Harvard University Press, 2000. P.72.

reference to the human genome as the "human being's operating system" are already solidly established.[10]

Along with Stocker, it is my fear that, with a continued investment in digital metaphors to describe biotechnology in public discourse, we are effectively undermining an ethical and reflective consideration of the various orders of life that function as the material basis of this technology. *(RE)embodying Biotechnology* undermines the use of these metaphors in describing biotech and, instead, propose and practice embodied language sets, embodied relationships, and moments of embodied reflexivity in the image, the representation, and the practice of contemporary biotechnology.

As a result, *(RE)embodying Biotechnology* is a reciprocal and hopefully dialogic text, which conceives of biotechnology as a pluralistic, ongoing process of manipulating life and manipulating ourselves, with an emphasis on social and political criticism. My efforts are focused on the democratization of biotechnology. I am proposing an interdisciplinary research / creation strategy for achieving this goal. My process includes participation in real hands-on laboratory practices, the production of complex artworks, and critical theorization and reflection. I believe that by participating in the biological sciences individual non-specialists can become empowered because they gain a new understanding of their ethical relationship to biotechnology. I am proposing an embodied,

[10] Gerfried Stocker and Christine Schopf. Edits. *LifeScience: Ars Electronica 99.* New York: Springer-Verlang, 1999. P.23.

empathetic, participatory, and populist-driven investment in analyzing proposed biotechnologies outside of primarily economic criteria. The intended outcome of my research / creation (my artistic practice, and *(RE)embodying Biotechnology*) is to allow you, the reader, to come to your own conclusions regarding the multiple ways biotechnological research is practiced today. My greatest criticism is not of biotechnology in general but of the poor and often misleading dissemination of information to the general public that effectively excludes individuals and communities from participating in determining the directionality of this significant technological revolution.

This research is influenced greatly by a form of thinking about science and technology proposed by the artist group Critical Art Ensemble (CAE). The introduction to *The Molecular Invasion* explains how this model evaluates biotechnological processes on a case-by-case basis.

> Each product or process has to be taken on a case-bye-case basis. Some appear disastrous (primarily to the environment), while others seem soundly engineered and useful. The real question of GMOs is how to create models of risk assessment that are accessible to those not trained in biology so people can tell the difference between a product that amounts to little more than pollutants for profit and those which have a

practical and desirable function, while at the same time having no environmental impact.[11]

Certainly, this specified investigation of each procedure and protocol amounts to a lot of work. But it is deeply important that we, as individuals and as a society, come to our own independent conclusions about the efficacy and ethics of biotechnological protocols.

Here, I am reminded of the image of Noam Chomsky surrounded by stacks of newspapers as part of his daily reading and research in the documentary *Manufacturing Consent: Noam Chomsky and the Media.* He states:

> The point is that you have to work. And that's why the propaganda system is so successful. Very few people are going to have the time or the energy or the commitment to carry out the constant battle that's required to get outside of Lehrer, or Dan Rather, or somebody like that. The easy thing to do, you know, you come home from work, you're tired, you had a busy day, you're not going to spend the evening carrying out a research project. So you turn on the tube, you say it's probably right, or you look at the headlines in the paper, and then you're watching sports or something. That's basically the way the system of indoctrination works. Sure the other

[11] Critical Art Ensemble. *The Molecular Invasion.* Brooklyn: Autonomedia, 2002. P.3-4.

stuff is there, but you're going to work to find it.[12]

Chomsky's critical attitude, prevalent throughout his lectures and publications, proposes that individuals take responsibility for their lives by doing their own research — outside of popular media, propaganda, and even his own assertions — to come to informed conclusions about social and political issues. The focus of *(RE)embodying Biotechnology* is to describe one enabling strategy that is akin to Chomsky's notion of 'work' to understand and arrive at independent conclusions about biotechnological protocols. Unlike Chomsky, my 'work' is not merely and analysis of news discourse. My 'work' is carried out from a hands-on perspective within the laboratory.

This position advocates a critical, participatory approach for engaging with biotechnology. It is the central thrust of *(RE)embodying Biotechnology* and reflects my continued investment in bioart production. I present a research / creation project from at least three different standpoints: personal, political, and artistic. The results include a written text, three appendices (including my personal lab notes), and documentation of my collaborative art practice over the past ten years. I mobilize a number of disciplinary perspectives (communication and media studies, anthropology, art history, creative writing, and contemporary

[12] Mark Achbar and Peter Wintonick, *Manufacturing Consent: Noam Chomsky and the Media*, 1992. 2:39:15

art production) towards an implicated ecological relationship with evolving biotechnologies.

The structure of the text itself reflects the varying verisimilitudes of conflicting arguments, hindsight, and grey areas that erupt as complications when engaging critically with bodies in biotechnology (although, despite this chaos, rationality is still significant to this dialogue). Most often, I choose to maintain a collected distance from what some may perceive of as 'the horror'[13] of life harnessed in the laboratory. This strategy of both breaking with the academic canon and strangely adhering to it is indicative of my general approach to research and production. With *(RE)embodying Biotechnology*, form assumes the qualities of subject or, more accurately, subjectivities. With the goal of educing Chomsky's 'work' in the reader, I reveal my own 'work' for your consideration.

Towards that end, let me provide a brief chapter outline. Chapter 2 provides an introduction into the gross over-specialization of the biological sciences, as well as the powerful significance of artists infiltrating the specialist class. In Chapter 3, I address the incursion of digital metaphors in describing the biotechnological sphere to the general public and introduce the reader to alternative language sets, propagating more implicated and embodied language for describing scientific protocols. Chapter 4 details the actualities of bioart production, with a case study of the exhibition *BIOTEKNICA: LiveLifeLab*, authored by myself and

[13] Joseph Conrad. *Heart of Darkness*. 1902; available online: URL: http://www.gutenberg.org/etext/526 [date of last access: 07/12/2008]

Shawn Bailey at the FOFA Gallery in Montreal in 2007. I have also included a copy of the video documentation from this installation, produced by Yen-Chao Lin, entitled *BIOTEKNICA: LiveLifeLab*. The concluding chapter discusses the results of this approach, as I have experienced and perceived them, and provides a more phenomenological understanding and engagement with biotechnology as an instance of implicated ecology. Lastly, I have chosen to include three appendices for further information and to better elucidate the 'work' involved in this kind of research. The appendices include: (1) my personal lab notes from the 2006 residency at SymbioticA, (2) a basic tissue culture protocol, and (3) a segment of the human research ethics application submitted by Shawn Bailey and myself to Concordia University in 2005.

Having presented a clear introduction to the concerns of *(RE)embodying Biotechnology* I wish to define two central concepts, biotechnology and the body. I will then describe my collaborative research / creation project *BIOTEKNICA*. This undertaking serves as a catalyst and case study for the re-embodiment of biotechnology and is essential to the foundations of this text.

Defining Biotechnology

I want to establish a working definition of biotechnology through the intersection of multiple texts in order to formulate a temporally and materially plural

description of the field. Outside of the humanities, biotechnology is typically understood in three different ways: (1) as a function of the economy, (2) in terms of disciplinary boundaries established in science and engineering, and (3) in terms of its techniques and protocols. I wish to touch briefly on all three of these understandings and put them in dialogue with research in the humanities so as to provide a more contingent reading of this complex field.

We have already encountered Robert Bud's contemporary definition of biotechnology, which links it to the economy: "...the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services."[14] This fairly common definition is mirrored in texts which have been developed by organizations in the financial and investment sectors. Another good example of this understanding is found in a text by The Organization for Economic Co-operation and Development: "The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services."[15] This definition captures some of the dominant ideologies that define biotechnology. However, I am critical of this economic reductionist understanding of bodies in biotechnology.

---

[14] Robert Bud, *The Uses of Life: A History of Biotechnology*, Cambridge: Cambridge University Press, 1993. P.1.

[15] Organization for Economic Co-operation and Development, "*Statistical Definition of Biotechnology.*" From OECD website; available online: URL: http://www.oecd.org/documentprint/0,3455,en_2649_34537_1933994_1_1_1_1, 00.html [date of last access: 10/10/2007]

From the perspective of science and engineering, definitions of biotechnology are often based on the boarders between the disciplines. For example, Health Canada relies on the definition of biotechnology proposed in the *Canadian Environmental Protection Act* of 1999. It describes biotechnology as "the application of science and engineering to the direct or indirect use of living organisms of parts or products of living organisms, in their natural or modified forms."[16] This perspective is quite common — and not without historical significance, as Robert Bud illustrates in his process of tracing the origins of contemporary biotechnology during the industrial revolution.

> The concept of biotechnology would, by contrast, integrate the contemporary ideal of manufacturing with visions of humanity and its environment, and a faith in the privileged view of life. Though it is perhaps surprising to find the metaphor of the machine relevant even to organic philosophers, for them the machine became a symbol of the system that was more then the sum of its parts and has an irreducible character of its own. Thus, both the severely mechanistic models of biological organisms were endowed with some special organizing or developmental character not available to man-made systems, yielded concepts of biotechnics.[17]

---

[16] Health Canada, "*About Biotechnology.*" From Health Canada website; available online: URL: http://www.hc-sc.gc.ca/sr-sr/biotech/about-apropos/index_e.html [date of last access: 10/10/2007]

[17] Robert Bud, *The Uses of Life: A History of Biotechnology*, Cambridge: Cambridge University Press, 1993. P.52.

This perception of biotechnology reduces the biotechnological manipulation of life to a mechanical action, defined by the boundaries of established disciplines.

The previous example comes from public policy documents, but this tendency also occurs in scientist's description of their own actions. In the book *The Second Creation: Dolly and the age of Biological Control*, Dr. Ian Wilmut[18] defines biotechnology in a similar fashion — as an intersection of disciplines with emphasis on the contribution made by the hard sciences.

> Technology without Science is, well technology: stone tools, windmills and mud huts. Technology with science is "high technology"; "high tech" is the technology that emerges from science. "Biotechnology" is high tech of a biological nature: genetic engineering and cloning are prime examples.[19]

Wilmut's colloquial definition of biotechnology is likely intended for mass audiences. I would argue, however, that there is a distinctly partisan scientific viewpoint expressed in this quotation, simultaneously claiming biotechnology and other 'high' technologies for the sciences and deploying highly optimistic, promotional language sets in persuading the general public of the intrinsic merits of biotech.

---

[18] (Head of the research consortium at The Roslin Institute responsible for generating the first cloned mammal Dolly the sheep in 1997)

[19] Ian Whilmut, Keith Campbell, and Colin Tudge, *The Second Creation: Dolly and the age of Biological Control.* Cambridge: Harvard University Press, 2000. p. 10.

One other discursive tendency is to define biotechnology by its techniques, procedures, and protocols. For example, the *Cartagena Protocol on Biosafety* authored by the Convention on Biological Diversity (2004) relies heavily on the idea of technique in defining the field:

> (i) "Modern biotechnology" means the application of:
>
> a. In vitro nucleic acid techniques, including recombinant deoxyribonucleic acid (DNA) and direct injection of nucleic acid into cells or organelles, or
>
> b. Fusion of cells beyond the taxonomic family,
>
> that overcome natural physiological reproductive or recombination barriers and that are not techniques used in traditional breeding and selection;[20]

Contemporary definitions of biotechnology such as these often prioritize genetic manipulation as a central component of the field. Another example of this type of technical emphasis is this rudimentary definition provided by Stephen Heuser in his article "What is Biotechnology?" published in the *Boston Globe*:

> In a strict sense, it means altering live cells and putting them to work. By

[20] The Cartagena Protocol on Biosafety, "*Article 3. Use of Terms.*" From The Convention of Biological Diversity website; available online: URL: http://www.cbd.int/biosafety/articles.shtml?a=cpb-03 [date of last access: 10/10/2007]

> splicing new genes into the DNA of bacteria or other organisms, scientists can program them to make drugs. They can also introduce new genes into crops and create microbes that produce industrial chemicals.
>
> More broadly, biotech embraces a spectrum of medical science, from sophisticated biochemistry to machines that can build new DNA. In the business world, the term "biotechnology company" is often shorthand for any small or start-up pharmaceutical firm.[21]

Although these statements come from two very different types of documents, they are similar because of their reduction of biotechnology to technique alone.

I am critical of this reductionism for two reasons. First, technique-based definitions of the biotechnological field often suffer from 'genohype,'[22] which places overwhelming significance on genetics and genetic manipulation as the defining features of an otherwise very diversified field. Second, technique-based definitions tend to eliminate the social, political, and economic factors that also work to constitute biotechnology in its contemporary manifestation.

---

[21] Stephen Heuser, "*What is Biotechnology?*" From *The Boston Globe* website; available online: URL: http://www.boston.com/business/technology/biotechnology/articles/2007/05/06/what_is_biotechnology/ [date of last access: 10/10/2007], May 06, 2007.

[22] Neil A. Holtzman, "*Are genetic tests adequately regulated?*" *Science*, 286 (4539), pp. 409-410, 1999.

If we look to the debates in the philosophy of science, we can find an alternative vision of biotechnology. In these discourses there is a tendency to explain the social and political factors that structure and influence the field. This perspective, for example, informs Paul Brodwin's introduction to *Biotechnology and Culture: Bodies, Anxieties, Ethics*:

> The word "biotechnology" denotes much more then material devices, designed for specific medical functions. It also includes the techniques for using them: the background practices and treatment rituals in which a given device acquires its meanings. The value and meaning of biotechnologies, like those of all manufactured objects, are not inherent properties but rather judgments made by people who use them (Appadurai). These judgments arise first among the laboratory researchers who fashion the technology and their colleagues and financial supporters (for example Rainbow). The judgments continue in the clinic as people gradually master a new instrument or machine, routinize it as a standard therapy, and embed it in the complex negotiations among health care workers, patients, their families, insurers and others. Finally, certain biotechnologies become powerful public symbols even for those who never directly encounter them.[23]

I am very interested in the perspective offered by Brodwin, as it allows for individual and community contributions to an otherwise 'technical field.'

---

[23] Paul E. Brodwin, (edt) *Biotechnology and Culture: Bodies, Anxieties, Ethics*, Bloomington and Indianapolis: Indiana University Press, 2000. P.2.

In other contemporary critical circles biotechnology is often read with an emphasis on the intersection of the biological sciences with computation. In *The Biotech Century: Harnessing the Gene and Remaking the World*, Jeremy Rifkin argues for the importance of the conjunction of "the genetic revolution and the computer revolution"[24] with molecular biology, as well as the expanding field of bioinformatics, as central to his definition of biotechnology. Another noted critic, Eugene Thacker, places similar significance on digital technologies in his definition of biotechnology in *Data Made Flesh: Biotechnology and the Discourse of the Post Human*. He states, "When we consider advances in these fields, it becomes apparent that what characterizes biotech is a unique relationship between the biological and the informatic."[25] I would certainly agree that the conjunction of genetics with computation in molecular biology is of cornerstone significance; Thacker and Rifkin (amongst others) provide insightful descriptions and analysis of this important intersection. However, I am concerned by the overarching dominance of bioinformatics in defining the entire field of biotechnology, as well as the prioritization of only the most contemporary incarnations of biotech in describing a set of practices that have evolved over hundreds of years. As was the case for mechanical models during the height of industrialization, I see us applying our most recent technological paradigm,

---

[24] Jeremy Rifkin. *The Biotech Century: Harnessing the Gene and Remaking the World.* New York: Tharcher/Putnam, 1998.p. xv.

[25] Eugene Thacker. "Data Made Flesh: Biotechnology & the Discourse of the Posthuman", Cultural Critique 53 Available online: URL: http://www.upress.umn.edu/journals/cc53.html [date of last access: 08/01/2005]

computation, to the description of the nature of all things — including living systems — in the present, past, and future.

I advocate for an understanding of biotechnology that reflects the long history of biotechnological experimentation that has been conducted by humankind. If we look to the example established in *A Feeling for the Organism: The Life and Work of Barbara McClintoch*, Evelyn Fox-Keller reminds us that the biological sciences — specifically, the field of genetics — proved successful in explaining complex natural phenomena like heredity, mutation, and transposition, by utilizing pre-digital observational methodologies of inquiry.[26] I suggest we look to other instances in the history of the instrumentalization of biology prior to the advent of mass computation in the sciences — for example, tissue engineering, in vitro fertilization, selective breeding, pasteurization — before we embrace biotechnology as the intersection of computation with biology. Although we see that the digital is indispensable for recording, documenting, and modeling such experiments, I propose that we look to contemporary practices of biotechnological research where laboratory protocols are not dictated by computation but rather by biological practices that are practical, tangible, and accessible.

I am interested in applying the theoretical understanding of technology proposed by Jennifer Daryl Slack in *Rethinking Communication Vol. 2 Paradigm Exemplars*

---

[26] Evelyn Fox-Keller. *A Feeling for the Organism: The Life and Work of Barbara McClintock.* New York: Henry Holt and Company, 1983. p. 181.

in order to better describe this complex field. In the chapter, "Contextualizing Technology," she states:

> "... that a technology is not simply an object connected in various ways to the institutional and organizational structures from within which it emerges to be reconnected in a new context, but that it is always an articulated moment of interconnections among the range of social practices, discursive statements, ideological positions, social forces, and social groups within which the object moves.[27]

Taking this definition of technology into consideration, my overarching definition of biotechnology becomes far more contingent and temporal; it becomes less focused on a description of the techniques involved and more focused on understanding biotechnology as an intersection between a variety of interests and agents. This understanding, in conjunction with the methodology proposed by Critical Art Ensemble (from the general to the very specific analysis and understanding of biotech), opens up the possibility for a dialogic or complexity-driven engagement with the pluralism that constitutes biotechnology today.

Slack's definition can be expanded further to develop a description of biotechnology. Here, the 'so called' object of biotechnology is not a stable entity

---

[27] Jennifer Daryl Slack. "Contextualizing Technology" from *Rethinking Communication vol. 2 Paradigm Exemplars.* Brenda Dervin, Lawrence Grossberg, Barbara J. O'Keefe, and Ellen Wartella edts. Bervily Hills: Sage Publications, 1989. p.339.

— it is not only moving but growing, pulsating, living, and dying as it moves through other forces. Thacker draws our attention to this very point. He says, "Biotech research is unique in that, on the one hand it employs the technologies common to other posthuman fields (principally, computer/information technologies), but on the other hand, its constant 'object' of study is the domain of the biological (a domain traditionally set apart from the technological)."[28] His work with the notion of biomedia will prove to be of great value in this regard, but requires tweaking to suit my purposes. The understanding of biotechnology that I propose resides at a shifting intersection of life forms with time, place, ideologies, and intentionalities in perpetuating a technology of living systems: a techno-ecology.

Understanding the Body

Ironically, one of the first step towards re-embodying biotechnology must begin with language. From my perspective, we need to reconceptualize biotechnology as a technology of living systems — a technology of bodies. For this definition to operate successfully, we must expand our understanding of a body to include multiplicities of bodies — the human body, the animal body, a body of water, bodies within the body, even antibodies. This expanded definition of the body has echoes in the work of Elizabeth Grosz.

---

[28] Eugene Thacker. "Data Made Flesh: Biotechnology & the Discourse of the Posthuman", Cultural Critique 53 Available online: URL: http://www.upress.umn.edu/journals/cc53.html [date of last access: 08/01/2005]

In *Volatile Bodies: Towards a Corporeal Feminism* she argues that the mind/body dualism prevalent throughout philosophy must be refigured for feminist purposes. She states, "misogynist thought confines women to the biological requirements of reproduction on the assumption that because of particular biological, physiological, and endocrinological transformations, women are somehow *more* biological, *more* corporeal, and *more* natural than men."[29] She proposes that we mobilize the body through a range of desperate discourses that are not restricted to naturalist and scientific models. She suggests, "A plural, multiple field of possible body "types", no one of which functions as the delegate or representative of the others, must be created, a "field" of body types – young and old, black and white, male and female, animal and human, inanimate and animate – which, in being recognized in their specificity, cannot take on the coercive role of singular norm or ideals for all the others."[30] Grosz's philosophy is convincing. With a shift in the definition of the body towards a plural and multiple field of possible bodies, we can begin to imagine animal bodies, chimera bodies, bacterial bodies, even scientist and non-specialist bodies as key participants in biotechnology. Additionally, she doesn't see the body as just flesh, but as a semiotic factor – a body of language.

I am also interested in Donna Haraway's critical conceptualization of the cyborg likewise incorporates bioinformatics into the biotechnological body fold. Haraway

---

[29] Elizabeth Grosz, *Volatile Bodies: Towards a Corporeal Feminism.* Australia: Allen & Unwin 1994. p.15.
[30] *ibid.* p.22.

is important because she understands the implications of bioinformatics in current conceptions of the body. Just as I am arguing that it is a great oversight to conceive of the bodies in biotechnology as primarily informatic and therefore virtualized, I maintain that it would also prove a grave oversight not to acknowledge the power of computational and technological components of the bodies in biotechnology. Haraway defines the cyborg as such:

> A cyborg is a hybrid creature, composed of organism and machine. But, cyborgs are compounded of special kinds of machines and special kinds of organisms appropriate to the late twentieth century. Cyborgs are post-Second World War hybrid entities made of, first, ourselves and other organic creatures in our unchosen 'high-technological' guise as information systems, texts, and ergonomically controlled labouring, desiring, and reproducing systems.[31]

Like Haraway, I am focused on developing a plural field of bodies – animal, human, semi-living, cellular, and even hybrid bodies, operating in the biotechnological domain. As Haraway argues, "Cyborg imagery can suggest a way out of the maze of dualisms in which we have explained our bodies and our

---

[31] Donna Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature.* Routledge: New York, 1991. P.1.

tools to ourselves. This is a dream not of common language, but of a powerful infidel heteroglossia."[32]

Though a deeply important task, shifting the language surrounding biotechnology in the media, classrooms, and hospitals from one of pure programming to a language of plural embodiment may also prove damaging to progress in other areas of ethics and human rights — particularly for women, in regard to abortion. In arguing for a widespread acknowledgement of the bodies in biotechnology, I may be inadvertently contributing to pro-life arguments in the public debate about abortion and reproductive technologies. If my argument for a plural field of bodies is misinterpreted as a 'vitalist' assertion, then one might assume that I am also arguing against the death or termination of all orders of life — against actions such as abortion. Rather than 'vitalism,' I see my arguments as more closely aligned with a sort of 'organicism.'

Donna Haraway aptly outlines the distinguishing factors between these conceptualizations of life in *Crystals, Fabrics, and Fields: Metaphors that Shape Embryos*:

> Vitalism and organicism share basic questions and positions. From a negative point of view, both maintain that the study of parts does not suffice to explain the study of the whole. The methods and conclusions of other sciences, in particular physics and chemistry, are held to be

[32] *ibid.* P.181.

applicable to organisms but radically insufficient. Second, the form of the whole is important in embryological development, animal behavior, reproduction, and physiology. By whatever means, the properties of the whole are essential in determining the nature and behavior of the parts at each stage in the life cycle as vice versa. Last, both organicists and vitalists stress the teleological behavior of organisms: there is at least the appearance of goal-directedness and design in biological phenomena.[33]

She continues,

> Nevertheless, organicists and vitalists differ fundamentally on where they locate the root of wholeness and consequent regulative behavior of organisms. Vitalists of all hues assert some non-physical entity – either a nonquantifiable vital force like Driesch's entelechy or some basic difference between "vital substance" and ordinary matter. Organicists insists on wholeness, directedness, and regulation can be explained fully without such notions.[34]

The distinction between vitalism and organicism is important to my argument. Though I am suggesting that we embrace a wide notion of possible bodies within the laboratory site, I am not suggesting that we in turn apply the notion of a 'vital force' or 'soul' in our understanding of these bodies.

---

[33] Donna Haraway, *Crystals, fabrics, and Fields: Metaphors that Shape Embryos.* Berkeley, California: North Atlantic Books, 1976, 2004. p.33.
[34] Donna Haraway, *Crystals, fabrics, and Fields: Metaphors that Shape Embryos.* Berkeley, California: North Atlantic Books, 1976, 2004. p.34.

My intention is to acknowledge and draw public attention to these issues so that they may be viewed outside of didactic models and anthropocentrism in order to illustrate the significance of all the bodies intersecting at the site of biotechnology. I wish to consider each cell, plant, ecosystem, and animal (and, by extension, each patient and fetus) an emergent body of varying verisimilitudes in interaction with other bodies; I wish to consider each body — sometimes growing, sometimes dying — as life. In addition, the end of life should not be seen as an intrinsic failure, or as something to be avoided at all costs, but as a significant and acceptable component of the life cycle. I am arguing that we need to truly embrace the murky, messy, and sometimes violent processes of living. I am suggesting that we take a moment to 'look our meat in the eye'. I am suggesting that we create a site, and a body of language, that invites the public to formulate their own complex opinions and understandings about each specific technological practice in the field of biotechnology. If we can adopt this notion of an embodied technology, we are more likely, as a society, to formulate responsible, informed, and grateful attitudes to the consequences resulting from our choices.

In *Beyond the Body of Bioethics: Challenging the Convention*, Margrit Shildrick challenges conventional bioethical strategies. She argues that we need to embrace increasingly fluid and contingent strategies of interpreting the ethics of

the body. The first component of her argument suggests that, with evolving models for understanding the body in humanities-based circles, we have already relinquished an oversimplified, fixed definition of the body, that is central to conventional ethical (and often moral) evaluation.

The second important point she makes is in regards to interpreting the ethic of biotechnologies, the very locus of interpretation — biotech — is itself producing contingent and multiple incarnations of the body and therefore requires pluralistic treatment. Shildrick suggests:

> The problem with – and, I would argue, the relative limitations of mainstream bioethics is that its concentration on issues such as choice and consent, property interests, rational decision making, and equality of access still relies on the traditional ethical model in which the ultimate determinants of moral agency are individuality and rationality. It is not that these things are unimportant, but that they are rooted in a world that is being radically transformed by the capacities of bioscience to very and extend the hitherto limited things of which bodies seem capable. Where once the material body could be taken as relatively stable and predictable (although postmodernists would argue that has always been an illusion), the technological possibilities of a postmodern age - and this is especially clear in the area of reproduction and genetics – continually disrupt humanist certainties.[35]

---

[35] Margrit Shildrick, "Beyond the Body of Bioethics: Challenging the Conventions." From Ethics of the Body: Postconventional Challenges, M.

Shildrick argues that traditional notions of ethics are based on liberal humanist beliefs, such as liberty and equality, that rely on binary notions: the division between mind and body, subject and object, right and wrong.[36] In the process of introducing an array of papers analyzing ethics and the body in the biotechnological age, Shildrick instead proposes a multifold (and sometimes contradictory) approach to bioethics in order to better reflect the transient nature of the body in the biotechnological age. I am particularly interested in her work for its dialogical model of engaging in bioethics as it applies to biotechnological bodies and its relevance to my ongoing collaborative art/research project, *BIOTEKNICA*.

BIOTEKNICA[37]

From 2000 until 2007, Shawn Bailey and I developed a collaborative research / creation project called *BIOTEKNICA*.[38] Our initial focus was an artistic and

---

Shildrick and R. Mykitiuk Edts. Cambridge and London: The MIT Press. 2005 p.9.

[36] *ibid* p.5.

[37] A large portion of the following BIOTEKNICA description is taken from various papers published collaboratively by myself and Shawn Bailey between 2000-2007. All other portions of this thesis are singularly authored by myself, Jennifer Willet.

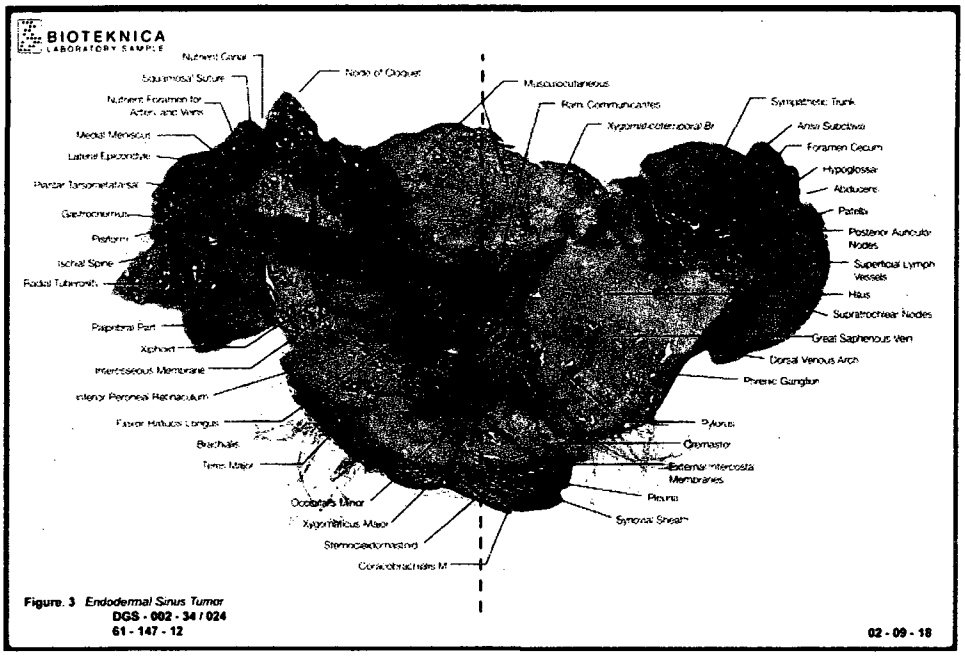
[38] BIOTEKNICA was a two-person artist collective that produced a variety of performances, artworks, and academic papers and lectures. Our collaborative research was funded by The Canada Council for the Arts, the Conseil des arts et des lettres du Québec, and Hexagram, amongst others. Most notably, we received three year funding from The Social Science and Humanities Research Council of Canada in 2005 (S.Bailey principle researcher, J.Willet collaboraitor) for *BIOTEKNICA: Organic Tissue Prototypes*. All works produced by BIOTEKNICA members are 50% co-authored by both parties. BIOTEKNICA

academic investigation of the corporate representation of biotechnology in the public sphere, with the application of media studies as well as methodologies of social and political criticism. We began by looking at a number of biotech websites, advertising campaigns, and printed material. It became immediately clear to us that the representation of biotechnological research as propagated by most biotech firms provided the general public with generalized, sterilized, technologized, and sometimes even euphemistic images of biotechnology, often overlooking or even misrepresenting the specific nature of the procedures and protocols which make use of living systems. In other words, we saw a great disparity between the public representation of biotechnology and the actual nature of the various biotech research trajectories. We sought to rectify this schism through the development of our own artistic and theoretical practice, where we created a fictitious corporation called *BIOTEKNICA* in order to house a variety of avant-garde art actions, research trajectories, and an extensive photographic archive, all of which provided alternative representations of the bodies in biotechnology outside of the prescribed corporate dictum.

---

has been exhibited in various forms including the EnterMultimediale festival, Prague (2007), FOFA Gallery, Montreal (2007), ISEA San Jose, USA (2006), Biennial Electronic Arts Perth Perth, Australia (2004), The European Media Arts Festival Osnabrück , Germany (2003), La Société des arts et technologiques (SAT) Montreal, Canada (2005), and The Forest City Gallery London, Canada (2004), amongst others. In addition BIOTEKNICA has been presented in interviews and conferences at multiple venues across Canada, and in France, Australia, Scotland, Germany, Czech Republic, Serbia, Bulgaria, Turkey, Slovenia, Australia and Spain. BIOTEKNICA research has been conducted during residencies at The Banff Centre for the Arts Banff, Canada (2002, 2007), and SymbioticA, The University of Western Australia, Perth, Australia (2004, 2006).

We sought an imaginary biotechnological product that would serve as a locus for a subjective (and sometimes ironic) vision of the biotechnological body. This desire led us to a particularly important and grotesque object of biotechnological study: the teratoma. (*fig.*1.) A teratoma is an abnormal and monstrous tumor, quite often cancerous and metastasizing in the body of a host organism (whether human or animal). It is also an important site of numerous biotechnological investigations conducted by governments and corporations. The teratoma is a pluripotent germinal cell tumor, in that its cells differentiate as they divide and proliferate, much like a fetus. However, the teratoma differs from a fetus in many ways. A teratoma requires no instance of fertilization to commence growth. Though most often found in the reproductive organs, a teratoma can manifest itself throughout the body, whether fetal or adult. As well, the appearance of a teratoma differs significantly from a healthy fetus in its irrational and grotesque construction. Though a teratoma is almost genetically identical to its host organism, and contains an assortment of 'normal' tissues such as skin, nails, hair, and teeth, its structure is confused, asymmetrical, and dysfunctional. One of our viewers once described the teratoma as having the appearance of a "baby in a blender."



(*Fig.*1.)

Shawn Bailey and Jennifer Willet
BIOTEKNICA: Teratoma Anatomy
Digitally Generated Duratrans
2004

In her insightful book *Teratologies: A Cultural Study of Cancer,* Jackie Stacey equates these irregular cysts with little monsters — a virgin conception of sorts, deep within the bowels of the human body.[39] Stacey looks to films like *The Fly*, *Rosemary's Baby*, and *Aliens* to understand how the little-known teratoma is interpreted outside of its clinical setting. Her interest in the teratoma lies in its metaphoric qualities in terms of the grotesque, the slippage between traditional self/other distinctions, notions of disease, and the healthy human body. On a more personal level, the teratoma holds great significance for Stacey as she had one removed from her ovary in 1991.

---

[39] Jackie Stacey, *Teratologies: A Cultural Study of Cancer.* New York: Routledge, 1997. P.60.

In some scientific circles, the teratoma is interpreted as an instance of cloning in nature, however non-viable, that has the potential to provide valuable information towards understanding and instrumentalizing parthenogenesis (the development of a fetus from an unfertilized egg).[40] In addition, there is great interest in teratomatic tumors that form outside of the reproductive organs, as their location suggests that a process of reverse cellular differentiation has occurred in order to provide an otherwise differentiated cell with capabilities similar to those of a stem cell. Other people, particularly a growing number of fundamentalist Christian rights advocates, see the teratoma as a possible ethical source for harvesting stem cells for research. It is their argument that the teratoma, unlike a fetus, will never result in a live birth and thus does not possess a soul. Dr. William Hurlbut, a physician and consulting professor at Stanford University and a member of the U.S. President's Council on Bioethics, leads this proposition in American political debates.[41] In May 2005, the council published the "White Paper: Alternative Sources of Pluripotent Stem Cells," which includes a section investigating the efficacy of Hurlbut's proposal to create 'biological artifacts' rather than organisms in order to harvest viable stem cells. The report states:

ANT, the modified procedure proposed by Hurlbut, involves altering the

---

[40] Advanced Cell Technology, *Press Release: Researchers Develop Specialized Cell Types From Embryonic Monkey Stem Cells,* Advanced Cell Technology corporate website; no longer available online URL: http://www.advancedcell.com/press.htm [date of last access 02/05/2002]

[41] Clive Thompson, "How to Farm Stem Cells without Loosing your Soul" in Wired Magazine, Issue. 13.6, 2005: Available online: URL: http://www.wired.com/wired/archive/13.06/stemcells.html [date of last access: 15/07/2007]

somatic cell nucleus *before* its transfer to the oocyte, and in such a way that the resulting biological entity, while being a source of pluripotent stem cells, *would lack the essential attributes and capacities of a human embryo.*

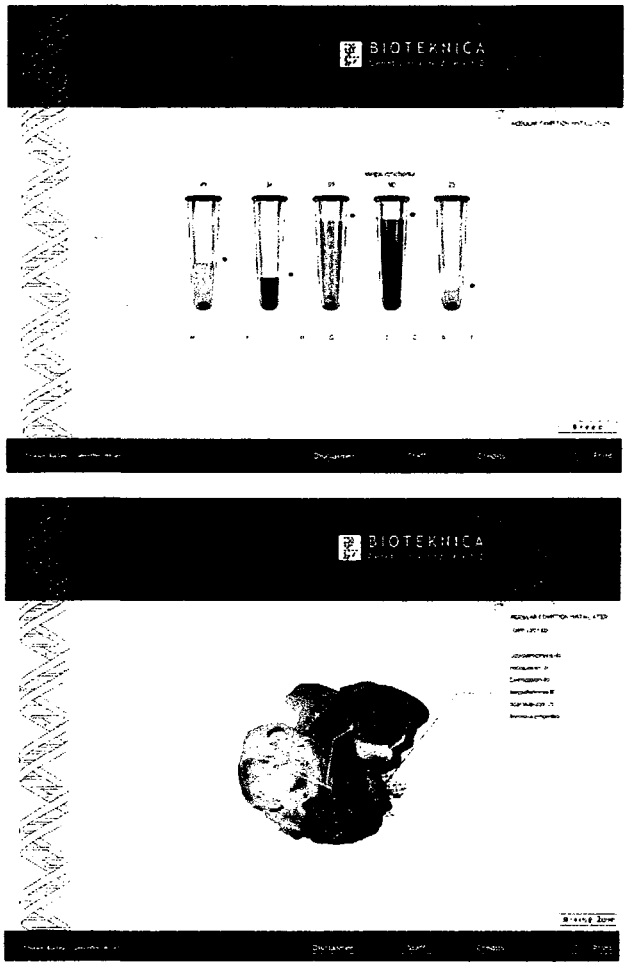
In offering his proposal for ANT, Hurlbut emphasizes that no embryo would ever be created or destroyed; since the genetic alteration is carried out in the somatic cell nucleus before transfer, the biological artifact is "*brought into existence* with a genetic structure insufficient to generate a human embryo." Hurlbut compares the product of ANT to certain ovarian teratomas and hydatidiform moles, genetically or epigenetically abnormal natural products of failed fertilization that are not living beings but "chaotic, disorganized, and nonfunctional masses." If, as Hurlbut suggests, the biological artifact is ethically equivalent to a tissue culture, teratoma, or mole, there would seem to be nothing ethically problematic about harvesting stem cells from it.[42]

With these debates in mind, we deployed the teratoma as a real object of biotechnological research and, simultaneously, as an ironic and monstrous product in the production of *BIOTEKNICA*.

---

[42] The President's Council on Bioethics, "WHITE PAPER: Alternative Sources of Pluripotent Stem Cells." Available online: URL: http://www.bioethics.gov/reports/white_paper/text.html [date of last access: 10/10/2007]

In order to support the hoax that was our corporate presence in the public sphere, we produced a series of written and visual documents. We developed a website, a corporate video, and a promotional brochure. In 2004, with the assistance of artist/programmers David Bouchard and David Jhave Johnston, we developed the first functional interface for the *BIOTEKNICA Virtual Laboratory.* In the virtual laboratory (*Fig.*2.), users are provided with a laboratory interface (mixing zone), consisting of a number of empty vials which can be filled with varying amounts of 'bodily' fluids to concoct a unique teratoma. Each vial is identified by terminology of our own creation, invented to seem scientific: osteogenicphysis, histiopioesis, dermaplasm, megalytrichoma, scaroadipocyte. To any specialist, the language is clearly fraudulent and confused but, in the public sphere, the non-specialist user interprets the interface as interactive, however inaccessible in its scientific content. This body of work was intentionally presented in an ambiguous fashion — sometimes in the context of art, and at other times as factual representation of a growing biotech firm. The purpose of these representations was to illicit a response from the viewer based on their perceptions of *BIOTEKNICA* in a variety of different situations.



(*Fig.*2.)

Shawn Bailey and Jennifer Willet
BIOTEKNICA Virtual Laboratory
CDROM and Website
2004

As we began to receive and interpret viewer responses, we looked to develop new and more visceral corporeal models for our teratoma product line so as to shift the project towards a directed bodily engagement between the viewer and the teratomatic product line. The clean, cool design and the confident corporate voice proved to have a serializing effect on the otherwise grotesque content of

the work. The visceral and unruly nature of these technologies, these artistic pieces, and the instrumentalization of the biological in biotechnology became compartmentalized and diluted by the corporate overtones. Our corporate presence — even with the inclusion of monstrous teratoma images — was arguably too successful, too convincing, further contributing to the prescribed reification of corporate goals as an established value set in evaluating evolving biotechnologies. This reaction was counter-productive to our objective of encouraging the viewer to develop their own conclusions about the efficacy of the technologies, procedures, and protocols presented.

To remedy this perceived problem of reception, we decided to introduce the viewer's body to the biotechnological body in a phenomenological manner. With the assistance of artist and designer Kevin Finlayson, we developed a series of meat sculpture product lines, utilizing store-bought animal products, synthetic wigs, and sewing materials to mimic the appearance of the teratoma. We designed the sculptures with numerous parts of various animals that can be purchased at the butcher or grocery store. These fist-sized sculptural chimeras could contain a chunk of beef tripe, a lamb's kidney, some unshaven pork-belly, a bisected chicken, or a heart turned inside-out in order to suggest an actual teratoma. The life-sized sculptures were presented frozen in sterile bags, freeze-dried on a silica bed, or refrigerated in laboratory glassware containing suspensions of formalin. Each presentation mobilized a visceral and corporeal reaction in the viewer — often somewhere between fascination and disgust.

In conjunction with the meat sculptures, we designed a performance called *BIOTEKNICA Public Autopsy* (*fig.*3.), where we performed public dissections of the specimens in the tradition of Rembrandt's *The Anatomy Lesson of Dr. Tulp* (1632) and Dr. Günter von Hagens' public autopsy in London's *Atlantis Gallery* (2002). This strategy proved quite successful; the performed surgeries were convincing in their appearance. However, these performances were also destabilized by the very context of their performance (galleries, public venues, raves, university art laboratories) as well as by the content conveyed, whether verbally, through costume, or media representation. These events provoked more questions than answers in their propagation — something that we found to be inherently necessary in their production of affect in the viewer.

In addition to the representational strategies deployed by the meat sculptures, we sought a 'real' and actualized participatory relationship with the very technologies we were representing and theorizing. In 2003, we met Oron Catts and Ionat Zurr of Tissue Culture and Art Project (TC&A)[43] at The European Media Arts Festival (EMAF) in Osnabrück, Germany. They invited us to submit an application for a residency at SymbioticA: The Art and Science Collaborative Research Centre[44], in the School of Anatomy and Human Biology at The University of Western

[43] Oron Catts, Ionat Zurr, *The Tissue Culture and Art Project*, artist website; available online: URL: http://www.tca.uwa.edu.au/ [date of last access: 01/01/2005]

[44] SymbioticA: The Art and Science Collaborative Research Laboratory institutional website; available online: URL: http://www.symbiotica.uwa.edu.au/ [date of last access: 01/01/2005]

Australia. Catts and Zurr pioneered the use of tissue culture (TC) and tissue engineering (TE) in the production of contemporary art.

(*Fig.*3.)

Shawn Bailey and Jennifer Willet
BIOTEKNICA Public Autopsy
The University of Victoria
CDROM and Website
2004

In 2000, TC&A artists (Oron Catts, Ionat Zurr and Guy Ben-Ary) developed a seminal work entitled *Tissue Culture and Art(ificial) Womb,* also known as *The*

Process of Giving Birth to Semi-Living Worry Dolls. (*fig.*4.) More widely know as *The Semi-Living Worry Dolls*, the work is comprised of a series of sculptures created utilizing tissue engineering technologies, set in a complex mobile (and biologically self-contained) laboratory environment. Oron Catts and Ionat Zurr have since continued with TC&A producing a number of important works involving tissue culture protocols, including *Pig Wings*, *Disembodied Cuisine*, *Victimless Leather*, and *Extra Ear 1/4 Scale* in collaboration with Stelarc. In addition, Oron Catts is Artistic Director of SymbioticA where, working with Dr. Stuart Bunt and Dr. Miranda Grounds, artists are invited to learn new techniques, facilitating the production of works that blur the boundaries between art and science. Catts and Zurr attribute great significance to training others in biotechnological techniques, consequently bringing more non-specialists into the fold. Their efforts to share these knowledges with others has culminated in the newly established SymbioticA Biotech Art Workshop, co-operated by Oron Catts and Gary Cass. A work of art in and of itself, this event provides hands-on, personal experience for artists, allowing them to work with techniques of DNA extraction, plant and animal tissue culture, bacteria plating, and genetic transformations.

(*Fig.*4.)

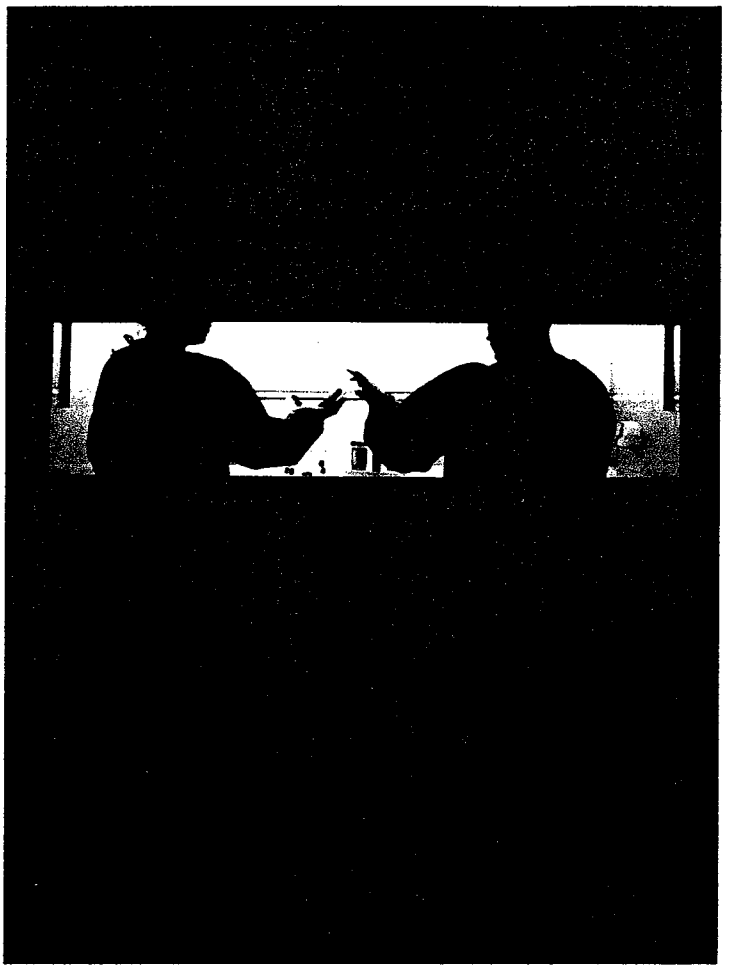
Tissue Culture & Art Project
The Process of Giving Birth to Semi-Living Worry Dolls
2000

With our proposed residency at SymbioticA, we wished to learn from their expertise and develop TE sculptures of our *BIOTEKNICA* teratomas, thus bringing our theoretical specimens out of their digital environment and into the laboratory in a critical, participatory manner. In our initial proposal, we postulated a series of three-dimensional tissue prototypes modeled on the teratoma-containing human tissue extracted from Shawn Bailey's body, though later

expanded our plans to include the use of animal cell lines in the production of this work.

In 2004, we commenced work for four months as Research Fellows at SymbioticA. Here, we proposed the development of a new work called *BIOTEKNICA: Organic Tissue Prototypes* as a representation of the *BIOTEKNICA* teratoma product line. These pieces consisted of three-dimensional polymer scaffolds, structurally crafted in order to match the irrationality manifested in the teratoma. The structures were completed with the application of tissue-engineering protocols in seeding and filling the matrices with living tissue.[45] During this time, we developed skills and strategies that allowed us to grow the prototypes from animal cell cultures with the assistance of TC&A (Catts, Zurr), as well as Professor Stuart Bunt, Dr. Stuart Hodgetts, Guy Ben-Ary, Cynthia Verspaget, Kira O'Reilly, Gary Cass, and Jane Coakley. (*fig*.5.)

[45]Some of our prototypes were seeded with P19 (a mouse teratoma cell line) and the 3T3 mouse fibroblast cell line. In the future we look forward to growing others with cells taken directly from the artist's (Bailey's) body through a shave skin biopsy procedure.



(*Fig.*5.)

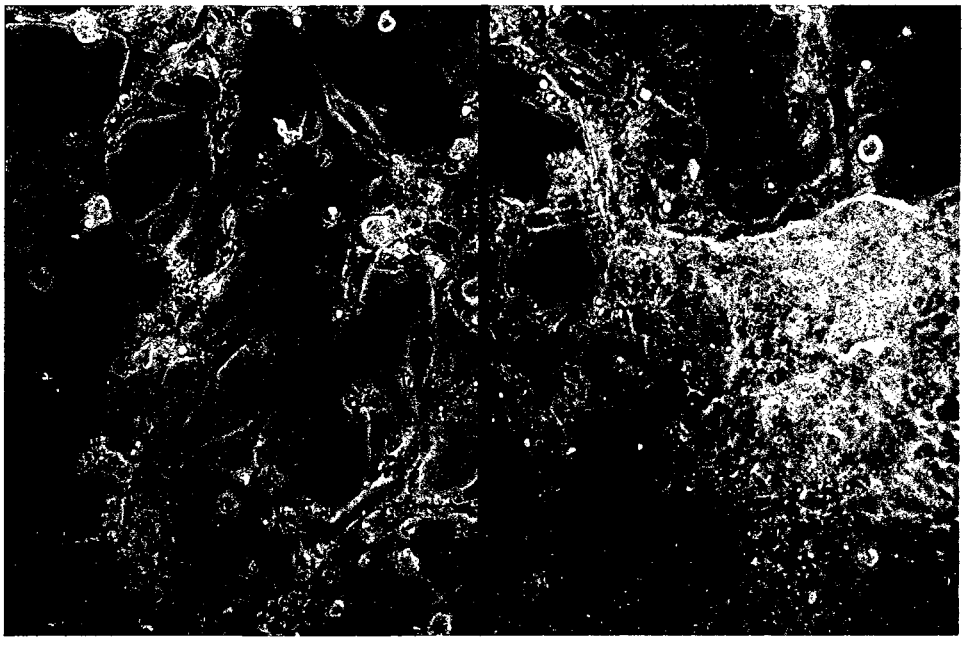
Shawn Bailey and Jennifer Willet
BIOTEKNICA Laboratory Documentation
SymbioticA, The University of Western Australia
2006

We began tissue culture training by growing pre-existing cell lines 3T3 (mouse fibroblast) and P19 (mouse teratoma) in the laboratory. Cell lines are isolated cells that have been developed for research purposes and are able to divide indefinitely when given the appropriate environment in a laboratory. For instance, the 3T3 cell line, established by Todaro and Green in 1962, is derived from fibroblast cells from a disaggregated Swiss mouse embryo. Fibroblast

tissue, also known as scar tissue, is made up of extremely hardy cells and is excellent for basic training in tissue culture protocols due to its relative vitality and tolerance for a range of conditions (and abuses). Though still subject to contamination, other cell lines, as well as primary living or recently deceased sources, can prove dishearteningly difficult for practicing amateurs to cultivate. Interestingly, the 3T3 line has achieved a sort of immortality: forty years after the death of its host donor, scientists and students all over the world continue to conduct research using generation after generation of a miniscule portion of the body of this long-deceased embryonic life form. At SymbioticA, we learned tissue culture cultivation, as well as techniques for observation and documentation, and at the end of our residency we began experiments grafting cells into three-dimensional structural matrixes. This residency marked our first foray into the field of 'wet' or biological art production.

In January 2006, we returned to SymbioticA to complete the renamed *Teratological Prototypes*, this time in collaboration with Zurr and Catts from TC&A. Here, we cultivated the P19 mouse teratoma cell line (*fig.*6.) in vitro, building up a substantial population of healthy cells, both live and frozen. Simultaneously, we completed a series of 3D scans of teratoma meat sculptures and, with 3D digital printing, molding, and casting techniques, produced a series of scale teratoma forms to serve as the sculptural scaffolds of the final *Teratological Prototypes*. Each teratoma form was cast in a bioabsorbable polymer called P4HB, presented in two half-sections and sewn together with

surgical thread. The teratoma scaffolds were placed in a bioreactor chamber, along with an abundant population of cells and nutrient solution, and then stored in a water-jacketed CO2 incubator. As the bioreactor turns, cells are persuaded to attach themselves to the scaffolds rather than the interior walls of the chamber. The medium is replaced three to five times weekly with fresh nutrients and serums in order to allow substantial cell division to occur, resulting in the slow growth of fragile tissue culture sculptures.

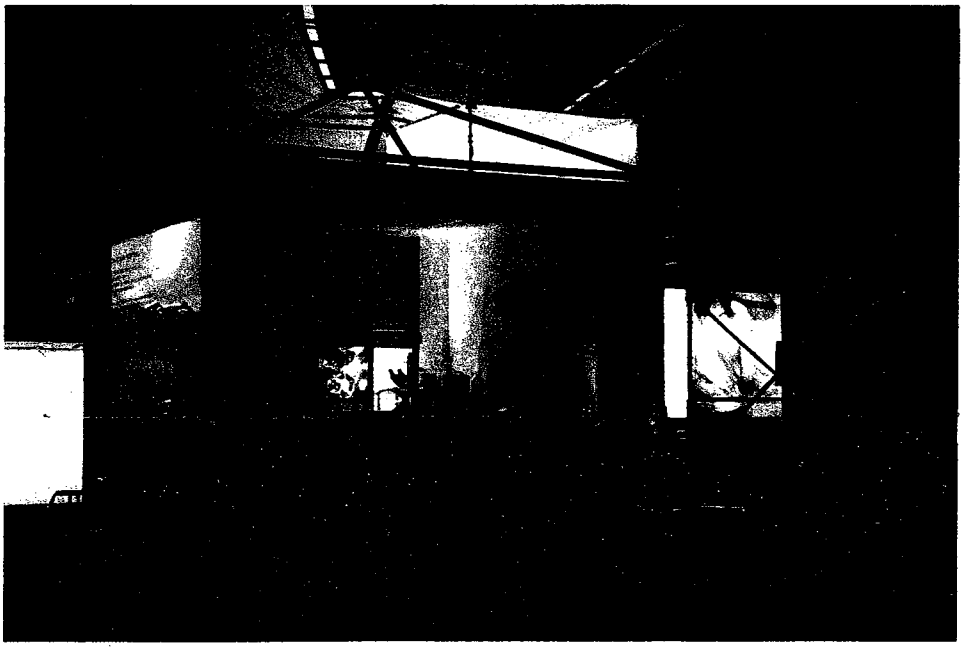


(*Fig.*6.)

Shawn Bailey and Jennifer Willet
BIOTEKNICA Laboratory Documentation (P19 Cell Line)
SymbioticA, The University of Western Australia
2004

The *Teratological Prototypes* were exhibited for the first time at ISEA Zero One San Jose in August 2006. (*Fig.* 7, *Fig.* 8., *fig.* 9.) On site, we built a functional

tissue culture laboratory maintaining the sterile environment necessary to grow a series of three *Teratological Prototypes* live for public view. In 2007, we exhibited a related work, called *BIOTEKNICA: LiveLifeLab* (see attached video), another functional laboratory installation, at the FOFA Gallery at Concordia University. Chapter 4 will present this exhibit in detail. Since then, I have continued to conduct hands-on, laboratory-based research at San Jose State University (2006), the Concordia University Department of Biological Sciences (2007), and The University of Leiden, affiliated with The Art and Genomics Centre (2007/2008).



(*Fig.7.*)

Shawn Bailey, Jennifer Willet, Oron Catts and Ionat Zurr.
Teratological Prototypes
ISEA (International Society for Electronic Arts) Zero One San Jose
2006

(*Fig.*8.)

Shawn Bailey, Jennifer Willet, Oron Catts and Ionat Zurr.
Teratological Prototypes
ISEA (International Society for Electronic Arts) Zero One San Jose
2006

With these extraordinary experiences as a non-specialist working in the laboratory came two significant shifts in my understanding of biotechnology: (1) it became apparent to me that the digital metaphors proliferated in the media, public, and even academic discourses are somewhat problematic, and serve to obfuscate the very wet, embodied, and bloody nature of harnessing life inherent in biotechnology, and (2) the over-specialization of the biosciences promotes a perceived exclusivity. In reality, these technologies can be utilized with no threat of harm by individuals from all back grounds and demographics. The biosciences (the 'life' sciences) are not so difficult or so dangerous as to

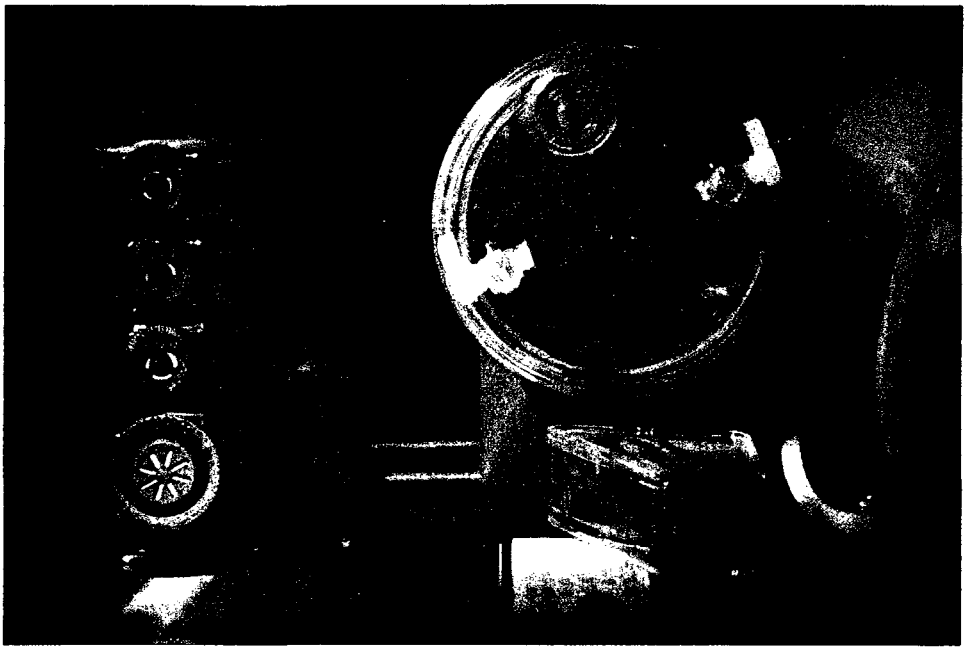
necessitate over specialize, and sometimes absolute secrecy. Critical Art Ensemble would agree. They write:

> The perception that Science is too difficult for anyone other then a specialist to understand is socially engrained in those separated from the discipline on an everyday life basis. The walls of the division of technical labor seam unbreachable. The common English expression "it's not rocket science," usually made as a sarcastic remark when someone has inordinate trouble with an easy task, is but one example of a manifestation of public reverence for the intellectual intensity of science and its separation from common daily activities.[46]

In other words, the democratization of biotechnology is not only socially and politically necessary but also practically feasible in terms of health and safety, and the physical and intellectual prowess required to engage directly with this skill set. In my experience, working in the lab is a lot like cooking. It is an exact science that is, at the same time, always open to personal interpretation – where mistakes, accidents, and intentional deviation often prove more successful than following the recipe.

---

[46] Critical Art Ensemble. *The Molecular Invasion.* Brooklyn: Autonomedia, 2002. P.4.



(*Fig.*9.)

Shawn Bailey, Jennifer Willet, Oron Catts and Ionat Zurr.
Teratological Prototypes
ISEA (International Society for Electronic Arts) Zero One San Jose
2006

(RE)embodying Biotechnology theorizes, articulates, and demonstrates the visual narratives, performative actions, and biological artworks constructed by Bailey and myself through the duration of our research / creation project *BIOTEKNICA*. I am working to describe and analyze the embodied knowledges and experiences I acquired at the UWA, and in a number of laboratories all over the world since. I choose the title *(RE)embodying Biotechnology* for a number of reasons. The "(RE)" implies that biotechnology has always been an embodied, life-based process. I see an urgent need to re-engender the language surrounding biotechnology with indicators of embodiment. In addition, a *(RE)embodied Biotechnology* also includes the human body and the

practitioners' body in a interrelated loop between all subjects, objects, processes, and protocols involved in an extended technology of bodies.

In retrospect, I understand my experiences at SymbioticA as an induction of sorts — an induction into biotechnological practices, an induction into the specialist class. My colleague and I were invited into the highly guarded site of the biological research laboratory, where individuals from the arts and humanities (media studies, literary theory, art history, literature, philosophy, and fine art) are given a brief glimpse of the inner workings of one of the most significant and arguably most powerful arms of the technoscientific industrial complex. I am extremely grateful for having been allowed this important opportunity. However, it was also incredibly difficult, cathartic and disheartening at times, to experience first hand the instrumentalization (and industrialization) of living systems as a key aspect of biotechnological research. Simultaneously, it was also strangely understandable when evaluating our research goals, the goals of the artists and scientists working alongside us in the labs, and the long trajectory of the manipulation of living systems in the name of research, health, economy, and capital. However, what was made abundantly clear, and is the focus of this text, is the enormity of the gap between the representation of biotechnological research in the public realm and the actuality of biotech — the people, the processes, and the knowledges that are practiced every day in the laboratory.

2 | The Artist as Specialist:

Creative Methodologies for Public Implication in the Biological Sciences.

With long-established traditions in biomedical and biotechnology fields, the general public holds very little agency in the decision-making processes that dictate research trajectories, evaluation criteria, and the application of advancements made in the biosciences. Yet, in my view, the general public is encouraged to have a passive relationship with evolving biotechnologies. Ironically, we the public tend to receive both the advantages and disadvantages of the proliferation of biotechnology, yet we are asked to merely trust the specialists to manage its development and proliferation. I am interested in pursuing avenues of intervention where the individual layperson — and the public as a heterogeneous, social, political entity — possesses an empowered, reciprocal relationship with biotechnology.

A problematic aspect of debates surrounding biotechnology is that the over-specialization of the sciences tends to preclude any invested participation from the individual non-specialist. People don't feel implicated in biotechnology; they don't feel as though they have enough knowledge to assert their own opinions. We all concede the power to make these complex and difficult decisions to scientists, corporations, and the government. I see this lack of implication and involvement on the part of the general public as the result of a deeply rooted insecurity — an established belief that science is intrinsically too difficult to allow

us, as laypeople, to understand evolving biotechnologies, let alone participate in their development in any meaningful way. Richard Lewontin proposes a similar argument in *Biology as Ideology: The Doctrine of DNA* (1991):

> Not only the methods and institutions of science are said to be above ordinary human relations but, of course, the product of science is claimed to be a kind of universal truth. The secrets of nature are unlocked. Once the truth about nature is revealed, one must accept the facts of life. When science speaks, let no dog bark. Finally, science speaks in mysterious words. No one except an expert can understand what scientists say and do, and we require the mediation of special people – science journalists, for example, or professors who speak on the radio – to explain the mysteries of nature because otherwise there is nothing but indecipherable formulas.[1]

One strategy to combat a programmed public malaise regarding biotechnology is to effectively trump the authority of the specialist class (of scientists and engineers, and business people.) This shift can be achieved by placing alternative individuals into specialist roles in the public eye. In my opinion, the insertion of visible and intellectual difference into traditional roles of scientific authority can serve to empower non-specialists, enabling them to participate

---

[1] Richard Lewontin. *Biology as Ideology: The Doctrine of DNA*, (Concord: House of Anansi Press, as part of the Canadian Broadcasting Corporation Massey Lecture Series, 1991). pp. 8-9.

more fully in biotechnological debates. These transgressive biotechnological practices have the potential to reveal and illuminate the bodies in biotechnology through alternative viewpoints, discourses, and metaphors propagated by non-specialist participants in the biological sciences. I am proposing a participatory, interdisciplinary incursion into the practice and public representation of biotechnology.

If artists, academics, plumbers, accountants and housewives contribute to the production of biotechnology, the authority of the specialist — the doctor, the lab technician, the scientist — will be diminished. Alternative voices, subjectivities, and interpretations of biotechnology will be heard and perpetuated in public debate. No longer will the white lab coat and all its connotations — the extensive education, the complex language set, the progressive rationality, the assumed comprehension of natural truths — prevail as the only valid, authoritative voice when determining biotechnological research trajectories and evaluation criteria. I am particularly interested in mobilizing the transformative potential of the artist as a non-specialist and will continue to emphasize this position with the understanding that this interdisciplinary methodology could also be successfully mobilized by other non-specialist communities.

The work of Edward Said informs my proposition, especially his call for interdisciplinarity, as a model for the inclusion of non-specialists in the biotechnological field. Said describes the possible benefits as well as the

unavoidable difficulties in joining the specialist class (particularly as it pertains to academia) in "Opponents, Audiences, Constituencies." Said argues that universities "...appear to exercise an almost totally unrestrained influence: (*in*) the principle that knowledge ought to exist, be sought after and disseminated in a very divided form."[2] Within this framework,

> You cannot simply choose to be a sociologist or a psychoanalyst; you cannot simply make statements that what you say as a historian (however well it may have been researched) enters historical discourse. You have to pass through certain rules of accreditation, you must learn the rules, you must speak the language, you must master the idioms and you must accept the authorities of the field – determined in many of the same ways – to which you want to contribute.[3]

With this division of knowledge into smaller and smaller groups of specialization — and with extensive chains of prescribed rites of passage into each field — interdisciplinarity, though touted as the primary goal of most contemporary universities and research centers, has little legitimacy in the back rooms (and boardrooms) of institutional culture. Individuals working in this manner are often perceived of as 'jacks of all trades, but master of none.' Also, researchers with interdisciplinary concerns often complain of the pressure to attain expertise in

---

[2]Edward Said. Opponents, Audiences, Constituencies, and Community from *The Anti-Aesthetic: Essays on Postmodern Culture*. Hal Foster edt. (New York: The New Press, 1998), p. 62.
[3] *Ibid.*

multiple fields in order to be taken seriously in any domain. If an individual or research trajectory cannot be discretely categorized in its meaning, historical evolution, and rigid standards of evaluation (regarding funding, exhibition, and publication), it can prove cumbersome and unruly, sometimes even illegitimate, in the institutional setting.

In the same article, Said argues that we need to collapse the borders between areas of specialization in order to impinge upon exclusionary forms of power that stem from the discipline-based system of knowledge production and exchange. He states, "Instead of non*interference* and specialization, there must be *interference*, a crossing of borders and obstacles, and a determined attempt to generalize exactly at those points where generalizations seem impossible to make."[4] At the time this was written, he intended to motivate theorists and critics to expand their audiences and participate in journalism as a means of exposing more generalized audiences to the evolving theories, whether post-colonial, feminist, post-Marxist, or queer, to name a few. However, I am proposing an exaggerated form of interference through more disparate forms of interdisciplinarity. Instead of academic writers participating in mass print media publication, I am arguing for a critical, participatory methodology for interdisciplinary incursion in contemporary biotechnologies. My principle interest lies at the intersection of art and science, and I propose that this strategy can be

[4] Edward Said. Opponents, Audiences, Constituencies, and Community from *The Anti-Aesthetic: Essays on Postmodern Culture*. Hal Foster edt. (New York: The New Press, 1998), p.11.

deployed in any number of fields. In my understanding (as well as that of Said), radical interdisciplinarity is inherently political, counteracting established hierarchies and divisions of power in the institutional setting, the production of knowledge, and the distribution of this knowledge in public discourse.

Said's proposition allows for non-specialist interference in biotechnology in its public representation, but also functions as a strategy for transforming academic traditions of specialization. In other words, opening the closed field of biotechnology to perceived non-specialists effectively changes established research practices in the arts and humanities, where second- and third-order texts are often utilized as primary sources in analyzing specializations such as biotechnology and the sciences. As a result, researchers and journalists often misrepresent or misunderstand the very nature of the practices, the protocols, and even the living entities that they are writing about in the biotechnological sphere. Academic tradition does not encourage a direct transfer of knowledge — and, more significantly, of experience — across specializations. From personal experience, I can attest that it is very challenging for a humanities-based researcher to fully understand the complexities of genetic modification (for example) without ever having set foot in a laboratory or having performed any GM protocols. This difficulty also applies to a more general audience: how is an individual to think in a complex critical manner about biotechnology if he or she has no hands-on experience in the field? Essentially, my argument is two-fold: (1) real, hands-on experience with biotechnological protocols allows non-

specialists such as myself to obtain knowledge and therefore empowerment in the critical debates surrounding biotechnology; (2) a shift in the representation of the practice of biotechnology to include non-specialists may allow the public to perceive their own access and implication in biotechnology and, therefore, will greatly increase participation in the field. As a result of this proposed involvement with biotechnological protocols, I believe that the bodies in biotechnology will become accessible through this first-order experience to the non-specialist practitioner and, by extension, to the general public. This accessibility may be achieved through shifting representational strategies, metaphors, and language sets to describe biotechnological research.

The Hacker

In his article "A Biotech Hobbyist Manifesto," Eugene Thacker suggests that we look to another specialized technological field that had been profoundly affected by non-specialist, amateur, and non-professional contributions to its public representation and technological development: computing. "The hobbyist sub culture which emerged around personal computing valued certain things: a commitment to the innovative potential of the individual, a liberal belief in the democratic possibilities of new technologies, an interest in DIY (*Do-it-yourself*) "hands-on" knowledges, and a counter-culture investment in a computer

"revolution.""[5] This article focuses on early examples for individual participation in computing from the 1970s, when individuals were building their own home computers from kits — a participation which resulted in the astounding success of personal computer corporations like Apple and IBM. Thacker postulates this form of hobbyist intervention as a failed example, swayed too strongly and eventually subsumed by corporate and market economy values. He argues that free choice has not been achieved in this domain. From my perspective, the capitalist economy in which digital (and biotechnological) technologies thrive is far too entrenched in Western ideology to be overcome in these specific instances. However, I would argue (from the standpoint of working 'within the system') that traditional hierarchies have been challenged in the digital economy by individual amateur ventures into the field.

I, too, am interested in examples drawn from the analysis of computing and digital culture, but I would place more focus on the hacker and the ways in which this figure serves as an example for our potential participation in science and technology. In order to define the hacker, I look to Wikipedia, an open source encyclopedia authored by millions of users — a site where hackers are presumably able to define themselves:

---

[5] Eugene Thacker. « A Biotech Hobbyist » from Creative Biotechnology: A User's Manual; available online: URL: http://www.locusplus.org.uk/biotech_hobbyist.html [date of last access: 09/01/2006] p. 39.

A hacker is a person who creates and modifies computer software and computer hardware, including computer programming, administration, and security-related items.

In computer programming, a *hacker* is a programmer who *hacks* or reaches a goal by employing a series of modifications to exploit or extend existing code or resources.

In computer security, a *hacker* is a person able to exploit a system or gain unauthorized access through skill and tactics. This usually refers to a black hat hacker. There are also white hats (ethical hackers), and grey hats. (*See: Hacker (computer security)*)

In other technical fields, *hacker* is extended to mean a person who makes things work beyond perceived limits through their own technical skill, such as a hardware hacker, or reality hacker.[6]

Hacker involvement in the digital domain has become understood as a central factor in the digital revolution and essential to the continued advancement of knowledge and technology in the field. Hackers often posses knowledge sets and problem solving skills that rival, and possibly exceed, those of the professionals in the industry. On the other hand, as in the instance of Steve Wozniak and Steve Jobs (co-founders of Apple), many individuals have

---

[6] *Wikipedia: The Free Encyclopedia.* available online: URL: http://en.wikipedia.org/wiki/Hacker [date of last access: 05/04/2006]

transformed hacker culture into successful corporate enterprises. To use another example Linux and Firefox, where hacker culture has produced open source products that rival industry models.

The hacker is presented in popular culture [i.e. in films like Hackers (1995) and Antitrust (2001)] as a wayward, chaotic figure, sometimes functioning as an instigator towards egalitarian incursions and participation in the digital sphere. In actual instances of hacker activities, the 'black hat' hacker posits a mischievous, even threatening, counterplayer to established computing corporations through a number of highly publicized (and highly prosecuted) illegal hacks; examples include individuals such as Kevin Mitnick, Gary McKinnon, and the Cult of the Dead Cow. Whether or not these individuals and their actions are interpreted as legitimate and/or ethical, the popular media representation of the hacker as a fifteen-year-old boy, working in his garage to take down large corporate networks and databases, serves an important function in the democratization of computing technologies. The dominant image of the specialized computer scientist is undermined by the of powerful programming specialists in track pants, drinking soda pop, and living with their parents.

All of these visions of hacker culture (the amateur programmer turned multi-millionaire business guru, the youthful 'black hat' hacker toppling industry giants from their home PC) contribute to a trickle down effect of DIY culture in the digital sphere. Today, with the rise of podcasting, file sharing, twitter, wikis, and blogs,

in addition to open source models for the production of operating systems, networks, hardware, software, and content, millions of 'hackers' all over the world are engaging in unpaid work that rivals and challenges the authority of professional production in the field. In his lecture "What Business Can Learn from Open Source"[7] at the 2005 O'Reilly Open Source Convention, Paul Grahm argues that the resounding marketplace success of blogging and open source models means that businesses need to look to models of amateurism in order to survive the rise of hacker culture. He argues that professionalism is overrated; it is an established fashion that breeds formality and sterility, leading to reduced imaginativity and productivity. He equates professionalism to 'pretend work' and open source, individuated participation to 'real work.' With professionalism, work and life are separate entities,[8] but with amateurism, work and life are intrinsically interconnected. This interconnectedness, in turn, breeds deep personal investment, dedication, and imaginative potential, leading to far greater gains in productivity and accomplishment.

The successes of hacker culture in the digital domain, public perception of the digital sphere promotes an egalitarian ideal for the perpetuation of digital

---

[7] Paul Grahm. "What Business Can Learn from Open Source" presented at the *O'Reilly Open Source Convention* (2005) available online: URL: http://www.itconversations.com/shows/detail657.html [date of last access: 05/04/2006]

[8] Paul Grahm's cutting criticism of professionalization – as an artificial structure that segregates work and life could also be applied to notions of scientific objectivism from an interdisciplinary critical standpoint. Suggesting that with the division of science as distinct from life as counter intuitive and counter productive.

technologies. Unlike the hard sciences, computer science and its technical applications are perceived as publicly and individually accessible. Even accounting for Lary Irving's "Digital Divide"[9] and the rise of mega-corporations like Microsoft in the digital sphere, the perpetuation of hacker models in the industry and the larger cultural sphere fosters an important element of individual participation and implication in the evolution, value, and trajectories of digital technologies.

In his 1991 text, *Hacking Away at the Counter-Culture*, Andrew Ross provides an early description of this phenomenon that has since resulted in further shifts away from specialization in imagining computer skills and technology.

> The elite class profile of the hacker prodigy as that of an under-socialized college nerd has become democratized and customized in recent years; it is no longer exclusively associated with institutionally acquired college expertise, and increasingly it dresses streetwise. In a recent article that documents the spread of the computer underground from college wiz-kids to a broader youth sub culture termed 'cyberpunks,' after the movement among science fiction novelists, the original hacker phone phreak Captain Crunch is described as lamenting the fact that cyberculture is no longer an

[9] The 'digital divide' is a term championed by United States of America politician Lary Irving (serving under Bill Clinton) to describe the growing gap between those who have access to computer technologies, and those who do not, with an emphasis on North / South international politics.

'elite' one, and that hacker-valid information is much easier to obtain these days.[10]

I am arguing that Ross' investigation can be effectively applied to evolving biotechnologies. Computing as he argues is as an excellent example of how a specialized technological industry that may be revolutionized through individual, hands-on participation.

However, the hacker model does not address the transformation of the technological object, which is of great interest to me in terms of understanding biotechnology. Although digital accessibility and authorship have achieved some sort of transparency in Western society, our understanding of the fundamental principles of computation remains intact. Biotechnology, as well as the continual proliferation of digital metaphors used to describe the life sciences, requires an even more foundational shift: a shift not only in the perception of accessibility but also in the perception of the biotechnological object towards unruly, embodied, live models.

The Amateur

[10] Andrew Ross. "Hacking Away at the Counter-Culture," in *The Cybercultures Reader.* David Bell and Barbara Kennedy Edts. London and New York: Routledge. 2000. p. 259.

Although I prefer the term "non-specialist," I am essentially arguing for amateur participation in biotechnology — in academia, the public sphere, and individualized experience. "Amateur" is an elusive but important term in promoting radical interdisciplinarity, utilized by a variety of theorists to describe artistic participation in scientific procedures. In colloquial terms, "amateur" refers to an individual with little education or skill who participates in a practice for personal enjoyment. An amateur is almost never provided with financial compensation for their work. Referring to someone as an amateur can often be interpreted as a harsh criticism, as it evokes pejorative stereotypes such as the Sunday painter or community theatre. However, amateurism does not always carry these negative connotations. Historically, the amateur scientist with a chemistry laboratory in his or her shed, the amateur astronomer, and the amateur radio operator have all been interpreted as connoisseurs, skilled admirers, and even valued contributors to fields as they have evolved throughout the ages. Even today, the amateur athlete — one who does not receive a salary for their sportsmanship — is considered the most elite example of athleticism in our society.

In *For the Love of It: Amateuring and Its Rivals*, Wayne Booth proposes the amateur as one who engages in a practice for the love and pleasure of it with no practical use or endgame.[11] Booth is a celebrated American professor of literary criticism who writes candidly about his musical amateurism as a cellist. I am

[11] Wayne Booth. *For the Love of It: Amateuring and Its Rivals.* Chicago: University of Chicago Press. 1999. P.14

interested in the participatory nature of his representation of this activity (as opposed to an observatory or research-based action) but concerned about his implication that there is no practical use or value in amateur engagements. His model sees the amateur's role as one of appreciation rather than implicated analysis and propagation of a field.

In her work *Academic Instincts*, Marjorie Garber provides a more complex interpretation of amateurism with a directed focus on amateurism in academia. She argues that the term "amateur" is intrinsically linked to the term "professional;" amateurism is understood as a labour of love, rather than as a professional engagement in a field. Garber divides amateurs into two distinct types: the amateur professional, a person trained in one field who writes, thinks, and practices in another; and the professional amateur, who she describes as more of a public intellectual, most often with no professional affiliations.[12] Though her focus is on academia (whereas the scope of my argument is intended to serve a far wider audience), she provides us with some insight into the difficulty encountered by humanities-based researchers and, by extension, other individuals making amateur inroads into scientific fields. She states, "Humanist intellectuals like Lacan, Kristeva, and Luce Irigaray are not regarded as provocative readers of science but as imposters, spouters of "fashionable nonsense." The split between amateurs and professionals reproduces itself in the relative standing of fields: scientists can become humanists more easily than

---

[12] Marjorie Garber. *Academic instincts*. Princeton, N.J.: Princeton University Press, 2001. p. 20.

humanists can become scientists, in part because the humanities themselves are perceived as closer to 'love' than is science."[13] Given the perceived imbalance in value and measurable benefit to society between the arts and the sciences, it is even more important that researchers in the arts and humanities continue to cross the perceived boarders of the hard sciences.

The Non-Specialist

I am interested in perpetuating a growing trend towards the revitalization of amateur models in the sciences, particularly in the realm of biotechnology. This revitalization has the transformative potential to open the field to non-specialist participation. However, if this action is to succeed, we must remain acutely aware of the powerful authority and impenetrability that has developed around the sciences since the rise of modernism. The scientist, unlike the computer programmer, is a specialist, rather than a professional. The pursuit of science is understood as an objective and systematic means of obtaining knowledge about the natural world. Science (and, by extension, medicine) is seen as one of the highest orders of knowledge and comprehension in Western society. For the conceptions of the amateur and the hacker to be successfully applied to and included in scientific fields, the terminology we employ in describing these activities must shift away from these sometimes derogatory terms. I believe that

[13] *Ibid.* p.32.

the term "non-specialist" is the most viable way to describe the interjection of unsanctioned participation in what is perceived as an elite set of skills.

I am proposing this terminology for three reasons. First, it indicates that the established paradigm in the hard sciences is one of specialization rather than professionalism. This distinction is important because the term "professional" is related to the fields of business and commerce, where the final goal is inherently economic success. The pursuit of scientific specialization is linked to a different goal: the acquisition of knowledge in order to understand the natural world. Second, the term "non-specialist" suggests that an individual is participating in a field outside their educational knowledge, but it also allows for a wide range of interpretation in their skill or knowledge in that scientific field (from layperson to almost expert). The term "amateur," on the other hand, encourages the interpretation of the non-specialist individual as unskilled, unfocused, and with no invested participation in any given knowledge set. Third, the use of "non-specialist" as opposed to "hacker" circumnavigates the sinister connotations of the hacker-terrorist in popular culture — which, at this time in history, can only prove damaging for those who participate in scientific fields. These associations are only intensified in the field of biotechnology due to international preoccupation with (and fear of) bio-terrorism.

As Thacker points out, there is a substantial disparity in motivation between amateur trends in computing and non-specialist participation biotechnology.

> Like the computer hobbyist, the biotech hobbyist brings the non-specialist into specialist zones of activity, involving self-directed learning, hands-on experience, community building, and shared knowledges. Unlike the computer hobbyist, the biotech hobbyist does not see this development on non-specialization as an opportunistic means for establishing a start up company.[14]

I, too, would like to step away from market economy models as an incentive for non-specialist scientific investigation.

It is already the case that academic and commercial research in the biotechnological field is primarily driven by commercial concerns, financial bottom lines, and patent rights. It is imperative that alternative intentionalities enter into public discourse as a means of considering the ramifications, side effects, and drawbacks of current research trajectories outside of economic concerns. From my perspective, art is an exceptionally well-fashioned tool for non-commercial meditation and participation in this domain. Birgit Richard argues a similar point in her chapter summating the 1999 Ars Electronica Net Symposium. She states that "Human needs within biological contexts which are not taken into

---

[14] Eugene Thacker. « A Biotech Hobbyist » from Creative Biotechnology: A User's Manual; available online: URL: http://www.locusplus.org.uk/biotech_hobbyist.html [date of last access: 09/01/2006] p. 39.

consideration by economic interests should be worked out."[15] She, along with Thacker and myself, sees great potential in non-specialist research from an artistic standpoint, as it presents a viable point of entry into biotechnological discourse. She argues,

> Heightening awareness of the potential and dangers of a new technology before it confronts society with a *fait accompli* is one essential task of art. Technical as well as interpretational standards are quickly accepted as established facts. With the projection of future genetic worlds, art stimulates communication.[16]

In my opinion, artists are particularly well-equipped to participate successfully in science for two reasons. First, the methodologies of contemporary artistic research are inherently fluid and transdisciplinarity; they are able to adjust repeatedly to the multiplicity of concerns, knowledges, and tendencies that is required for critical engagement with science and its practices. Second, in terms of opening up the public representation of non-specialists as participants in the hard sciences, artists serve as an ideal model for the democratization of biotechnological research. If we see artists — on the television, in the newspaper, in a gallery — actively engaging with the tools of science and

---

[15] *Ibid.* p. 33.

[16] Brigit Richard. "I – Biology and Fake Life Construction: Communication Fragments from the LifeSciences Internet Symposium" from *LifeScience: Ars Electronica 99*. Gerfried Stocker and Christine Schopf. Edits. New York: Springer-Verlang, 1999. p. 30.

technology, it creates a precedent in the public opinion of the sciences, allowing them to be seen as open, fluid, and accessible. I am reminded of the worn-out (and generally North American) criticism of Modern art: "my kid could do that." This model suggests that, given the public presentation of art/science research and production in a society plagued by overspecialization, if artists can do science, maybe you (and your kid) can too!

In order to perpetuate a more inclusive, embodied model for biotechnology, we need to develop visions of biotechnology that are more open, more participatory, and less digitized, less sensationalized. Almost no popular media sources contribute to this representational shift, but there is a nascent momentum to be found in alternative venues — where artists, theorists, and media activists work against the established authoritative, corporate visions of biotechnology. I wish to elucidate one artistic field, in which non-specialist participation — generally, in science; specifically, in biology and biotechnology — is proliferating on a significant scale: bioart. Due to my personal interest and involvement in the field, I would like to present bioart as a case study to illustrate the ways in which the non-specialist can shift public representation — and, by extension, public implication and public understanding — in the field of biotechnology. This is not to say that other forms of artistic production are incapable of serving these purposes. It is also essential to consider groups and intentionalities outside of the arts as important contributors to these types of incursions. However, as it is my area of interest and facility, bioart will serve as an excellent example in

establishing my argument.

Bioart

Bioart is an emerging field of art/science research and production. The term "bioart" can refer to many things, and its definition is currently subject to debate at conferences, in publications, and in online discussion groups across the world. I define bioart as a set of practices that have recently erupted in the growing use of biology, or life, in the production of art. This definition can include something as fundamental as the mobilization of animals, plants, bacteria, or the human body in the production of artwork (including both live and deceased specimens), as well as artworks developed for non-human biological audiences. Bioart can also involve the mobilization of the biological sciences and biotechnologies in art production, utilizing technologies such as genetic engineering, tissue culture, and bioinformatics.[17] However, bioart is still an evolving field, and as such it is highly contested. In order to better understand bioart and its complexities, I wish to draw from the writings of artists and theorists working in this domain.

George Gessert (an established bioartist known for the genetic manipulation of irises through breeding processes) defines bioart in his posting to an online

[17] Some definitions of BioArt also extend through bioinformatics to works that deploys a-life and artificial intelligence technologies – though this is not the intended focus of this line of inquiry.

discussion hosted by *Yasmin: Your Art and Science Mediterranean International Network.*

> Bioart is art that is alive or has living components. Not all bioart involves biotechnology, or genetic change. Bioart includes some kinds of ecological art and land art, for example Alan Sonfist's recreations of the original biota of Manhattan.[18]

Here, Gessert asserts a formal or media-based description of the field. His definition is useful in understanding the mechanics of what is bioart, but further explanation is needed to answer foundational questions. What does bioart do? How does it function? What is its place in society?

Adam Zaretsky, another long-time bioart practitioner, proposes a list of general objectives he sees as emergent in bioart practices:

- Reminding people about the ever-present complexities of vitality, mortality and mutation all around us.
- Giving non-experts the ability to speak intelligently about science without having to be a scientist.
- Providing hands on labs or exhibitions designed to get rid of fears of

[18] George Gessert. "Exhibiting BioArt" discussion group hosted by *Yasmin: Your Art and Science Mediterranean International Network.* available online: URL: http://www.media.uoa.gr/yasmin/viewtopic.php?t=775 [date of last access: 09/01/2006]

complexity while maximizing debates on intelligent applications of technology.

- Exhibiting works which rework preconceptions about relationships between human culture, other living beings and the environment.[19]

However, Zaretsky also reminds us that "The artists involved in bioart are not a group with a manifesto and a singular programmatic but instead have rifts, ethically, philosophically and politically, which keep them from any singular consensus."[20]

In my purview "bioart" can be seen as a blanket term that refers to a number of related methods of art production: genetic art, transgenic art, biotech art, vivo art, live art, life art, ecological art, land art, and, by some definitions, performance art and body art. Zaretsky is most interested in perpetuating the term "vivoarts" to describe "any artistic production that has a living component embedded in it at the time of its exhibition."[21] Renowned bioartist Eduardo Kac has coined the term "transgenic art" to describe his artistic production involving genetic engineering technologies. He states, "Transgenic art, I propose, is a new art form based on the use of genetic engineering techniques to transfer synthetic genes into an organism or to transfer natural genetic material from one species

---

[19] Adam Zaretsky. "The Mutagenic Arts" in *CIAC's Electronic Magazine* no. 23, 2005. Available online: URL: http://www.ciac.ca/magazine/archives/no_23/en/dossier.htm [date of last access: 09/01/2006]

[20] *Ibid.*

[21] *Ibid.*

into another, to create unique living beings."[22] He continues, "The nature of this new art is defined not only by the birth and growth of a new plant or animal *but above all the nature of the relationship between artist, public, and transgenic organism.*"[23] Instead of defining "the nature of this new art" solely by its media (like Gessert), or by the intentionalities of the artist (like Zaretsky), Kac postulates an articulated model where the artist, the public, and the biological art/entity (in this instance, the transgenic entity) each have trajectories, histories, relationships, and intentionalities that intersect at a given point in time. Though I am not directly interested in the perpetuation of even more rarified and specialized terms like "transgenic art," I am deeply intrigued by the model of bioart classification suggested by Kac's definition. In other words, applying articulation theory to the analysis of the intersection of two evolving fields — art and technology — has the potential to engage a heterogeneous audience.

"Bioart" is a permeable, interdisciplinary, and unruly term, but this is probably why I (as well as many others) am attracted to it. Jens Hauser, arguably the foremost curator, critic, and theorist in the field, elucidates the transient and transformative nature of bioart in his chapter "Bio Art — Taxonomy of an Etymological Monster," drawing our attention to the constant flux of both the biotechnological field and bioart.

---

[22] Eduardo Kac. "Transgenic Art" in *LifeScience: Ars Electronica 99.* Stocker, Gerfried and Christine Schopf. Edits. New York: Springer-Verlang, 1999. p. 289.
[23] *Ibid.* p. 289. (my emphasis)

> *Bio Art* isn't just a hybrid; it's also a proliferating mutant term. Biology's ascent to the status of "hottest" physical science has been accompanied by, on the one hand, the inflationary use of biological metaphors in the scholarly disciplines that study culture; on the other, a wide range of biotech procedures are simultaneously providing artists with the themes for their work as well as the expressive media with which to realize them. As this has transpired, the evolution of the term "Bio Art" has somewhat resembled the recent hyperbolic career path of the gene-hype launched by techno-industrial special interest groups in the 1990s that, in the wake of its zenith in conjunction with the media frenzy surrounding the Human Genome Project, has been slowly subsiding in the last few years. Bioart has not unfolded and developed in accordance with prescribed master codes of a determinant post-avant-garde manifesto; instead, it has been subject to a process of social drift and divers aesthetic influences from its environment.[24]

As Hauser argues, the definition of bioart is elusive and hazy at best. With the continual flux and change in biotechnology and bioart production, theorization, and exhibition comes the reification of practices originally conceived as performance art or body art by artists and historians alike. Artists like Stelarc and Orlan (understood as performance artists, or even artists engaged in body

---

[24] Jens Hauser. "Bio Art – Taxonomy of an Etymological Monster" from *Hybrid living in paradox: Ars Electronica 2005*. Christine Schöpf, Gerfried Stocker. Edts. Ostfildern-Ruit, New York, Hatje Cantz: D.A.P. Distributed Art Publishers, 2005. p.182.

modification, who practiced in the 1970s-80s) are today revisited and reinterpreted retroactively through the lens of bioart as artists engaged in the manipulation of life. These artists, among many others in the fields of performance and body art, are looking to bioart practitioners and organizations to imagine new artistic entry points into the body. Hauser writes, "Stelarc and Orlan, two of the seasoned pioneers of Body Art, have joined the Tissue Culture & Art Project in research that is being carried out at the SymbioticA Art & Science Collaborative Lab in Perth, in order to utilize tissue cultures to grow an "extra ear" and a patchwork-like mantel made up of hybrid skin cultures of diverse donors representing a variety of different ethnic origins."[25]

There is also a great deal of debate about what bioart is not. Practitioners and theorists in the field generally agree that work that does not include a 'life' component is not bioart. Gessert states, "Art that represents life (chromosomes, DNA, etc.) is not bioart. Computer simulations of genetic processes, evolution, plant growth, etc. are simulations of life and not alive, hence not bioart."[26] Hauser contributes a similar argument: "Bio-fictional 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 Lily Art" or "Cathedral

---

[25] *Ibid.* p. 184.

[26] George Gessert. "Exhibiting BioArt" discussion group hosted by *Yasmin: Your Art and Science Mediterranean International Network.* available online: URL: http://www.media.uoa.gr/yasmin/viewtopic.php?t=775 [date of last access: 09/01/2006]

Art.""[27] However, definitions of bioart are complicated by works that fall into the category of genetic art or genomic art. The field of genetics (as well as the larger field of bioinformatics) presents a taxonomical quandary, although it is often simply misinterpreted or misunderstood and therefore confuses the issue.[28] This confusion lies primarily in the fact that some genetic and transgenic works of art can include living, semi-living, or deceased (and preserved) fragments of life that would fall into the propositional category of bioart; however, in other instances, genetic art can also be defined as works that involve virtual incarnations or artificial life.

In some A-life circles, the distinction between natural and virtual incarnations of the emergent properties of what we refer to as "life" is considered negligent. In his text *The Garden in the Machine: The Emerging Science of Artificial Life*, Claus Emmeche explains that, for A-lifers, the "artificial" in "artificial life" refers to the artificial nature of the environment in which life is manifest, not the artificiality of the life itself. In other words, A-lifers purport that A-life produces very real life forms; the only difference is that, in these instances, life exists in entirely artificial (computational) environments. In his introduction, he states, "Life is a process, a complex, rhythmic pattern of matter and energy. What is important is not what kind of matter or what kind of energy we find, but rather the pattern, the process,

---

[27] Jens Hauser. "Bio Art – Taxonomy of an Etymological Monster" from Hybrid living in paradox: Ars Electronica 2005. Christine Schöpf, Gerfried Stocker. Edts. Ostfildern-Ruit, New York, Hatje Cantz: D.A.P. Distributed Art Publishers, 2005. p.182.

[28] In general, there is often a misinterpretation perpetuated in the public sphere that that all forms of biotechnology involve genetics. This is not the case.

the *form.*"[29] By his definition, artificial life artworks (and possibly other forms of digital art production) could be interpreted as part of the canon of bioart. This assertion may have been considered true in the past, but as bioart has evolved, so has the clarification of its definition.

In 1993, Peter Weibel curated an exhibition called "Genetic Art" for *Ars Electronica.* Weibel defines genetic art in 1993 as:

> Genetic art as artistic counterpart of genetic engineering is on the one hand intended to simulate processes of life with the same modern technological tools and methods as the latter. On the other hand, it is to use traditional methods and strategies for a critical reflection on the potential consequences of such simulations and the synthetic creation of life.[30]

He argues that genetic art embraces a variety of fields, including evolutionary art, biogenetic art, genetic engineering, algorithmic art, robotics, virtual beings, and artificial life. In the same year, Gessert postulated a different definition of genetic art: "Genetic art is art involving DNA. Domesticated ornamental plants, pets,

---

[29] Claus Emmeche. *The Garden in the Machine: The Emerging Science of Artificial Life.* Steven Sampson Trans. Princeton: Princeton University Press, 1994. p. 4.

[30] Peter Weibel. "About Genetic Art." from online archives of Ars Electronica 1993. Available online: URL: http://www.aec.at/en/archives/festival_archive/festival_catalogs/festival_artikel.asp?iProjectID=8828 [date of last access: 09/01/2006]

sporting animals, and consciousness-altering drug plants constitute a vast, unacknowledged genetic folk art."[31] In his *Leonardo* article, he states, "...genetic art is not simply a matter of inscribing individual human ideas and fictions into the DNA of other beings. Genetic Art involves extremely close and complex interactions among species."[32]

In his more contemporary analysis "Animals, Art and Technology", which was presented at the Break 2.3 New Media Festival (Ljubljana, Slovenia) in 2005, Jens Hauser describes a shift in the evolving field of bioart away from Weibel's virtual model and towards the one postulated by Gessert: "Bioart is re-materializing itself. The fascination with the 'code of life' is reseeding and making way for a phenomenological confrontation with wetwork."[33] He continues to describe bioart in more detail as it pertains to laboratory practices: "Bioart has become an art of transformation in vitro that manipulates biological materials at discrete levels (i.e. individual cells, proteins, genes, nucleotides) and creates displays that allow audiences to partake of them emotionally and cognitively."[34] In other words, bioart can be explained as a complex, evolving field that describes a heterogeneous group of art/science practitioners — as well as practices, productions, and assertions — at the intersection of technological, social, political, and aesthetic considerations of biology, emphasizing the

---

[31] Gessert, George. "Notes on Genetic Art," *Leonardo* Vol 26, No. 3 (1993). p. 205.
[32] *Ibid.* p. 210.
[33] Jens Hauser. "Animals, Art and Technology." as presented at the conference *New Species – Break 2.3 Festival 2005.* Ljubljana, Slovenia. 2005.
[34] *Ibid.*

manipulation and presentation of wet life (as opposed to a-life) in a reciprocal relationship between artist, life form, and audience.

Hauser's theory of bioart as a process of rematerializing bodies is a central to my thesis *(RE)embodying Biotechnology*. However, Hauser criticizes the over-politicization of bioart practices by artists and theorists, particularly in American circles. This is where our models differ. I see an intrinsic relationship between bioart practices and the politics of biotechnology. In my understanding, bioartists are usually individuals with a background outside of the hard sciences who are, either directly or inadvertently, staking a claim in the knowledge production of what is arguably the fastest growing field of economic and technological exploitation today: biotechnology. Their involvement is a definitively political action in relation to our current specialist-driven market economy model of biotechnology. Bioart is particularly powerful in that it challenges the firmly established belief that biotechnology is an entirely new field of research. It reminds us that biotechnology is a very old technology, one that uses biology to attain human-determined ends. Animal husbandry, agriculture, and gardening can all be understood as biotechnology through varieties of bioart production. In addition, bioart postulates new and more expansive models for imagining the specialist in cutting-edge biotechnological fields. Although I agree with Hauser's assertion that some artists do not deploy the political issues surrounding biotechnology as content in their work, I am arguing that the very action of non-specialist participation in the specialist sphere — as well as the mobilization of

the biological and biotechnological in the production of art — is intrinsically political.

A number of bioartists write specifically about the transformative potential of non-specialist participation in the biosciences. I am particularly interested in the writings of Critical Art Ensemble, as well as the writings of Natalie Jeremijenko, Heath Bunting and Eugene Thacker in *The Biotech Hobbyist,* as their social and political interpretation of amateurism in art/science production is similar to my own. Not all bioartists are interested in the social and political aspects of engaging in the biological sciences as artists, but for myself, and a large portion of the community, it is central to their research.

The *Biotech Hobbyist Magazine* was established in 1998 by bioartists Natalie Jeremijenko and Heath Bunting. Its first and only edition can still be accessed online.[35] In more recent years, Jermijenko and Bunting, along with Eugene Thacker and Denna Jones, formed the *Biotech Hobbyist Collective*, publishing new documents and DIY scientific protocols for public edification.[36] In her text "Amateurity and Biotechnology," Jeremijenko argues that the recent social and political changes, in the United States as well as on a global scale have militarized biology (in the form of biotechnology) in the public sphere, leaving

---

[35] Natalie Jeremijenko and Heath Bunting. *The Biotech Hobbyist.* Available online: URL: http://www.irational.org/biotech/ [date of last access: 09/01/2006]
[36] Natalie Jeremijenko and Heath Bunting. *The Biotech Hobbyist Magazine.* Available online: URL: http://xdesign.ucsd.edu/biotechhobbyist/ [date of last access: 09/01/2006]

biotechnology largely inaccessible to the general public. Unlike many others in the bioart field, she is not postulating that a culture of specialization is what prevents individuals from engaging in biotech; rather, it is a culture informed by fear, war, and bio-terrorism that dismisses public participation in biotechnological practices as dangerous. She argues forcibly in opposition to this shift towards militarization:

> The conflation of bioterrorism and biology can only be achieved by removing it from everyone's home, purging it from daily experience and reintroducing it as a threat (cross-dressed in a biohazard suit), from which the citizenry needs to be protected. It can only be achieved because most people have never walked into a lab, and never recognized that the pile of dirty test tubes, Petri dishes and unwashed equipment on the sink in the lab as familiar, these appear alien despite the fact they look rather like the pile of dishes beside the sink at home. They have never recognized that the laminar flow hoods are not so different from the stove vents in your kitchen, have never cultivated the bacteria in their mouth, sterilized (i.e. cooked) something or understood that we think with juicy biological concepts, organize genetic heritability as much through marriage and immigration laws and our performances in bedrooms as we do with sperm

> banks and gene markers. Life, and politics, and everything in between is biological. This is not a territory we can concede to the lobbyists.[37]

Jermijenko connects the criminalization of amateur biotechnology with the McCarthy-era criminalization of communism and socialism. She argues that biology and biological experimentation is not inherently dangerous; it is only rendered so when the industrial military complex expends enormous financial and human resources in weaponizing biological agents. She concludes that we should "take biotech material, experiments and inquiry in to the unsupervised autonomy of your home"[38] as a form of resistance. This action would reassert the autonomy of the individual in this field and also redefine the non-specialist as a valuable contributor to society and scientific knowledge.

> In the kits and explorations we have discussed, the one thing that is absolutely unequivocally clear is that biotechnology is not something confined to well funded academic and corporate labs. The ideas and technologies of biotech effect us all. Biotechnology has far reaching effects on our health, on our environment and on our politics and many effects we cannot yet know or specify. It even effects our own sense of political agency in the world: are we predetermined by genetic

---

[37] Natalie Jeremijenko. "Amateurity and Biotechnology" from *The Biotech Hobbyist Magazine*. Available online: URL: http://www.locusplus.org.uk/NJ01.pdf [date of last access: 09/01/2006] p.10.

[38] Natalie Jeremijenko. "Amateurity and Biotechnology" from *The Biotech Hobbyist Magazine*. Available online: URL: http://www.locusplus.org.uk/NJ01.pdf [date of last access: 09/01/2006] p.10. p.4.

dispositions, or by the environments in which we live. Biotech hobbyist emphasizes the later; this is where we can act, change and improve things.[39]

In "Amateurs and Hobbyists," Heath Bunting makes a similar argument: artists need to be active participants in biotechnological research. He illustrates his case by outlining a number of his own bioart projects. Bunting, like Eugene Thacker, links the biotech hobbyist movement to amateur models in the early computing industry — but unlike Thacker and Jeremijenko, Bunting sees an imminent future in which biotechnology achieves ubiquity in the home. He states, "Similarly I predict that in another ten years time or less the general public will be enthusiastic users of domestic biological equipment. As with computer systems, biotechnology gadgets will be access points to utility and identity products and will be treated with as little thought as mobile telephones are presently."[40] Although I am not persuaded that this movement is as imminent as Bunting predicts, it is interesting to note that biotech gadgets have already made their way into the home through avenues of children's science toy sets. Products such as the DNA Isolation Lab, the Discovery Kids Ultimate Labs DNA Explorer, and the CSI DNA Lab are all available for purchase online or at specialty toyshops. On some level, Bunting's prediction is already coming true: a number

---

[39] *Ibid.* p.10

[40] Heath Bunting. *The Biotech Hobbyist Magazine.* Available online: URL: http://xdesign.ucsd.edu/biotechhobbyist/ [date of last access: 09/01/2006] p.3.

of bioartists have purchased these toys for the purposes of research. At a substantially lower cost than purchasing new or used lab equipment, non-specialists who wish to experiment with biotechnology are able to acquire durable, functional, and portable equipment.

Critical Art Ensemble

Another major proponent of non-specialist participation in biotechnology from a politicized perspective is the acclaimed artist collective Critical Art Ensemble. Critical Art Ensemble (CAE) is a conglomeration of artists and activists working in the United States for the last decade. Its founding members include the artists Steve Kurtz, Steve Barnes, Dorian Burr, Hope Kurtz, and Beverly Schlee. The group often collaborates with artists such as Paul Vanouse, Faith Wilding, and Beatriz da Costa, as well as many others. CAE has published a number of books and articles focusing on tactical means for artists and activists to engage in hegemonic systems of power and control through capital. They write, "Tactical Media is situational ephemeral, and self-terminating. It encourages the use of any media that will engage a particular sociopolitical context in order to create molecular interventions and semiotic shocks that contribute to the negation of the rising intensity of authoritarian culture."[41]

---

[41] Critical Art Ensemble. in *The Interventionists: A User's Manual for the Creative Disruption of Everyday Life*. Thompson, Nato. Edt. 2004, Mass MoCA Press. p. 115.

In my understanding, CAE is engaged in a form of participatory post-Marxist criticism, focusing specifically on upsetting capital drives in technological sectors through amateur interventions in specialized biotechnologies. In *Electronic Civil Disobedience: and other unpopular ideas*, CAE argues that, in order for civil disobedience to be as effective today as it was in the 1960s, activists must familiarize themselves with the current channels for the flow of capital so that they can impede those flows from the outside. In the past, capital relied on physical infrastructure and therefore physical forms of protest were effective (for example, a sit-in). But with the digitization of capital must come the digitalization of resistance.[42]

With *(RE)embodying Biotechnology*, I am arguing that this strategy can be successfully applied in the biotechnological sphere — that with the biotechnologization of capital that occurs in technology sectors today, resistance must also occur on a biological level if it is to be effective. CAE's more recent writings and artworks, which focus on biotechnology (and particularly transgenics), are a stunning example of complex biotechnological resistance through amateur production. Resistance, as it is mobilized by CAE, is complex and can easily be misinterpreted as a blanket critique of all transgenic production in the biotechnological sphere. In this instance, resistance implies risk assessment — third-party, non-specialist risk assessment of individual instances

---

[42] Critical Art Ensemble. *Electronic Civil Disobedience: And Other Unpopular Ideas*. Brooklyn: Autonomedia, 1996. p. 117.

of transgenic manipulation towards informed dialogue, critique, and consent. CAE explains,

> When we do projects concerning transgenics, one of the most common questions participants ask is whether CAE is for or against genetically modified Organisms (GMO's). The reply from group members is always the same: We have no general position. Each product or process has to be taken on a case-by-case basis. Some appear disastrous (primarily to the environment), while others seem soundly engineered and useful.

CAE is a staunch supporter of amateur science in general and, more specifically, amateurism as a form of activism and/or intervention in the authoritative capitalist drives in the biotechnological sector. They suggest that the amateur possesses a vital role in knowledge production in the hard sciences: "They (amateurs) can have the ability to spot contradictions and rhetorical cover-ups within the dominate paradigms, are freer to recombine elements of paradigms thought dead or unrelated, and can apply every day life experience to their deliberations with greater ease than can specialists."[43]

CAE outlines their reasoning for this deployment of amateur biotechnological strategies in their seminal work *The Molecular Invasion*. In chapter 3,

---

[43] Critical Art Ensemble. in *The Interventionists: A User's Manual for the Creative Disruption of Everyday Life*. Thompson, Nato. Edt. 2004, Mass MoCA Press. p. 147.

"Transgenic Production and Cultural Resistance: A Seven Point Plan," they outline a strategy for cultural resistance, that relies heavily on notions of amateurism as an effective form of activism, against industrialized transgenic production that. The plan is as follows:

1 Demystify transgenic production and products

2 Neutralize public fear

3 Promote critical thinking

4 Undermine and attack Edenic and utopian rhetoric

5 Open the halls of science

6 Dissolve cultural boundaries of specialization

7 Build respect for amateurism[44]

CAE has taken a number of steps towards achieving these goals through the propagation of amateur scientific protocols and research methodologies in the production of art. For example, projects like *Free Range Grain*, *The Cult of the New Eve*, *Genterra* (*fig.*10.), and *Contestational Biology*, amongst others.

[44] Critical Art Ensemble. *The Molecular Invasion.* Brooklyn: Autonomedia, 2002. p. 59.

(*Fig.*10.)

Critical Art Ensemble in collaboration with Beatriz da Costa
Genterra
St. Norbert Art and Culture Center, Winnipeg
2001

CAE serves as arguably the best example of interdisciplinary non-specialist incursion into both the biotechnological field and the public representation of biotechnology and bioart, not simply because of the quality of their critical writings and artwork but because CAE now serves as a legal test case for the viability of amateurism in biotechnology. On May 11, 2004, Steve Kurtz, a professor, artist and member of Critical Art Ensemble, woke up to find that his wife, Hope Kurtz, had suffered a heart attack and died in her sleep. He called 911. When the paramedics arrived, they observed laboratory equipment, samples of bacteria growing in Petri dishes, and books written on biological warfare and bio-terrorism in his home. Cranked up on the pervasive media

rhetoric of the 'War on Terror,' the police suspected that Kurtz's art supplies might be bio-terrorist weapons and contacted the FBI. The FBI sequestered Kurtz in a local hotel without pressing charges, sealed off his neighborhood, and, with a HAZMAT team dressed in biological hazard suits, confiscated his computers, manuscripts, and art supplies — even his wife's body.

Subsequently, Kurtz and nine of his colleagues were subpoenaed to testify before a grand jury. The FBI sought charges of terrorist activity under Section 175 of the US Biological Weapons Anti-Terrorism Act of 1989 and the expanded USA Patriot Act. This law prohibits the possession of "any biological agent, toxin, or delivery system" without the justification of "prophylactic, protective, bona fide research, or other peaceful purpose."[45] This law was applied to Kurtz's possession of equipment for DNA analysis and cultures of three common and harmless bacterial species (*Escherichia coli*, *Bacillus globigii*, and *Serratia marcescens*). Of course, the real danger posed by Kurtz and Critical Art Ensemble goes far beyond their possession of simple biological cultures. The true threat of Kurtz's practice is not to the health and safety of the American people but to the intellectual and ideological stronghold of the corporate and government monopoly over biotechnological practices.

The charges of biological terrorism were eventually dropped, as there was no

[45] United States Code: Title 18, Part 1, Chapter 10, § 175. Prohibitions with respect to biological weapons; as recorded by the *Legal Information Institute*, available online URL: http://www4.law.cornell.edu/uscode/18/175.html [date of last access: 06/15/05]

case to support this accusation. However, Kurtz was charged with a civil offence of wire and mail fraud to the amount of US$256.[46] Scientist Dr Robert Ferrell, Chairman of the University of Pittsburgh's Human Genetics Department, was also indicted for providing Kurtz with biological materials outside of the material transfer agreement he signed with ATCC (the distributor of the bacteria in question). If found guilty, Kurtz and Ferrell were looking at the possibility of spending 20 years in jail for committing a federal offence. During this time, Ferrell became gravely ill, pleaded guilty to a misdemeanor, and was fined $500.00 US and given one year unsupervised release for his part in the transaction.

Paradoxically, this unfortunate chain of events suggests that CAE's amateurism cannot be interpreted as entirely successful if it lands its artists, researchers, and activists in a position where incarceration is a possible outcome. On the other hand, this situation can be read as profoundly accurate, in political and tactical terms, due to the fact that the highest levels of the American government are mobilized in opposition to CAE's amateurism in an attempt to preserve specialization (and therefore government and corporate control) in the biological sciences.

---

[46] Critical Art Ensemble, *Critical Art Ensemble Defense Fund*, art collective website, available online URL: http://www.caedefensefund.org [date of last access: 06/15/05]

Anna Munster, in her analysis of Kurtz's case, sees the indictment of Kurtz and Ferrell as part of a continued societal push towards control of research, information, and life through the canon of specialization.

> It is clear that the policing of America means the confinement of people, knowledge, resources and cultural production to their proper spheres. Artists using materials that are authorized for scientific research cannot possibly be conducting research as well. They are clearly defrauding the public and this should be regarded suspiciously. As the American scientific community has been quick to note, bringing the fraud allegations against a scientist also has implications here for the ongoing conduct of scientific research (Park, 2004). The routine sharing of resources (materials) among laboratory researchers will be subjected to stricter regulation with the threat of fraud hanging over collaborative scientific research and hence this will see an increasing privatization of both research processes and outcomes.[47]

Munster's arguments, as well as the events that transpired in the American courts, are indicative of the powerful control mechanisms critiqued by CAE in their various publications. As of April 21, 2008, the charges have been dropped

[47] Anna Munster. "Why is Bioart Not Terrorism?: Some Critical Nodes in the Network of Informatic Life. » in Culture Machine; avaliable online: URL: http://culturemachine.tees.ac.uk/frm_f1.htm [date of last access: 09/01/2006]

against Steve Kurtz. It was found that there was no instance of fraud in regard to the transaction that occurred during the acquisition of the bacteria for CAE research. Certainly, damage has been done in terms of directing public opinion towards scientific amateurism and bioart as a possible form of bioterrorism — there was mass American media coverage of the FBI HASMAT teams rifling through Kurtz's home and neighborhood and subsequently much less coverage of the downgrading and eventual dismissal of charges against Kurtz. But a critical precedent has been set in the US legal system in regard to material transfer agreements, and even more significantly in terms of the value and validity of non-specialist participatory models for engaging in biotechnology.

Bioart in the Media

Outside of this significant but rare instance of the vilification of bioart practices, bioart discourse has begun to surface in popular media sources as a valid and fruitful incursion into the biotechnological sciences. bioart seems to have captured the contemporary media imagination on a number of levels: as a quirky and humorous practice, as a tool of social and political activism and criticism, as a 'new' evolution in artistic practices, and even as a locus or 'quotable source' in the evaluation of contemporary biotechnological research.

For example, in her article "Bio-artists use science to create art," Jessica M.

Pasko writes,

> Adam Zaretsky once spent 48 hours playing Engelbert Humperdincks's Greatest Hits to a dish of E.coli bacteria to determine whether vibrations or sounds influenced bacterial growth. Watching the bacteria's antibiotic production increase, Zaretsky decided that perhaps even cells were annoyed by constant subjection to "loud, really awful lounge music."[48]

Although some could interpret this humorous portrayal of biological art practices as too playful, and possibly dismissive of the social and political ramifications of Zaretsky's work, I see the tone of this type of 'human interest' reporting as influential in propagating accessibility to the reader. This article is an especially good example, as it addresses the 'professional' successes of the artist and mixes outrageous and entertaining references to Engelbert Humperdinck with reflective philosophical assertions made by the artist himself: "(Bio-art) is a way of looking where we interface with ourselves, human culture and the rest of the living world," claims Zaretsky.[49] The combination of such a witty, almost self-deprecating tone and sanctioned, even institutionalized criticism of science

---

[48] Jessica M. Pasko, "Bio-artists use science to create art," in USA Today, March 5, 2007. Available online URL: http://www.usatoday.com/tech/science/ethics/2007-03-05-bio-art_N.htm [date of last access: 06/15/08]

[49] *Ibid.*

allows for a very accessible set of arguments for the democratization of biotechnology. The article concludes in a similar manner: with black humor.

> Part of the problem with bio-art, explained RPI faculty member and Kurtz's colleague Rich Pell, is that much of it seems shrouded in secrecy because of the laboratory setting. Pell and Reodica are working to combat this through the creation of the Center for Bio-Media, a gallery, lab and educational facility that will be open to the public.
>
> "With bio-art, rather than just freaking out about it, you can then go into a lab where things are actually happening and then have an 'educated freak-out,'" Pell said.[50]

It seems that the emphasis on social and political activism and science criticism also translates well into more generalized media outlets. Oron Catts and Ionat Zurr, of Tissue Culture & Art Project, are well versed in speaking to the media in a way that emphasizes the critical strategies in their artworks. In the *Wired Magazine* article "Jacket Grows from Living Tissue," they are represented as such:

> While there's still lots of research to be done before a fully formed live jacket can be created, the artists are quick to point out that they aren't interested in creating commercial products or even furthering scientific

---

[50] Jessica M. Pasko, "Bio-artists use science to create art," in USA Today, March 5, 2007. Available online URL: http://www.usatoday.com/tech/science/ethics/2007-03-05-bio-art_N.htm [date of last access: 06/15/08]

research. Calling themselves conceptual artists who create working prototypes, they say their aim is to bring to the forefront the philosophical implications of making living organisms tools for our own purposes.

"It's quite a scary thing, our attitude to life as it is at the moment," said Zurr. "And the more we manipulate life for human-centric purposes, I wonder now how compassionate we are going to be towards those living systems. Our work is more about questioning these things rather than saying, 'This is great, let's go for it.'"[51]

Even scientific sources that discuss bioart in the media recognize the critical and transformative potential of bioart. Here, Dr. Stuart Newman speaks candidly about Eduardo Kac's *GFP Bunny* project as having significant potential in public discourse surrounding biotechnology:

Even one of Kac's most passionate critics applauds him for drawing attention to what is now being done in genetics research.

"It kind of turns the searchlights back on scientists," said Stuart A. Newman, a professor of cell biology and anatomy at New York Medical College who uses glowing proteins to track how animal limbs develop.

---

[51] Lakshmi Sandhana, "Jacket grows from living tissue," in *Wired Magazine*. Oct. 12, 2004. Available online URL: http://www.wired.com/science/discoveries/news/2004/10/65248 [date of last access: 06/15/08]

"There are some pretty awfully deformed animals in transgenic research, and scientists have sometimes done these things with no good theory behind it."[52]

Also, in a most interesting turn, *Wired Magazine* actually quotes bioartist Oron Catts as a critical source for evaluating unrelated scientific claims in the article "Careful with that Petri dish," where scientists are working with NASA towards growing human replacement organs with tissue engineering technologies in gravity-free environments. The article concludes with a quote from Catts:

"It sounds very interesting and might work for small pieces of tissue rather than full organs," said Oron Catts, director of SymbioticA. "The thing about microgravity tissue engineering is that it's a great way to make semi-living tissue, but the jury is still out in regard to getting the right morphology for eventual transplant into the body."[53]

I do see very promising inroads into mass media representations of bioart as an accessible and transformative social and political practice. However, the quantity

---

[52] Gareth Cook, "Cross hare: Hop and glow," in The Boston Globe. Sept. 17, 2000. Available online URL: http://www.ekac.org/bostong.html [date of last access: 06/15/08]

[53] Lakshmi Sandhana, "Careful with that Petri dish," in *Wired Magazine*. Aug.16, 2004. Available online URL: http://www.wired.com/science/space/news/2004/08/64577 [date of last access: 06/15/08]

of mainstream reporting is still relatively low, and quite often the complexity and depth of content is disappointing.

Articles published in artistic or scientific journals are far more likely to delve into the complexity of bioart practices.

> "Transgenic animals are often talked about as objects," he says, delighted by the attention Alba has received. "I want to talk about transgenics as social subjects, and contextualize their existence as for its own sake, to shift the discourse away from this cliché of Frankenstein and Dr. Moreau." Kac doesn't want to comment on genetics as much as he likes "going in the trenches" and using genetic engineering to hold a mirror to itself. "I am not interested in reinstating scientific principles," he says. "My work doesn't visualize science, it is not meant to duplicate the information that circulates from science to media to the public. It is meant to intervene, to change, to criticize, point out, reflect and modify." He doesn't really consider Alba to be "art" at all. Rather, she is but a small part of a much larger, more political project. The GFP Bunny project, says Kac, includes not only the process of bringing Alba into the world and integrating her into society, but also deliberately provoking the fears, imaginations and hopes we have attached to genetics and new life forms. One small hop for Alba; one large hop for mankind.[54]

---

[54] Ulli Allmendinger, "One small hop for Alba, one large hop for mankind," in *NY Arts Magazine*, Vol.6 No. 6 June 2001. Available online URL: http://www.ekac.org/ulli.html [date of last access: 06/15/08]

Though the examples that I have provided are telling in regards to public perceptions of bioart practices, instances of bioart coverage in the news media are still relatively rare. As bioart is still an emerging practice on the international art scene, I imagine that media references will continue to grow in numbers as the field expands in public discourse.

3 | (RE)embodying Digital Metaphors in Biotechnology

> *Insert block of new genes into a freshly fertilized egg. The one cell becomes two, then four, then eight. Each new version carries the extra information. In nine months, a baby is born. Every cell in his or her body contains the extra genes.*
>
> *Daniel Q. Haney, Life Magazine.*[1]

In his 2000 article "Designing Baby: Scientists on Verge of Manipulating Human DNA," Daniel Q. Haney describes an evolving biotechnological process called human germline engineering. He explains how scientists are working to genetically alter human blastocysts soon after conception so that genetic changes will be passed on to the embryo's future offspring. Haney is exuberant in his description of the therapeutic potentialities of this instance of biotechnology, but brief and almost curt in describing the actual processes that are involved in germline engineering. He relies heavily on digital metaphors to describe wet biotechnological practices (involving living organisms) to the general public, suggesting that this biotechnological process is much like computation. In his article "Were You Born That Way?" (1998), which was

---

[1] Daniel Q. Haney, "Designing Baby: Scientists on Verge of Manipulating Human DNA" Associated Press, March 5, 2000. Available online: URL: http://www.genetics-and-society.org/resources/items/20000305_ap_haney.html [date of last access: 08/01/2005]

published in *Life Magazine*, George Howe Cult compares the future of genetic engineering to shopping online. "By the time my daughter's grandchild is ready to give birth, prospective parents may design their children at the computer, scrolling through genetic menus to pick and choose, from their own DNA pools, specific gene clusters for height, weight and eye color, as well as for assertiveness, extroversion, happiness and so on."[2] Contemporary media representations of biotechnology often place great emphasis on notions of digitality and programmability as inherent technologies of the human organism, suggesting that our 'cumulative' technology — computation — performs the ultimate science: enforcing the dominion of human intelligence over nature through the application of numeric code to living organisms.

<copy> <paste> <insert> <delete> <error>

<code> <program> <download>

<cross-platform> <software> <hardware>

These terms, although derived from a variety of linguistic sources, traditions, and histories, are all used extensively in describing and interacting with the digital domain and have come to evoke strong references to computation in the mind of the speaker, writer, listener, or reader. With the exponential proliferation of computational technologies on arguably a global scale, we have comfortably

[2] George Howe, and Anne Hollister. "Were You Born That Way" in *LIFE Magazine*, Apr98, Vol. 21, Issue 4.

positioned ourselves, historically and technologically, in the digital era. Digital information and communication technologies dominate substantial portions of our personal, social and work lives. Email, the Internet, podcasts, chatrooms, downloads, iPods, BlackBerrys, cellphones, and portable hard drives are present throughout our daily lives.

Questions about affect arise when one considers our deeply intimate and reciprocal relationships with digital technologies as individuals, as a society, and as a civilization. In his introduction to *The Cybercultures Reader*, David Bell writes,

> Are we now so inseparable from our computers that we have effectively become them? Are they us? Are they extensions of our identities – prostheses? Do we blend with them, each incorporating the other, to become hybrid cybernetic organisms – cyborgs?[3]

The normalization (or even the naturalization) of computational infrastructure in our society, ecology, and personal lives has lead to a reciprocal inflection where matter and existence is interpreted through a digital technological lens.

---

[3]David Bell, "Cybercultures Reader: A User's Guide" from *The Cybercultures Reader.* David Bell and Barbara M. Kennedy. Edts. New York: Routledge, 2000. p.4.

In his work *The Biotech Century: Harnessing the Gene and Remaking the World*, Jeremy Rifkin reminds us that, with each technological revolution, society begins to interpret itself and the natural world through the metaphors of the dominant technological paradigm. He illustrates how the dawn of the printing press, a communication technology that was absolutely central to the industrial revolution, created new avenues for political and economic activity and new systems of organizing knowledge — effectively changing human consciousness and creating the new bourgeois man and woman of the modern era.[4] With the computer revolution, a similar phenomenon occurs. As digital technologies permeate our existence, they change the very foundations of our conceptualization to coincide with this powerful model.

> Every major economic and social revolution in history has been accompanied by a new explanation of the creation of life and the workings of nature. The new concept of nature is always the most important strand of the matrix that makes up any new social order. In each instance, the new cosmology serves to justify the rightness and inevitability of the new way human beings are organizing their world by suggesting that nature itself is organized along similar lines. Thus every society can feel comfortable that the way it is conducting its activities is compatible with

[4] Jeremy Rifkin, *The Biotech Century: Harnessing the Gene and Remaking the World*, (New York: Tharcher/Putnam, 1998), p. 176.

the natural order of things, and therefore, a legitimate reflection of nature's grand design.[5]

Rifkin both identifies this phenomenon and is subject to it himself. It is inescapable for all of us. A few pages earlier in this text, Rifkin states, "The computer's mode of organization – especially parallel computing – mirrors the processes of living systems where each of the parts is a node in a dynamic network of relationships that is continually readjusting and renewing itself at every level of its existence as it maintains a living presence."[6] As we are inherently a product of our own production and reproduction of a computation ecology, it is impossible to escape this conceptual loop in which nature and information cohabitate and interact with one another.

However, it is my assertion that, with the ubiquity of digital media in all aspects of society, we run the risk of applying this model indiscriminately — to our understanding of nature, the body, and biotechnology. I, too, am subject to this phenomenon; it is evident in my existence, my self-concept, and my academic and artistic research trajectories that possess deep cybernetic underpinnings. I am convinced that there are significant parallels between computational models and emergent natural behaviors. I am, however, concerned about the resulting conceptual collapse of disparity between instances of embodiment and virtuality, particularly as it pertains to ethical debates surrounding biotechnology.

---

[5] *Ibid.* p.197.
[6] *Ibid.* p.180.

I am not arguing for a distinct border between the body and technology, between nature and culture. Cybernetic theory, articulation, pluralism, and, most imperatively, dialogical analysis all inform my understanding of the complex, evolutionary, and sometimes contradictory intersection of computation and biology as it affects our bodies, our society, and our ecology. However, in this particular text, I see a strong tendency to describe, imagine, and imbue biotechnological protocols with visions and languages that often replace wet and sometimes bloody biological manipulations with digital and computational task descriptions — a replacement that has the potential to distort the invested, embodied, and ecological implications of this type of research. It is my assertion that, with this shift in public discourse away from organicism, ethical debates addressing biotechnology and its specific protocols (such as tissue culture, protein magnification, and mammalian cloning) are often misinformed and inhibited by the continual reinvestment in powerful computational metaphors. How are we to reconcile the ethical issues presented by the instrumentalization of life in biotechnology if we only refer to and imagine the field as a virtual one? In other words, there must be variety and divergence in ethical consideration as it is applied to information — and as it is applied to the body.

In this chapter, I want to explore the power of digital metaphors in constructing ideological frameworks for the consideration of the ethical implications of evolving biotechnologies. My interest here does not reside in the specificity of

certain biotechnological ethical debates in and of themselves (as that is outside of the scope of this text). Instead, I want to identify the dangers of mobilizing digital metaphors in public discourse surrounding biotechnology and investigate the possibility of shifting our language and imaginings towards more embodied models and paradigms. The goal of this project is to facilitate new grounds of consideration for the general public, specialists, lobbyists, corporations, and governments in an interdisciplinary and dialogical manner so that we can discuss, consider, practice, and plan our relationship — both current and future — with ourselves and our ecology in the biotech era. I am only proposing a new model for complex discourse; the resulting outcomes and decision-making trajectories are left open to the public.

To support this proposal, I will address a number of points beginning with a brief analysis of how metaphors shape our world and our conceptualization. I will identify digital metaphors commonly used in describing biotechnology in a variety of media, with an emphasis on written and spoken language. I will then locate the possible origins of and the practical and theoretical reasons for the continued perpetuation of these metaphors. This chapter will close with proposed alternative language sets (as primarily generated from the arts and humanities) towards the (re)embodiment of biotechnological terminology in public discourse.

Metaphors

To begin with this analysis, we need to address the power of metaphors in shaping our concepts of ourselves and the world. George Lakoff and Mark Johnson extensively explore the role of metaphors in our construction of meaning in *Metaphors We Live By*. They argue that the use of metaphor is pervasive in everyday life — in our language, our thought, our action — and also functions as a central component of our conceptual system. They define metaphor as such: "The essence of metaphor is understanding and experiencing one thing in terms of another."[7] Commonly used metaphors establish culturally specific norms for understanding a concept, action, or thing. For example, Lakoff and Johnson address the Western metaphor of argument as war, elucidating a variety of linguistic examples for their readers.

> Your claims are *indefensible.*
>
> He *attacked every weak point* in my argument
>
> His criticisms were *right on target.*
>
> He *shot down* all of my arguments.[8]

The pervasiveness of this adversarial model naturalizes the concept that an argument is inherently like a war. However, this is not the case. For example,

---

[7] George Lakoff and Mark Johnson, *Metaphors We Live By*. Chicago: Chicago University Press, 1980. p.5.
[8] *Ibid.* p.4.

> Imagine a culture where an argument is viewed as a dance, the participants are seen as performers, and the goal is to perform in a balanced and aesthetically pleasing way. In such a culture people would view arguments differently, carry them out differently, and talk about them differently. But *we* would probably not view them as arguing at all: they would simply be doing something different.[9]

They argue that metaphors are essential for human conceptualization and communication. However, they also address some of the possible drawbacks of relying so heavily on metaphorical systems of understanding. For example, they argue that strong metaphors only allow us to focus on one aspect of the metaphorized concept, keeping "us from focusing on other aspects of the concept that are inconsistent with that metaphor."[10] This explains my concern with digital metaphors for understanding biotechnology.

Certainly, biotechnology is saturated with computation, both literally and figuratively, but it is important to remember that they are not entirely equal; they are not inherently the same. The most significant difference between biotechnology and computation is the element of organic (and sometimes sentient) life, which is pervasive throughout biotechnology and generally absent (or existing in satellite relation as the user) in the computational domain. "It is

---

[9] George Lakoff and Mark Johnson, *Metaphors We Live By*. Chicago: Chicago University Press, 1980. p.5.
[10] *Ibid* p.10.

important to see that the metaphorical structuring involved here is partial, not total. If it were total, one concept would actually *be* the other, not merely be understood in terms of it."[11] If we accept the arguments of Lakoff and Johnson and deploy their methodology, we can deduce, from the following statements, that individuals and public discourse generally accept and perpetuate digital metaphors in describing evolving biotechnologies.

> Recent advances in genetic engineering now allow the design of *programmable* biological *artifacts*.[12]

> Working with lung cancer tissue and laboratory-grown lines of lung cancer cells, the investigators used high-resolution machinery to *scan* the cells' chromosomes. They found several areas that had already been identified as having *copy-number errors*, plus five new ones - two where genes had been *deleted*, and three where they had been over-*copied*.[13]

---

[11] *Ibid* p.13.

[12] Dan L. Burk, "Lex genetica: The law and ethics of programming biological code" from *Ethics and Information Technology 4*, Netherlands: Kluwer Academic Publishers, 2002. pp. 109-121. Available online: URL: http://www.student.cs.uwaterloo.ca/~cs492/papers/biocode.pdf [date of last access: 02/01/2009] (My emphasis.)

[13] "DNA-scanning technology finds possible sites of cancer genes in chromosomes of lung cancer cells" from *Harvard Science Medicine + Health* June 30, 2005. Available online: URL: http://www.harvardscience.harvard.edu/medicine-health/articles/dna-scanning-technology-finds-possible-sites-cancer-genes-chromosomes-lung- [date of last access: 02/01/2009] (My emphasis.)

The bacterium behind one of mankind's deadliest scourges, tuberculosis, is helping researchers at the Commerce Department's National Institute of Standards and Technology (NIST) and the Department of Energy's Brookhaven National Laboratory (BNL) move closer to answering the decades-old question of what controls the *switching on* and *off* of genes that carry out all of life's functions.[14]

The actual transfer of a gene is carried out in a complex "*cut and paste*" procedure.[15]

As long as DNA specimens are a youthful 60,000 years old or less and are in good condition, scientists say they can *decode* an organism's DNA sequence from something as simple as a piece of hair.[16]

---

[14] "Determining How 'Gene Switch' Works: Using Tuberculosis Bacteria To End 25-Year Quest." from *Medical News Today*, Feb. 9, 2009. Available online: URL: http://www.medicalnewstoday.com/articles/138280.php [date of last access: 02/15/2009] (My emphasis.)

[15] "How Does Biotechnology Work?" from *Canadian Food Inspection Agency – Resource Centre.* Available online: URL: http://www.inspection.gc.ca/english/sci/biotech/gen/canadae.shtml [date of last access: 02/01/2009] (My emphasis.)

[16] Melissa Suran, "Jurassic Park in Millennium Park? Penn State prof says it could happen." from *Medill Reports*, Chicago: Northwestern University, Feb. 4, 2009. Available online: URL: http://news.medill.northwestern.edu/chicago/news.aspx?id=114307 [date of last access: 02/15/2009] (My emphasis.)

This set of ideas can also be applied more specifically to the scientific domain itself. Metaphors possess great power not only in public discourse but in specialized discourses as well.

If we imagine the power of metaphor as it exists in the scientific community, we can look to the model of the paradigm as asserted by Thomas Kuhn in his now canonical text *The Structure of Scientific Revolutions* (1967). At the time of publication, his arguments were considered quite controversial, as his thesis directly challenges the perception of science as a purely objective field of inquiry. Instead, he argues that scientific inquiry, although an integral (and possibly optimal) mode of seeking knowledge, is a field based in interpretation and subject to a multitude of variables rather than an exact reflection of the universe around us. He suggests that the majority of scientific work (normal science) is driven by paradigms, which he defines as community-driven models for understanding the natural world, as well as the driving force for establishing parameters and strategies for scientifically investigating that world. He states, "Paradigms gain their status because they are more successful than their competitors in solving a few problems that the group of practitioners has come to recognize as acute."[17] This is not to say that a paradigm is necessarily true or completely successful, but rather that a community of scientifically established individuals has agreed to a set of basic principles by which to guide their research.

---

[17] Kuhn, Thomas S. *The Structure of Scientific Revolutions* (second Edition, enlarged) Chicago: The University of Chicago Press, 1970. p.23

In *Crystals, Fabrics, and Fields: Metaphors that Shape Embryos*, Donna Harraway claims that "An important aspect of a paradigm is metaphor, and it is suggestive to investigate the use of metaphor to direct research and its interpretation."[18] "A metaphor is the vital spirit of a paradigm (or perhaps its basic organizing relation)."[19] "The crudeness of a paradigm picture both stimulates and bounds the imagination, giving direction to the power of abstract expression, and linking the contributions of images private to a particular scientist, words that aim to communicate insight and theories that formalize tested common understanding."[20] She argues that metaphors are so powerful in the mind of the beholder (specifically the scientist) that they can even effect paradigmatic change in the scientific community. Harraway explains her primary thesis for her understanding of metaphor to the reader:

> The focus of this study is a period of crisis and reformulation of basic concepts in experimental embryology and cell biology. The two major concepts sketched above, that of the significance of the metaphor in a revolutionary change in paradigm and that of the progressive concretization of aesthetic dictates, together form the core of the analysis.[21]

---

[18] Donna Haraway. *Crystals, fabrics, and Fields: Metaphors that Shape Embryos*. Berkeley, California: North Atlantic Books, 1976, 2004. p.2.
[19] *Ibid.* p.9.
[20] *Ibid.* p.189.
[21] *Ibid.* p.13.

This work, originally published in 1976, does not address digital metaphors in the biological sciences directly, but it does lay the groundwork for important future analysis of the perpetuation of digitality as a metaphor for the biological in the hard sciences.

Although this area of investigation is outside the focus of this text (as I am focusing on public discourse), I have selected a few extracts from scientific abstracts hosted on the BIOSIS Preview[22] journal search service that exemplify the use of digital metaphors in describing biotechnological protocols in scientific literature for consideration.

> The ability to measure accurately comparative levels of protein expression after drug challenge, metabolic stress, developmental *programming* or other perturbation represents one of the most important goals in post-genomics malaria research.[23]

---

[22] *Bios Previews*, Available online: URL: http://scientific.thomson.com/products/bp/ [date of last access: 06/01/2008]

[23] Nirmalan, Niroshini; Sims, Paul F. G.; Hyde, John E. "Quantitative proteomics of the human malaria parasite Plasmodium falciparum and its application to studies of development and inhibition" in *Molecular Microbiology* 52 (4) : 1187-1199 May 2004. (My emphasis.)

> Recombinant DNA technology was used to *delete* the gene *encoding* lactate dehydrogenase in BCS3-L1 making it entirely deficient in lactic acid production.[24]

> See is, moreover, incorporated into proteins by an expansion of the genetic *code* as the translation of selenoproteins involves the *decoding* of a UGA codon, otherwise being a termination codon.[25]

What I am most interested in — and what is closest to the heart of *(RE)Embodying Biotechnology* — is the powerful influence that these metaphors have in shaping public opinion and understanding of the science and industry of biotechnology. I am most interested in digital metaphors for biotechnology as they are presented in television, news (both in print and online), non-documentary film, and literature, as it is these sources that contribute greatly to the public imagining and understanding of biotechnology, rather than scientific journals and academic analysis. We have already reviewed a selection of quotations from popular news sources that reinforce or exhibit these metaphors in terms of 'factual' reporting, but we must also consider fictional incarnations of

---

[24] Jeffrey D. Hillman, "Genetically modified Streptococcus mutans for the prevention of dental caries"in *Antonie van Leeuwenhoek* 82 (1-2) : 361-366 August, 2002. (My emphasis.)

[25] Linda Johansson, Gafvelin, Guro; Arner, Elias S. J. "Selenocysteine in proteins - properties and biotechnological use" in *Biochimica et Biophysica Acta* 1726 (1) : 1-13 OCT 30 2005. (My emphasis.)

biotechnology as they, too, contribute to depicting biotechnology as a programmable or virtualized practice.

Michael Clark writes, "Films with genetic themes represent the point where modern biomedical science meets subjective concerns and cultural anxieties about individual identity and freedom, and their implicit and explicit messages reach and influence millions of people in all walks of life who will probably never watch a BBC 'Horizon' documentary or read a popular science book on genetics."[26] Fictionalized accounts of biotechnology, particularly in the form of mainstream commercial films, reach an immeasurably wide, international audience.

These films capture both the attention and the imagination of the public, effectively cultivating their perceptions of biotechnology in a manner that is arguably more potent than other forms of media. In his book *Screening DNA: Exploring the Cinema-Genetics Interface*, Stephen Nottingham writes:

> The importance of stories in helping us think through scientific issues has been increasingly recognized in recent years. In particular, the repeated use of metaphors has been shown to shape how we perceive and understand issues. The images presented by popular culture appear to

[26] Michael Clark, "Genetic theames in Fiction films" from *The Welcome Trust*. Available online: URL: http://genome.wellcome.ac.uk/doc_WTD023539.html [date of last access: 02/15/2009]

have some influence on common belief, and determine what is perceived as socially acceptable.[27]

Eugene Thacker argues that popular culture is a site where cultural anxieties and ambiguities can be played out. He also argues the films, however, rarely focus on biotechnology as a primary subject. He states, "Films 'about' genetics and biotechnology are usually of two types: those that contain, almost incidentally, genetics and biotechnology, but only to motivate the action of the film, or those that use genetics and biotechnology to raise larger 'human' issues."[28] In an online interview with Roy Christopher in 2006, Thacker traces the powerful outcomes of genetics as represented in film:

> One thing it means is that these sciences and technologies are normalized in a way that the general public going to a film will "accept" their inclusion as a matter of course. Certainly there are always SF geeks who dispute the technical accuracy of how the genetic mutation actually creates the superhero or villain, but on a general level these technosciences have become a part of a certain cultural imaginary.

My concern lies in the representation of the technical actions performed in biotechnology. This concern can be seen as easily dismissible — merely a

---

[27] Stephen Nottingham, *Screening DNA: Exploring the Cinema-Genetics Interface*. DNA Books, 2000. Available online: URL: http://ourworld.compuserve.com/homepages/Stephen_Nottingham/DNA1.htm [date of last access: 02/15/2009]

[28] Eugene Thacker, *The Global Genome : Biotechnology, Politics, and Culture*. Cambridge: The MIT Press, 2005. p.341.

geek's desire for technical accuracy — but I am not interested in pure accuracy; rather, I am concerned about the ramifications of the visual metaphors that depict biotechnological protocols as inherently digital.

Representations of biotechnology in non-documentary films often emphasize the practice of digital technological processes and protocols, in both contemporary and future incarnations. An excellent example is Stephen Spielberg's *Jurassic Park* (1993). The film depicts a well-meaning scientist who, using DNA extracted from blood stored within fossilized mosquitoes, clones prehistoric dinosaurs. The cloning process is described to audiences through a theme park mascot character called Mr. DNA. He explains, "thinking machines, super computers, and gene sequencers break down the strand in a minute and virtual reality displays show our geneticists the gaps in the DNA sequence." He prattles on, listing the virtues of cloning, and discusses the connection between genetic and digital codes. The laboratory is represented as a sterile computational site where, through programming and robotics, life is conceived, in the form of infant prehistoric dinosaurs.

W.J.T. Mitchell writes about *Jurassic Park* in *The Last Dinosaur Book: The Life and Times of a Cultural Icon*:

> Powerful new computers make it possible to imagine the resurrection of the dinosaur as nothing more than a computational problem in biogenetic engineering. The same computers make possible digital animation

techniques that replace robotics as the cinematic technology of choice. The dinosaur is a cyborg, a computer-animated animal, in both the story and the medium in which the story is represented.[29]

Nottingham notes that *Jurassic Park* is the third-largest grossing film in cinema history, behind *Star Wars* (1977) and *E.T.: The Extra Terrestrial* (1982), up until the release of *Titanic* in 1997.[30] Produced sixteen years ago, *Jurassic Park* is indicative of a flood of representations within the last three decades that reinforce public conceptions of biotechnology as primarily centered around genetic or digital manipulations of the body. Since that time, hundreds of films have been released that continue to shape public conceptions of biotechnology as driven by computation and interface, particularly when it comes to genetics.

As Thacker argues, filmic representations of biotechnology certainly can and should be understood as incredibly complex in the messages and metaphors they portray to the general public in regard to ethics, embodiment, and genetic technologies. I am not suggesting a blanket one-to-one ratio of representation, where all instances of biotechnology in film are solely rooted in portraying didactic, digital incarnations of biotech. However, I see a prevalent discourse which is based on the notion of interface — with an emphasis on those

---

[29] W.J.T Mitchell, *The Last Dinosaur Book: The Life and Times of a Cultural Icon.* Chicago: The University of Chicago Press, 1998.
[30] Stephen Nottingham, *Screening DNA: Exploring the Cinema-Genetics Interface.* DNA Books, 2000. Available online: URL: http://ourworld.compuserve.com/homepages/Stephen_Nottingham/DNA1.htm [date of last access: 02/15/2009]

biotechnologies rooted in genetics. These representations often present fully actualized organisms (bodies) as the output of computational protocols.

This focus is evident in a variety of films like *Minority Report* (2002), in which fetishized digital interfaces that are connected to three psychics, or "precogs," allow police investigators to apprehend criminals before a crime is committed. *Godsend* (2004) also relies on the premise of clean digital/video interfaces, this time used in the production of a cloned child in order to replace the diseased son of a grieving couple. In these instances, among others, the technical practices of biotechnology are misrepresented (or only partially represented) as an extension of computation with little or no attention given to the multitude of orders of life present in real instances of biotech, let alone the embodied (wet, bloody, unruly, and sometimes fatal) and reciprocal practices of manufacturing, maintaining and manipulating life in the lab.

Identifying and investigating digital metaphors for embodied biotechnological practices in fictional film representations of the field could (and should) constitute a significant body of academic research, although this necessary exploration is unachievable within this context. However, I choose to touch on this significant area in a tertiary way in order to support my own arguments without overlooking this critically important genre of representation in terms of its contribution to public discourse surrounding biotechnology.

The identification of computational metaphors in public biotechnological discourse leads us to an important question: where do digital metaphors for describing biotechnological protocols come from?

Molecular Biology and Bioinformatics

The short answer is molecular biology. Molecular biology, a term originally coined by Warren Weaver of the Rockefeller Foundation in the 1930s, generally refers to a branch of biology that studies the chemical and physical properties of life at a molecular level. This interdisciplinary field came to prominence in scientific circles in the 1940s with the discovery of the structure of DNA and subsequent research on protein production and molecular genetics (amongst others). Pnina G. Abir-Am highlights the rise of molecular biology, noting two shifts in the scientific perception of biology during this era: (1) molecular biology essentially displaced evolution as the central problem of the biological sciences, and (2) nucleic acids were conceptually transformed into messages of biological information.[31]

Lily E. Kay, in *The Molecular Vision of Life*, points to Dr. Erwin Schrödinger and his arguments for a genetic 'code script' in *What is Life?*, as a the forefather of informatic models for understanding biology at the molecular level. A Nobel

[31] Pnina G. Abir-Am, "The Politics of Macromolecules: Molecular Biologists, Biochemists, and Rhetoric" in *Osiris*, 2nd Series, Vol. 7, Science after '40. 1992. P.166

Prize-winning quantum physicist, Schrödinger applies his knowledge and understanding of the physical properties of the external world to the inner workings of the organism. *What is Life?* arguably functions as a locus for the metaphorical conjunction of computational and biological functions as early as 1944. He writes:

> It is these chromosomes, or probably only an axial skeleton fiber of what we actually see under the microscope as the chromosome, that contain in some kind of *code-script* the entire pattern of the individual's future development and of its functioning in the mature state. Every complete set of chromosomes contains the full *code*; so there are, as a rule, two copies of the latter in the fertilized egg cell, which forms the earliest stage of the future individual. In calling the structure of the chromosome fibers a *code-script* we mean that the all-penetrating mind, once conceived by Laplace, to which every causal connection lay immediately open, could tell from their structure whether the egg would develop, under suitable conditions, into a black cock or into a speckled hen, into a fly or a maize plant, a rhododendron, a beetle, a mouse or a woman.[32]

James D. Watson confirms the significance and direct influence of this assertion in his retelling of the events leading to a successful model for DNA in *DNA: The Secret of Life*.

---

[32] Erwin Schrodinger, *What is Life?* Cambridge: Cambridge University Press, 1944. Available online: URL: http://faculty.washington.edu/lynnhank/LIFE.doc [date of last access: 02/15/2009]

> Schrödinger argued that life could be thought of in terms of storing and passing on biological information. Chromosomes were thus simply information bearers. Because so much information had to be packed into every cell, it must be compressed into what Schrödinger called a "hereditary code-script" embedded in the molecular fabric of chromosomes. To understand life, then, we would have to identify these molecules, and crack their code.[33]

In reading *What is Life?* so many decades after its publication, what strikes me most is the relative timing of Schrödinger's analysis.

Historically, the Second World War marks a significant milestone in the development of computational technologies, where researchers and governments dedicated substantial resources towards computation-driven decryption devices — early computers. Schrödinger's text was conceived and published at a time when computation, transcription, and code were central lines of research and inquiry on an international scale. His model was undoubtedly influenced by this influx of activity. If we re-examine Watson's account of his contribution to the growing field of molecular biology, we see that he states, "To understand life, then, we would have to identify these molecules, and *crack their code*."[34] His choice of words implies that researchers, at that time, conceived of

---

[33] James D. Watson and Andrew Berry. *DNA The Secret of Life.* New York: Alfred A. Knopf Press, 2004. p. 35.
[34] *Ibid.*

the molecular make-up of life as an encrypted message that needed to be deciphered. Watson's language perpetuates a model of cryptography as science, analogous to then contemporary war strategies and the birth of modern computational devices. Sixty years later, the application of this type of language prevails; only now computation and molecular biology are dominant features in our civilian technological landscape. The militaristic implications of these statements are desaturated but not forgotten. Instead, decrypting (and, inversely, encryption) is conceived as a mundane computational function, emphasizing digital coding models (or programming), that is central to public understanding of biological functions.

In Watson's time, research in both fields — molecular biology and computation — was functioning at only the most elite levels of government, academia, and industry. Since the end of the Second World War, computers have proliferated exponentially in availability and computing power. These changes have occurred in the government, in business, and in public sectors of developed countries. On the other hand, molecular biology, as both an object of study and (more recently) as a technological tool, has only shown direct application and utilization in non-specialized spheres in the past few decades. Though both fields stem from a similar era, computation is often understood in public discourse as a predecessor to biotechnology and, more specifically, to molecular biology. This relationship may provide further explanation for the continued application of computational metaphors in our description and understanding of the biotechnological domain.

If we look to *The Language of New Media*, Lev Manovich argues that we often use our experience, knowledge, and language of pre-existing innovations to describe and interpret new technologies. I suggest that this paradigm, which is rooted in communication studies, is a viable strategy for interpreting the language surrounding innovation in other fields as well. Contemporary language surrounding biotechnology places great emphasis on digital processes as a predecessor of the instrumentalization of biological tools — and therefore as a viable means of understanding and describing biotechnology. As a result, the biotech era becomes inherently understood as a byproduct of the information age.

In *How We Became Posthuman*, Katherine N. Hayles makes an argument that is similar to the position presented by Manovich, and certainly evocative of Rifkin's assertions as well. She links the presuppositions of cybernetics with some of the foundational assumptions that are mobilized in evolutionary biology.

> The models proposed by evolutionary biologists have encoded within them cultural attitudes and assumptions formed by the same history they propose to analyze; ... To take only one example, the computer model advanced by Jerome H. Barkow, Leda Cosmides, and John Tooby in *The Adapted Mind: Evolutionary Psychology and the Generation of Culture* to explain human evolutionary psychology testifies at least as much to the

importance of information technologies in shaping contemporary world views as it does to human brain function.[35]

However, our reliance on digital metaphors is more complicated than the progressive application of technological language in describing new processes. Biotechnology, though an old field, has experienced a contemporary renaissance due to the intersection of computation and the biological sciences.

Arthur Kroker investigates this intersection from (an arguably validated) paranoid standpoint, utilizing dramatic language and terrifying imagery to elucidate his understanding of the convergence of the gap between computation and biology. In his introduction to *The Will to Technology & The Culture of Nihilism*, he describes his text as riding "the surface of the body in the form of digital media meant to amplify and extend the human sensorium, and, more urgently, technology as it invades the surface of the body, colonizing, coding, and manipulating the genetic code."[36] In a view much different than the one presented by Hayles, Kroker sees a truly dystopic endgame at play. He sees an intentionality within this convergence, leading us towards a more harnessable human — a body directly accessible to programmation by hierarchical power structures. He imagines the instrumentalization of humanity as hard/wet ware:

---

[35] Katherine N. Hayles. *How We Became Post-Human: Virtual Bodies in Cybernetics, Literature, and Informatics.* Chicago: University of Chicago Press, 1999, P. 284.

[36] Arthur Kroker, The Will to Technology & The Culture of Nihilism: Heidegger, Nietzsche, & Marx. Toronto: University of Toronto Press, 2004. p. 3.

> Are we suiciding ourselves to virtual life? The law of external recurrence will not be denied. We do not have a special exemption. The harvesting of other species will inevitably have its reverse side: the harvesting of the human species at the lip of the Net. Maybe the larger cultural discourse that we are presently caught up in is that digitality and biotech are the chosen mechanisms by which human beings will be interfaced to the data world, genetically modified for more perfect system transparency.[37]

A very real form of convergence thrives in the multi-billion dollar, international industry of bioinformatics. Bioinformatics generally refers to the use of computational systems to store, manipulate, analyze, model, and even outsource biological data.

The National Institutes of Health, Biomedical Information Science and Technology Initiative (BISTI) in the United States of America defines bioinformatics as "Research, development, or application of computational tools and approaches for expanding the use of biological, medical, behavioral or health data, including those to acquire, store, organize, archive, analyze, or visualize such data."[38] Bioinformatics, or computational biology, has revolutionized biotechnology in a way that allows for the modeling of molecular components and processes that is exponentially more complex than was possible prior to the

---

[37] *Ibid.* p. 209.

[38] *The National Institutes of Health, Biomedical Information Science and Technology Initiative* Available online: URL: http://www.bisti.nih.gov/CompuBioDef.pdf [date of last access: 06/01/2008]

advent of powerful computer systems. For example, the *Human Genome Project* (HGP) — a thirteen-year research effort coordinated by the US Department of Energy and the American National Institutes of Health that focused on sequencing the approximately 3 billion chemical base pairs that comprise the human genome — would not have been even imaginable before the introduction of computation to molecular biology.

Further complicating my analysis of possible origins and reasons for the perpetuation of digital metaphors in biotechnology, bioinformatics, by some definitions, can also refer to the practice of computation utilizing molecular biological protocols — in other words, the practice of mobilizing DNA as a computational device rather than using silicon-based microchips. In his now canonical paper "Molecular Computation of Solutions to Combinatorial Problems," which appeared in *Science* (1994), Dr. Leonard Adleman published the first experimental results of studies in which DNA molecules were mobilized in a computational manner to solve a mathematical problem. In his conclusion, he writes, "Nonetheless, for certain intrinsically complex problems, such as the directed Hamiltonian path problem where existing electronic computers are very inefficient and where massively parallel searches can be organized to take advantage of the operations that molecular biology currently provides, it is

conceivable that molecular computation might complete with electronic computation in the near term."[39]

In both specialist and public circles, the perceived success of bioinformatics in research projects such as the HGP has created great excitement and optimism in the future of molecular biology as a programmable therapeutic tool. This almost unfettered enthusiasm can be located in a variety of sources. For example, to mark the 2003 announced completion of the HGP — as well as the fiftieth anniversary of Watson and Crick's model for the structure of DNA — *Nature* published a special edition containing articles on this theme, including "A Vision for the Future of Genomics Research," celebrating recent biotechnological achievements:

> The project's new research strategies and experimental technologies have generated a steady stream of ever-larger and more complex genomic data sets that have poured into public databases and have transformed the study of virtually all life processes. The genomic approach of technology development and large-scale generation of community resource data sets has introduced an important new dimension into biological and biomedical research. Interwoven advances in genetics, comparative genomics, high-throughput biochemistry and bioinformatics are providing biologists with a markedly improved repertoire of research tools that will allow the

[39] Adleman, Leonard. "Molecular Computation of Solutions to Combinatorial Problems" in Science, New Series, Vol. 266, Nov.11, 1994. p. 1023.

functioning of organisms in health and disease to be analyzed and comprehended at an unprecedented level of molecular detail.[40]

However, in circles aligned more closely with philosophy of science than government or industry sources, there is growing criticism for the exclusive application of computational biological models for understanding and harnessing life. For example, Richard Lewontin, himself a celebrated scientist specializing in genetics and evolutionary biology, writes critically about the perpetuation of computational models for interpreting all aspects of life in his work *The Triple Helix: Gene, Organism, and Environment.* He states, "The development of an individual is explained in standard biology as an unfolding of an sequence of events already set by a genetic program, "[41] with no accounting for embryological development or environmental factors that, he suggests, contribute immeasurably to the formation of an organism. He argues that this contemporary conception of the origin of life is similar to eighteenth-century models of preformationism that depict complex life as the product of a single sperm, which was then thought to contain all the components of life — a microscopic infant that was waiting for the right conditions for it to grow into healthy adult form. He argues that contemporary models, although now relying on computational metaphors to explain developmental biology, still stand on the fundamental

---

[40] Francis S. Collins, Eric D. Green, Alan E. Guttmacher and Mark S. Guyer, ""A Vision for the Future of Genomics Research." *Nature*, Vol. 422, No. 6934, April 24, 2003, p. 835-847.

[41] Richard Lewontin, *The Triple Helix: Gene, Organism, and Enviroment*, Cambridge: Harvard University Press, 2000. p.11.

perception that life is somehow predetermined — only now by a programmable code called DNA instead of a single sperm. He explains how bioinformatics has been deeply impressed upon our concept of life, even in scientific circles. For example, "One of the most eminent molecular biologists, Sydney Brenner, speaking before a group of colleagues, claimed that if he had the complete sequence of DNA of an organism and a large enough computer then he could compute the organism."[42] To combat this gross overgeneralization, Lewontin elucidates the results of experiments involving genetically identical specimens that express difference through developmental and environmental change.

Where Lewontin focuses more on making biological inroads towards critiquing the dominance of bioinformatics as an extension of molecular biology, theorists like Jeremy Rifkin approach the same problem by analyzing the nature of the computational technology as it attempts to describe life. Rifkin illustrates the manifestation of computational gene-sequencing protocols on the screen:

> The letters and words are in the form of phosphorescent glows and are both ephemeral and frictionless. They do not exist *a priori* as individual solid units but rather come into existence on the screen when the software instructions call them forth. They have no past or future but exist only in the moment they are flickering on and off the screen.[43]

---

[42] Richard Lewontin, *The Triple Helix: Gene, Organism, and Enviroment*, Cambridge: Harvard University Press, 2000. p.10.
[43] Jeremy Rifkin, The Biotech Century: Harnessing the Gene and Remaking the World. New York: Tharcher/Putnam, 1998. p.180.

This description draws attention to the providence implicated in the digital display of information that correlates with the molecular composition of a given gene or organism.

I want to look back two decades to earlier models for understanding scientific inscription before the mass proliferation of computational models — to the work of Bruno Latour and Steven Woolgar in *Laboratory Life: The Construction of Scientific Facts*. What Rifkin and I are both edging towards, though from different perspectives, is best explained in terms of what Latour and Woolgar call the 'phenomenotechnique,'[44] where, using the example of experimental biology, 'natural' phenomena are observed, measured, and simultaneously produced by complex scientific techniques that are applied to the object of study. They argue that various scientific apparatuses function as inscription devices, producing a body of literature — in the form of charts, graphs, and numerical representation — to provide the scientific community with information about the object they measure. "A first consequence of the relegation of material processes to the realm of the merely technical is that inscriptions are seen as direct indicators of the substance under study."[45] An example of a contemporary biotechnological phenomenotechnique is DNA amplification [called Polymerase Chain Reaction (PCR)]. In PCR, tiny samples of DNA are multiplied into billions of copies through controlled temperature changes, which causes the DNA to first split into

---

[44] Latour, Bruno and Steve Woolgar, *Laboratory Life: the construction of scientific facts.* (second edition, enlarged) Princeton: Princeton University Press, 1986. p.63.
[45] *ibid.*

single strands and then rejoin to form double strands, due to the natural attraction between complementary base pairs. The PCR Machine, where DNA is inserted and later removed after it has multiplied exponentially, serves as a bioassay: a specialized scientific apparatus that provides the researcher with experimental results surrounding a given substance or phenomenon that cannot be garnered through observational means. "Without a Bioassay, for example, a substance could not be said to exist."[46] In other words, "It is not simply that phenomena depend on certain material instrumentation; rather the phenomena are thoroughly constituted by the material setting of the laboratory."[47] Ironically, Latour and Woolgar are arguing that the scientific community produces a series of techniques and tools (bioassays) that are intended to serve as confirmation — evidence either for or against — for particular ideas, concepts, or theories[48] about the natural world. However, these bioassays can also be read as culturally loaded objects and protocols, producing the results they were designed to produce. As Rifkin says, describing computational biotechnological results, "They have no past or future but exist only in the moment they are flickering on and off the screen."[49]

Extrapolating from Latour and Woolgar's arguments, which were originally published in 1979, we can read contemporary bioassays — some of which exist

---

[46] *Ibid.*p.64.
[47] *Ibid.*
[48] *Ibid.*
[49] Jeremy Rifkin, *The Biotech Century: Harnessing the Gene and Remaking the World.* New York: Tharcher/Putnam, 1998. p.180.

only in computational form — as a way of modeling results based on programmed molecular rules; we can look at them as virtual bioassays, producing a 'real' biotechnological substance or phenomenon from computational protocols. In other words, contemporary biotechnological research can be understood, both metaphorically and now technologically, as producing and reproducing a new computational ecology both in the laboratory and the public sphere. Contemporary conceptualizations of a virtual laboratory (or computational bioassay) producing 'real' or 'natural' life remind me of similar arguments proposed by researchers in the artificial life community. Clause Emmeche, in *The Garden in the Machine*, argues that life forms generated computationally, though materially different then organic life, are, in process, equivalent to natural phenomena. He explains that for A-lifers, the "artificial" in "artificial life" refers to the artificial nature of the environment in which life is manifest, not the artificiality of the life itself. He argues, "Our unease with artificial life is due to an uncertainty about the question of whether it really is natures' own games that are depicted in the various simulations, or whether it is the autonomous games of an independent mathematical sphere that are given life and are achieved without any reference to reality. The naturalism of natural science is perceived to be threatened."[50]

[50] Emmeche, Claus *The Garden in the Machine: The Emerging Science of Artificial Life*. Steven Sampson Trans. Princeton: Princeton University Press, 1994. p.158.

Returning to my original assertion that there must be difference in ethical consideration as it is applied to information and as it is applied to the body, I want to emphasize that the notion of a type of verisimilitude between artificial life and organic life, whether metaphorical or literal, is a dangerous over-simplification.

In his essay "Data Made Flesh: Biotechnology and the Discourse of the Posthuman," Eugene Thacker presents a description of the complex, entangled relationship between the computational and the biological in contemporary biotechnology:

> Biotech research is unique in that, on the one hand, it employs the technologies common to other posthuman fields (principally, computer/information technologies), but on the other, its constant "object" of study is the domain of the biological (a domain traditionally set apart from the technological). Instead of being focused on disembodiment and virtuality, biotech research's approach to informatics is towards the capacities of information to materialize bodies (bodies amenable to current paradigms of medicine and health care).[51]

[51] Eugene Thacker. "Data Made Flesh: Biotechnology & the Discourse of the Posthuman", Cultural Critique 53 Available online: URL: http://www.upress.umn.edu/journals/cc53.html [date of last access: 08/01/2005]

He continues to elucidate this model in his seminal work *Biomedia* (2004), in which he coins the term 'biomedia' to describe the relationship between digital and biological protocols in the biotechnological sciences. He proposes that biomedia is a philosophy of technique — an informatic protocol of encoding, recoding, and decoding[52] to allow for the technical reconditioning of the biological sphere.[53] He argues that encoding should be understood as the processual translation from one medium to another, a shift in material substrates.[54] This process can be seen in a number of established biotechnological protocols: genome sequencing, protein analysis, digital microscopy, and also in biomedical applications like MRI and CT scans.

In other words, with Thacker's definition of encoding, the scope of biology is sampled for patterns of relationships, and the acquired information is transferred to a new media substrate: the computer. For Thacker, this process is not one of dematerialization but rather a shift of essential data from one medium to another. With the second step, recoding, in the biomedia protocol, we exit the wet biological lab and enter what Thacker calls the "dry lab" or "biology *in silico*,"[55] where biological data can be manipulated, comparatively analyzed, and programmed. He further explains his position:

---

[52] Thacker, Eugene. *Biomedia.* Minneapolis: University of Minnesota Press, 2004. p.25.
[53] *Ibid.* p.5.
[54] *Ibid.* p.16.
[55] *Ibid.* p.19.

> Bioinformatics tools provide a context in which these patterns of relationships are "recoded" as computational integers, algorithms, and sets of rules. It is not enough in the case of biomedia generally, to say that bioinformatics tools "simulate" the biological body or the cell, for there are no ontological claims being made in these practices of recoding. Rather, the bioinformatics tools, as recoding practices, assume the coexistence of multiple material substrates, and they also assume the capacity for inherent data (patterns of relationships) to be mobilized across those media. In this sense, "recoding" is equivalent to, but not identical with, "wet lab" work with the same patterns of relationships in test tubes, petri dishes, or bacterial plasmids.[56]

Thacker's understanding of biomedia postulates decoding as the final outcome of the biotechnological technique. Decoding is proposed as a form of cryptography, in which the body is rematerialized from informational source code towards novel reconditioning of biological data. Thacker is critical of this type of conflation, and yet at some level he replicates it.

For Thacker this shift does not necessitate returning to the biological but rather newly producing the biological. However, with Thacker's model, the biological is interpreted as media. Biological information is seen as transferable across media from the biological to the computational domain, ultimately leading us to a

---

[56] *Ibid.* p.21.

new biological manifestation. "The practices of encoding, recoding, and decoding are geared both to move across platforms and to always "return" to the biological domain in a different, technically optimized form. Biomedia returns to the biological in a spiral, in which the biological element is not effaced (the dream of immortality), but in which the biological element is optimized, impelled to realize, to rematerialize, a biology beyond itself."[57]

Although Thacker's definition of biotech is useful for its induction of the wet biological body into the bioinformatic fold, he still places overwhelming significance on molecular biology and computation in biotechnology — suffering from what some call 'genohype' — and consequently side-stepping the significant 'wet' biological practices that include little or no computational element. He mobilizes the field of bioinformatics as the defining feature of biotechnology. I, on the other hand, am interested in postulating a more complex model for understanding biotechnology, allowing us to view it not merely as a progressive development erupting from advances in computer sciences, nor as a field defined by its current trend towards bioinformatics, but instead as a living system that incorporates social, political, ideological, technological, and biological information and processes into a complex, temporally contingent model for understanding biotechnology.

---

[57] Thacker, Eugene. *Biomedia*. Minneapolis: University of Minnesota Press, 2004. p.27.

I am particularly concerned by the language deployed by Thacker in his description of the shift of information gathered from an organism — a body — to a dry lab computational site as a 'cross platform' shift. This language usually describes the ability to open files or software on two or more distinct operating systems that are supported by differing hardware models, shifting between Linux, PC Windows, or MAC. Whether this statement is interpreted metaphorically or literally, the model presented here is inadequate and threatens to equalize the biological and digital spheres.

Gerfried Stocker, in *New Images of Mankind*, argues that the utilization of this type of language only reinforces larger societal impulses towards the uniform application of informational models to our understanding of the body.

> Instead of the transformation of the human spirit into 0s and 1s, it is now the gigantic operation of the Human Genome Project which it is hoped will produce the decoding of the genome as the human operating system. And because we have learned so well over the long years of the digital information revolution to dress up everything in computer parlance, terminology like the "software of life" and reference to the human genome as the "human being's operating system" are already solidly established.[58]

---

[58] Gerfried Stocker, "New Images of Mankind" From *LifeScience: Ars Electronica 99*. Gerfried Stocker and Christine Schopf. Edits. New York: Springer-Verlang, 1999. p.23.

I want to elucidate two sets of overlapping and interconnected phenomena: (1) computation and digital media (specifically with bioinformatics) is a central aspect of contemporary biotechnological research, and (2) digital metaphors (often erupting from the success of bioinformatics and computational bioassays) are being ubiquitously applied as societal models for understanding biotechnology and, by extension, our conceptualization of the bodies, thus obfuscating transparent understanding and ethical debate in public discourse on biotechnology. Digital metaphors for the biotechnological body are confusing in that they allow the general public to conceive of biotechnological protocols as equivalent to virtual means of experimentation, rather than as the technological manipulation of living embodied entities. What is missing from the application of this overpowering metaphor is the acknowledgement of those attributes that fall outside of the given paradigm: the live bodies, parts of bodies, bacterial bodies, antibodies, all the bodies that are necessary and central to the propagation of biotechnological research.

Alternative Discourses

From my own experience, the industrialized mobilization of life as a technology and resource was the most significant realization I took away from my first experiences working in the labs at The University of Western Australia. During my second residency in 2006, I maintained extensive lab notes to record my experiences there (see appendix 1). In reading these documents years later, I

see a vast schism between the language and content of what I experienced and the language and content of what is represented in the public sphere in regard to biotechnological research. All of the preparatory reading I did in advance of working in the laboratories at SymbioticA was insufficient preparation for what to expect during my residencies.

I am particularly struck by the entries written on the day we received PAWS Animal Ethics Training[59] at the Large Animal Research Facility on UWA campus, as they indicate the embodied nature of biotechnological research — the 'life' in the lab.

> We begin with the rats. The rat handler is a nice young attractive man, who immediately tells us he prefers to work with rats as they don't bite as much. He immediately begins telling us all about the breed of rats, bread right on UWA campus. He lifts one out of a cage by its tail. It squirms. He says to hold onto it a third away from the rump, firmly but carefully, as sometimes the tail can be ripped off. He states that this can be a very upsetting experience for both the rat, and the handler. The rat is placed on his hand, with tail still in grasp. It immediately urinates all over his sleeve. Yellow spilling into white cotton. He allows the rat to hide its head

[59] *PAWS Animal Ethics Training*, The University of Western Australia. Available online: URL: http://www.research.uwa.edu.au/welcome/research_services/Ethics/animal_ethics/forms_information/pawes_course_information [date of last access: 02/01/2009]

in the crook of his arm.

> We are taught how to sex the animals. The male's genitals are farther from the anus then the females. Two rats are presented to us ass up. Then we are introduced to the mother with newborn pups. We are each given a small pup to hold. They are translucent, purple and pink skin, with organs, and stomach full of milk visible through the skin. The small rat pup splays still in my gloved hands, breathing, and heart visibly pumping. Vibrating. Trying to stay still with still closed eyes. I am holding life in my hands. Instrumentalized life in the biosciences takes on a new more concrete understanding in this moment. I am silent; I can't hear anything in the room for a few pregnant moments. I deliver the rat back to it's mother quickly, so as not to be bitten - and we are told never to handle pups without gloves on as the mother will immediately kill the pup if she smells our sent on the animal.[60]

It was this schism — between the public face of biotechnology and the actual, hands-on experience of the processes, procedures, and protocols that were (in my perception) so hot, loaded, and teaming with life — that necessitated *(RE)embodying Biotechnology* and led to what I can only describe as a cathartic

---

[60] Jennifer Willet. *BIOTEKNICA | ORGANIC TISSUE PROTOTYPES | LABORATORY NOTES*, unpublished manuscript, 2004.

and disillusioning induction into the specialist class. As a result, the urgency of this argument, and the thrust towards perpetuating alternative voices in the description and recounting of the biological sciences, has profound social and political ramifications — as well as great personal significance.

Within the Bioart Community, we can find a chorus of voices attesting to this schism, proliferating alternative language sets that describe biotechnology in the public sphere. For example, in Kathy High's artist website Embracing Animal,[61] she describes the protocols utilized for germline genetic engineering of transgenic rats in the laboratory:

> First, the scientist or breeder chooses a gene. This gene is isolated and many copies of it are made using the techniques of molecular biology (PCR, etc.) Then hormone injections are given to the egg-supplying (donor) rat [mom(1)] for hyper-ovulation. She releases many, many eggs from her ovaries. She spends her last night with a frisky male inseminator. Then she is killed and her fallopian tubes are cut open and the fertile rat eggs are suctioned out. These eggs are viewed closely under a microscope and a very small needle is used to inject them with the gene of choice. Then, hormone injections are given to one or more surrogate 'uterus' donors [moms(2)] to simulate a pseudo pregnant state. The embryos that tested positive for having taken up the new gene are

[61] Kathy High. *Embracing Animal*, artist website; available online: URL: http://embracinganimal.com [date of last access: 09/15/2005]

> implanted into the surrogate uterus of the [moms(2)] rats. The embryos that don't test positive are destroyed. Any rats that are born not expressing the gene of choice are killed after birth. Any rats that do have the transgene in their genomes are bred with each other and then bred with their sons and daughters to secure the continued transmission of the gene.[62]

As an artist engaging directly with genetically engineered rats, she deploys this description with full knowledge of the implications of her participation in this embodied technological exchange. She offers her readers access to the complexity of such practices without deploying a didactic or moralizing tone in her discussion of this complex phenomenon. However, there is an element of anthropromorphization; she labels the rats "mom 1" and "mom 2." Within the website, she presents this procedure and these life forms in a pluralistic fashion. Her text is not devoid of a positioning, but neither does it reject the use of scientific research strategies; instead, her writing investigates the complex relationship that we have with the resulting transgenic organisms.

Her website focuses on the lives of three transgenic lab rats: Matilda Barbie, Tara Barbie, and Star Barbie. Each were born in a laboratory environment where they served as breeding rats and, after donating approximately a year of their lives and two litters each to the propagation of scientific research, were

---

[62] *ibid.*

subsequently adopted by High to live out their days. For High, the rats become a locus for a matrix of generosities, demands, readings, and understandings. They are cute, but strangely grotesque. They demystify our fears of transgenic animals; but they also instill a greater fear in a science — and a humanity — that would engineer and manipulate such feeble animals for human gains. They are not pets, but they have human toys: a Fisher Price farm set, for example. We cannot help being touched by High's gesture of rescuing these animals from the fate of research specimens — and yet she writes of her own research with the rats, most notably administering homeopathic treatments and charting the effects. To what end? Is High only again instrumentalizing these organisms to serve human desires? It seems that the rats need her, but High also seems to need them. It is at this contradictory juncture that Embracing Animal is most successful: it explores the truly complex relationship between humankind and transgenic laboratory animals.

High's text describes the very same process that I present at the beginning of this chapter by Daniel Q. Haney in his *Life Magazine* article.

> Insert block of new genes into a freshly fertilized egg. The one cell becomes two, then four, then eight. Each new version carries the extra information. In nine months, a baby is born. Every cell in his or her body contains the extra genes.[63]

---

[63] Daniel Q. Haney, "Designing Baby: Scientists on Verge of Manipulating Human DNA" Associated Press, March 5, 2000. Available online: URL:

The disparate discourses and the level of detailed complex consideration revealed in comparing these two descriptions of virtually identical protocols is astonishing. Not only are digital metaphors the dominant model for understanding genetic engineering in this mass media representation, but all complexity inherent in the protocol is lost, failing to provide even a basic understanding of this process to the non-specialist reader — let alone any window into understanding the process in an embodied, reciprocal, or lived sense.

Another good example of artist-generated language sets that describe biotechnological protocols resides in a documentation of cultivating artificial skin grafts by Polona Tratnik, taken from her piece *37°C*:

> "Medical laboratories cultivate skin cells to provide skin substitutes (artificial skin) for transplants. The perception of this living tissue in the laboratory, however, dose not fit the everyday perception of skin. The skin comes from a living human body. It is cut out and sent to the laboratory, where it is cut into smaller parts – all the pigment cells are removed, as is fat. What is kept is only the cells, which are placed on a mainly transparent scaffold. Although this skin comes to the laboratory from the external world, it seems completely distant from that world; it is not at all similar to what we know as skin. When entering a laboratory we must put

---

http://www.genetics-and-society.org/resources/items/20000305_ap_haney.html [date of last access: 08/01/2005]

> on overalls and paper slippers and may not touch things without gloves. There is a certain contradiction between the warmth and intimacy of the body and life on the one hand, and the coldness, glass, metal, blue-green colors, sharp lights, and rationality of the laboratory on the other.[64]

Tratnik provides a description of the medical applications for the tissue culture technology she utilizes in her artwork. In *37°C*, she creates a gallery-sized incubator (a womb) and in it maintains a constant temperature of 37°C in order to successfully house several wax sculptures of body parts in vitrines that are layered with artificial human skin. However, in creating an ideal environment for the tissue culture sculptures, she is in turn creating an inhospitable environment for the gallery visitors. "A temperature of 37°C in the external environment is too high for us to feel comfortable, since our body is producing energy to warm itself exactly because we live in an environment that is colder than 37°C."

This same process (creating artificial skin) is described to the general public in a BBC article called "Artificial Skin 'Cuts Scarring'" by Pallab Ghosh:

> The skin is created from a matrix made up of fibrin, a protein found in healing wounds.

---

[64] Polona Tratnik, "37°C: From the Inside of a Being to the Thin Line of Life" in *Leonardo: Journal of the International Society for the Arts, Sciences and Technology*. Vol.38 No. 2, 2005. p. 103.

To this is added human fibroblasts - cells used by the body to synthesise new tissue.

In a process that effectively replicates the way the body makes new skin, the cells produce and release another protein, collagen, which makes the matrix more stable.

It is in this form that the "skin" is implanted into a wound.[65]

Ghosh's description of artificial skin relies heavily on retelling the laboratory protocol from an 'objective' standpoint. In his description, there is no allusion to the viscosity of the life involved in the procedure or to the larger social, political, embodied ramifications of this technologization of skin cells. Some would argue that the 'objectivity' of this news report, or the scientific language of this article, is desirable and works so as to not lead the reader in their interpretation of the procedure described. However, I would argue that the chosen language set also serves to disassociate the reader from a subjective, emotive, or embodied response to the procedure. Additionally, with the authority we ascribe to scientific language, Gosh's recounting of the production of artificial skin becomes intellectually impenetrable from the layperson's perspective.

---

[65] Pallab Ghosh, "Artificial skin 'cuts scarring'" from *BBC News*. Available online: URL: http://news.bbc.co.uk/2/hi/health/6236282.stm [date of last access: 08/01/2005]

I am not suggesting that scientific discourse surrounding biotechnology should not be perpetuated in public discourse. What I am suggesting is that we could benefit from a chorus of voices in describing these techniques and procedures. A pluralistic and dialogic public discourse filled with many language sets, including the voices of the hard sciences, non-specialists, literary voices, even those from the radical opposition of animal research like PETA,[66] would allow for the general public to have a deeper understanding of the biotechnological research that is conducted in highly specialized, closed sites. This chorus of representation would allow for complex public debate about scientific research today, as well as regarding our biotechnological future, in a meaningful and impactful way.

What will result from this measure? We can look to the discourse and representation surrounding human illness and disease in the last fifty years as an excellent example of the insertion of alternative voices into public discourse of science. In 1978, Susan Sontag published her now famous article "Illness as Metaphor." She writes aptly of her personal experience as a cancer patient in the 1970s and discusses the powerful impact that the war-based metaphors (often used to describe the diseased patient's body) had on her own personal suffering. "Military metaphors contribute to the stigmatizing of certain illnesses and, by extension, of those who are ill. It was the discovery of the stigmatization

[66] People for the Ethical Treatment of Animals Available online: URL: http://www.peta.org/ [date of last access: 08/01/2008]

of people who have cancer that lead me to write *Illness as Metaphor.*"[67] This text, and others like it, assert feminist, personal, experiential voices in discourse on medicine and are arguably responsible for significant shifts in both public debate and patient care since the 1950s. With this shift, thousands of alternative voices have entered into the narratives surrounding human illness to varying degrees of effect and influence on patient experience and medical practices and procedures. Jackie Stacey writes in 1997 of an almost overabundance of such voices in the polyphonic representation of cancer in contemporary society:

> The market for books about cancer is enormous. Amongst the expanding health and fitness/self-development/New Age and spirituality sections of highstreet bookstores and the increasing number of publications for sale in health food shops, books about cancer are not hard to find; in fact, they are hard to avoid.[68]

She continues:

> For many people with cancer these books are the starting point of coming to terms with the diagnosis. They are read in hope of finding a story that fits, of finding a story that offers hope, of even finding a story that ends happily. They are also read for information about the disease or about the treatment; some offer the chance to learn the language of oncology, to understand the principles of chemotherapy or radiotherapy; others

---

[67] Susan Sontag, "Aids and It's Metaphors" from *Illness as Metaphor and Aids and It's Metaphors.* New York: Doubleday, 1990. p.99.
[68] Jackie Stacey, *Teratologies: A Cultural Study of Cancer.* New York: Routledge, 1997. p. 2.

> educate their readers on the workings of the immune system, the anti-cancer diet or the negative effects of stress on the body. Read all of them and you can become an expert in your field, and expert on your particular disease and an expert on yourself.[69]

Although Stacey is critical of the wellspring of self-help books available to cancer patients and their families today, I would argue (and I am sure that she would agree) that the presence of these voices in the construction and representation of disease has lead to staggering changes in the medical system, patient empowerment, and general health knowledge since.

In making this argument, I need only to refer to the *Principles of Gynaecology* textbook published in 1962 by T.N.A. Jeffcoate. This text openly advocates lying to patients about their medical conditions (or lack thereof) with the understanding that clinical knowledge is best left restricted to the doctor or specialist in order to maintain the health and sanity of the patient. For example, in the treatment of dyspareunia (painful coitus), he instructs the physician:

> If it is clear that the patient is unlikely to co-operate, it is best to desist at once, to allay her fears and to explain that the entrance to the vagina is so narrow that it requires dilation under anesthesia. This operation is carried out to such an extent that the vagina will admit three fingers. As soon as local tenderness has subsided, usually at the end of 48 hours, graduated

---

[69] *Ibid.*

> glass or plastic vaginal dilators are passed by an experienced nurse or by the medical attendant. On the first occasion only the smallest size is used and the approach must be cautious. The real purpose of these instruments is not to dilate the vagina further but to convince the patient that her trouble is corrected and to give her confidence.[70]

Since that time, the proliferation of alternative voices in academia and in general public discourse, these hierarchical and restrictive practices are no longer accepted (or, at the very least, drastically reduced) in the medical establishment. In addition, the medical establishment itself has become a source of alternative language sets used to describe the human body, patient experience, and human illness.

Media personalities like Dr. Oz from Oprah[71] and Dr. Brian Goldman from the Canadian Broadcasting Corporation (CBC) radio program White Coat, Black Art[72] are medical practitioners who, through the media, are disseminating information and critical analysis of their own profession in the public sphere. For example, Goldman writes about patient pain management in his introduction to one of his radio broadcasts:

---

[70] T.N.A. Jeffcoate. *Principles of Gynaecology*. London: Butterworths, 1962. p.643

[71] Oprah.com Available online: URL: http://www.oprah.com/contributor/health/droz [date of last access: 02/01/2009]

[72] CBC Radio, *White Coat, Black Art* radio program. Available online: URL: http://www.cbc.ca/whitecoat/ [date of last access: 02/01/2009]

> For the vast majority of patients, the best method of doling out pain meds – by far – is to have you – not health professionals like me – in charge. You receive a supply of pills and take then when you feel you need to. Or, they hook you up to a pain pump and you push a button whenever you need a top up – with a lockout feature that keeps you from getting too many doses. Not only do patients like having control, but studies show that when they're given control, they use fewer meds than they do when people like me are in charge. The only downside to pain pumps is that they add to the cost of health care.
>
> But in my opinion, the extra cost is worth it.[73]

It is my argument that the successes we have seen in regard to growing patient empowerment and reflexive modification of the medical system in response to patient needs result from a number of important factors, including the insertion of alternative voices — patient voices — into public discourse surrounding the medical profession. I also believe that this model for the disruption of hegemonic power structures could be aptly applied to the biological sciences and the biotech industry. However, unlike in medicine, the alternative language sets are unlikely to spring forth from the 'object' of study — the life forms within the labs — and instead will have to come from alternative and amateur practitioners and/or visitors to the lab. When non-specialists enter the lab site, they perceive the

[73] *Ibid.*

environment, the processes, and intentionalities of the researchers differently then those with years of training and indoctrination into the biotechnological specialist class.

One early example of this type of transgression into the lab from an almost anthropological perspective is documented in Bruno Latour and Steve Woolgar's book *Laboratory Life: The Construction of Scientific Facts.* Latour spent 21 months in the 1970s as a resident in Roger Guillemin's lab at The Stalk Institute. Through a distinctly different language set and observational lens, Latour and Woolgar explain their interpretation of the site, the flow of information therein, and the roles of the various workers in the lab. Dr. Jonas Salk writes about his distinct use of language in his introduction to *Laboratory Life*:

> The approach chosen by Bruno Latour was to become part of a laboratory, to follow closely the daily and intimate processes of scientific work, while at the same time remain an "inside" outside observer, a kind of anthropological probe to study a scientific "culture" –to follow in every detail what the scientists do and how and what they think. He has cast what he observed into his own concepts and terms, which are essentially foreign to scientists. He has translated the bits of information into his own program and into the code of this profession. He has tried to observe scientists with the same cold and unblinking eye with which cells, or hormones, or chemical reactions are studied – a process which may

> evoke an uneasy feeling on the part of scientists who are unaccustomed to having themselves analyzed from such a vantage point.[74]

This type of work can be used to contextualize and locate the origins of the very language shift I am arguing for in Bioart practices as it relates to evolving biotechnological practices. It is possible that Adam Zaretsky and Julia Reodica state it best:

> Our pride and willingness to discuss important issues surrounding nature/culture issues and human/other relations implies a public invitation to intelligent debate. Conceptual novelties are expressed in the living arts, with or without the meddling of artists, scientists or ethicists. Life is alive and mutating, officially and unofficially. It is only within the situational ethics of pluralist integrities that an effective debate has a chance of flourishing. Life is not composed of pat answers and shallow assumptions.[75]

---

[74] Dr. Jonas Salk, "Introduction" from Latour, Bruno and Steve Woolgar, *Laboratory Life: the construction of scientific facts.* (second edition, enlarged) Princeton: Princeton University Press, 1986. p.12.

[75] Zaretsky, Adam and Julia Redioca. "The Workhorse Zoo Art and Bioethics Quiz." From *Emutagen*, artist website; available online: URL: http://www.emutagen.com/wrkhzoo.html [date of last access: 08/01/2008]

4 | *BIOTEKNICA: LiveLifeLab*: Practical Considerations in Exhibiting Bioart.

Up until this point, the emphasis of *(RE)embodying Biotechnology* has been relatively theoretical, historical, and political in arguing for the transformative potential of biological art practices, inspired by my experiences as an artist entering and working in the laboratory. In the introduction, I elucidated the overwhelming subjective transformation of art that I experienced as an artist entering the laboratory for the first time, learning to reimagine the body and gaining a new perspective on reciprocal ecologies. In Chapter 2, I argued for contemporary bioart practices as a strategy for undermining overspecialization in the hard sciences and democratizing biotechnology. In Chapter 3, I addressed the dangers of proliferating digital metaphors in public discourse surrounding biotechnology and looked to alternative language sets produced by the bioart community to describe bioart practices and the science supporting such work.

I now wish to focus on a more practical and experiential retelling of the pragmatic actions, the embodied and emotional responses, and the technical successes and failures resulting from a dedicated attempt at an artistic engagement with the tools of biotechnology in the public presentation of bioart. I wish to reveal the work involved in this type of research and creation: the relentless efforts necessary to create small moments of transformative, hands-on interaction — both reciprocal and embodied — between human non-specialists and the multifarious orders of life in the lab. In addition, of course, I want to address and

discuss the inclusion of these moments in public discourse through the site of the gallery and subsequent media representation.

A great deal of bioart production takes place within the labyrinths of scientific institutions. Artists seek access to these specialized sites in order to produce works that require rarified facilities, bioassays, restricted biological agents, and specialized training. Often the works produced in these sites are condemned to never leave the lab. Often documentation serves as the only exhibitable product of works made and/or actions conducted. Often bioart, in its embodied incarnation, serves a tiny audience of one (the artist), with the possible exception of a few more (the scientists sharing bench space in the lab). However, for myself and for a number of bioart practitioners, it is integral to extend these experiences to the general public. The exhibition of bioart practices has the potential to allow audiences to catch a glimpse of real biotechnological entities, to allow them the opportunity to experience hands-on, 'wet work' for themselves, and to allow them to come to their own experiential conclusions about the life forms and protocols with which the artist chose to engage.

The public presentation of 'live' bioart creates a number of concerns and issues pertaining to the mechanics of building a portable laboratory: local rules and regulations, gallery restrictions, and audience reception. To investigate this component of bioart production, as well as the performative, political, and artful nature of navigating the practicalities of its public presentation, I wish to present

an instance of *BIOTEKNICA* research, conducted in collaboration with Shawn Bailey: our second presentation of live biological work at a gallery site — *BIOTEKNICA: LiveLifeLab.* I will relate the artistic intentions of the exhibition, the techniques involved, and the institutional and technical hurdles we overcame in presenting this work in a gallery. Through the analysis of this event, I wish to elucidate the transformative and politicized actions towards the democratization of biotechnology that have been outlined in earlier chapters: (1) a shift in the language used to describe biotech in public discourse, (2) a shift in the representation of the biotech specialist towards a more inclusionary, interdisciplinary model, and (3) an instance of hands-on experience for non-specialists that demystifies and re-embodies biotechnological protocols.

The following excerpt from the *LiveLifeLab* gallery text provides an excellent introduction to the intent and content of this particular installation within the larger context of ongoing *BIOTEKNICA* research:

> BIOTEKNICA began as a media studies and interventionist art project, which projected its' viewers into a future where designer organisms are generated on demand. The organisms produced by BIOTEKNICA are modeled on the Teratoma, an unusual cancerous growth containing multiple tissues like hair, skin, and nervous systems. Monstrous as this may seem, scientists today see the Teratoma as an instance of spontaneous cloning, and are conducting research on the Teratoma with

the goal of developing future technologies. BIOTEKNICA both embraces and critiques biotechnology, considering the contradictions and deep underlying complexities that these technologies offer the future of humanity.

Since 2004 BIOTEKNICA has adopted a critical participatory methodology bringing our theoretical specimens out of their virtual environment and into biological science laboratories. Serving as Research Fellows at *SymbioticA: the Art and Science Collaborative Research Laboratory* at *The University of Western Australia*, Willet and Bailey began growing living prototypes that serve as new representations of the BIOTEKNICA product line. Here they commenced research with tissue culture protocols in the production of artwork as pioneered by Oron Catts and Ionat Zurr, of the internationally recognized *Tissue Culture & Art Project,* and *SymbioticA* founders. In 2006, they returned to *SymbioticA* – and worked in collaboration with Catts and Zurr on a new project entitled Teratological Prototypes. The four artists successfully constructed and exhibited a complex functional laboratory installation for *ISEA: Zero One San Jose* in the summer of 2006.[1]

The exhibition *BIOTEKNICA: LiveLifeLab* (Feb 27 – March 23, 2007) was hosted

[1] Jennifer Willet and Shawn Bailey, *BIOTEKNICA: LiveLifeLab*, exhibition statement, 2007.

at Concordia University's FOFA Gallery in the Integrated Engineering, Computer Science and Visual Arts Complex (EV) under the leadership of gallery coordinator Lynn Beavis. This exhibition marked *BIOTEKNICA's* first 'live' exhibition of tissue culture in Canada, as well as our first solo attempt at building a lab in a public site.[2]

LiveLifeLab was conceived of as an extended performance, where two artists within an institutional context would try to build a tissue culture laboratory, conduct research, and sustain life in a gallery environment. The project was described as such:

> BIOTEKNICA: LiveLifeLab is a new installation and durational performance that reflects BIOTEKNICA research and production to date. Here the traditional gallery setting serves multiple functions: exhibiting prototyped objects; video and digital print documentation; a live art performance site; and a tissue-engineering laboratory. In the context of LiveLifeLab, Bailey and Willet will conduct an 'experiment' of sorts (an art action) in which the two artists will construct a functional tissue culture lab in the gallery, and continue their ongoing research into creating new living art forms for the duration of the installation.

[2] In 2006, we built a portable lab in collaboration with Oron Catts and Ionat Zurr at *ISEA Zero One San Jose*.

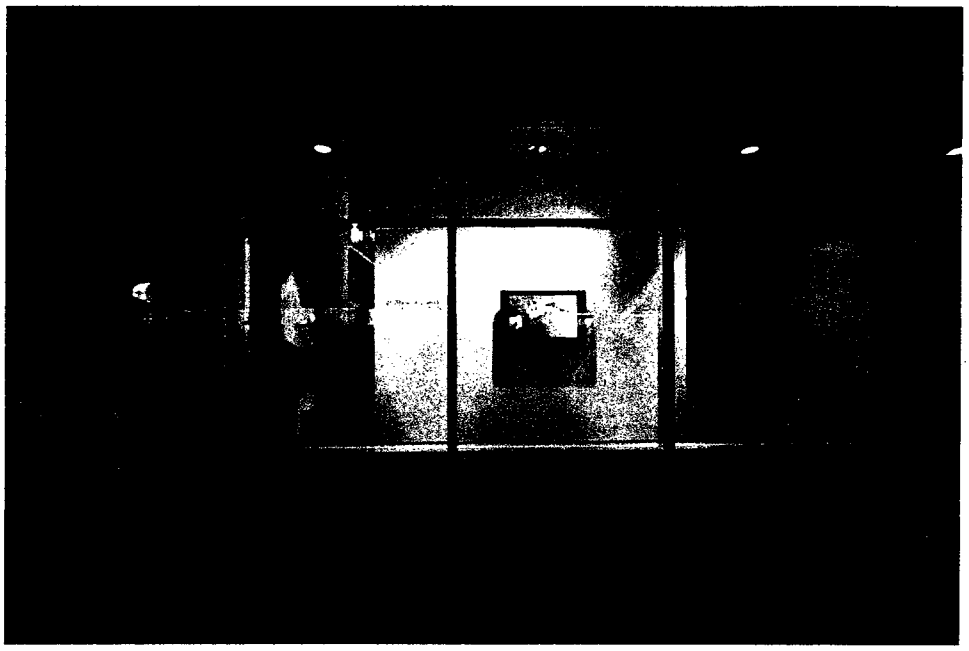
> This work results from ongoing questions arising for artists working with specialized scientific protocols and confronts the problems of *access* – *accountability* – and *specialization* – that typically inhibit non-specialist engagement and understanding of the sciences.
>
> LiveLifeLab is a propositional performance and installation that may result in transformative experimentation for the artists and viewers alike; or might simply fail, in infrastructure – material transfer agreements – sterility and/or aesthetics.[3]

The installation consisted of three distinct parts — the public street window, gallery installation, and functional laboratory — all linked ideologically and technically by a looped descriptive video.

Housed on St Catherine's street in Montreal, The FOFA Gallery has access to the largest shopping and entertainment street in the city. As one of our primary goals was the democratization of biotech (and, by extension, bioart and contemporary art in general), we sought an effective strategy to extend our reach outside of the university community and into the general public. We decided to activate the window with a 24-hour digital slideshow of photographic documentation of laboratory work conducted by *BIOTEKNICA* over the previous three years (*fig.*11). The softly pulsating images of tissue culture and tissue

[3] Jennifer Willet and Shawn Bailey, *BIOTEKNICA: LiveLifeLab*, exhibition statement, 2007.

engineering protocols luminesced in the window, attracting a range of interested (and sometimes confused) street traffic. Hands, cells, and flasks became actants in a reflective stainless steel theatre.



(*Fig.*11.)
Shawn Bailey and Jennifer Willet
BIOTEKNICA: LiveLifeLab
FOFA Gallery, Concordia University
2007

The main gallery space is accessible from the street and through internal corridors in the new Concordia Engineering, Computer Science and Visual Arts Integrated Complex (EV building). At this site, we presented a 'dry' gallery installation that was sparse, sterile, and grand in scale. We wished to integrate the cool, corporate sensibility of the EV building and the corporate criticism mantra of earlier *BIOTEKNICA* investigations in order to draw a connection

between our research, the site of the institution, and the 1997 Andrew Niccol film *Gattica*. We imagined this segment of the installation as a waiting room where visitors could view documentation and sculptural remnants of our work, also allowing them a place to sit, contemplate, and discuss the exhibition (*fig.*12). We presented sixteen large-scale, macro photographs of ongoing laboratory work conducted at SymbioticA and San Jose State University. Each image consisted of hands manipulating biological samples — instances of life — ranging from microscopic cell lines growing in flasks (not visible to the naked eye), cells seeded in scaffolds in bioreactor environments, and larger, more visceral animal parts (a bone and tongue) from which samples are harvested for growing primary cell cultures.

The tones of the images were sombre, cadaverous, and generally bleached of colour, with the occasional vivid tone of a bright pink plastic flask stopper or a deep purple nutrient solution. One wall featured fifteen of these oversized prints, creating a weighted wall of imagery — sterile, cool, and grotesque — so large as to attract viewers off of the street and impose a sense of authority upon them. The prints towered over the site — and over the viewer. Another wall featured a single image, most clearly representative of the outcome of our work on the *Teratological Prototypes*: a close-up of female gloved hands, cupping a bioreactor vessel (an artificial uterus,[4] of sorts) which contained three plump

[4] Marie-Pier Boucher, *Métaformation: prolégomènes à l'exo-sphère*, in progress, 2007.

prototypes engorged with living cells taken at ISEA (International Society for Electronic Arts) San Jose in 2006.

(*Fig.*12.)
Shawn Bailey and Jennifer Willet
BIOTEKNICA: LiveLifeLab
FOFA Gallery, Concordia University
2007

Across the gallery, in stark contrast to the abundance and colours of the prints, stood two small, internally lit glass shelves featuring preserved Teratological Prototypes (completed in 2006 in collaboration with TC&A), scaffolds, casting molds, and new prototype sculptures developed in Hexagram and l'Université de Montréal 3D rapid prototyping facilities with the assistance of Edgar Perez. The miniaturism, yellow light, and almost banality of these small works functioned in contrast to the industrial scale of biotechnological representation and reproduction, allowing for close scrutiny of each object.

Last, a video played on a large-scale, flat panel screen that was hung above a seating area consisting of two black leather benches and a round glass table with a large biohazard symbol etched into it. Titled *Teratological Prototypes*, the video served as documentation, as a source of technical information for the viewer, and reflexively as an artistic intervention, playing on tropes from corporate biotech videos and science documentaries. A soothing female voice explained the terms and processes presented on the screen, resonating throughout the entire gallery space. Sterile but sexual undertones permeated the video; penetration after penetration was shown, highlighting the ways in which scientific protocol reproduces life in the laboratory.

The last segment of *LiveLifeLab* was an approximate BSL1 tissue culture laboratory in a small room usually reserved for video projections (*fig.*13) . This project was approved by the university and built by artists. BSL1 stands for Biological Safety Level One, meaning that the lab "is suitable for work involving well-characterized agents not known to consistently cause disease in healthy adult humans, and of minimal potential hazard to laboratory personnel and the environment."[5] To meet BSL1 standards, a variety of precautions were taken, such as providing researchers with a hand wash station, sharps disposal, and

[5]Available online: URL: http://www.d.umn.edu/ehso/biosafety/bsl1.html [date of last access: 04/10/2007], Reproduced from "Biosafety in Microbiological and Biomedical Laboratories, BMBL 4th Edition" with permission from the Center for Disease Control (CDC).

enforcing a rule that banned eating on the site. These measures ensured that the site was clean, functional, and possessed no health risk to users or viewers.

(*Fig.*13.)
Shawn Bailey and Jennifer Willet
BIOTEKNICA: LiveLifeLab
FOFA Gallery, Concordia University
2007

In contrast to the stark nature of the rest of the installation, the lab was visually hot and theoretically loaded, overflowing with equipment and resulting associations. In addition, it was a colourful romper room, where artists engaged with live biological entities through scientific protocols. The predominant décor was established by the black walls and ceiling, large red shelves installed at the back of the site, an internally lit sterile hood borrowed from the Department of

Biology, and stainless steel workbenches. The polished metallic surfaces reflected light and colour throughout the room. Lab coats were baby blue, media lids were orange, and vial racks came in multiple colours. The site was cordoned off from the general public with transparent vinyl flaps, normally used in industrial loading bays and waste management facilities. Sometimes empty, and sometimes bustling with artists and curious visitors on tour, the lab was the heart of the installation. The liminal boundary between the lab and the gallery was signified by two small biohazard signs in order to meet BSL1 regulations, but these signs also alluded to the true biohazard in the installation: the human body. We are more likely to cause harm to the cell cultures then they are to us due to the possibility of contaminating the specimens with the billions of microorganisms hosted by the human body. Its contents were both functional and aesthetic, both sterile and multicoloured, and the room was literally packed to the ceiling with equipment and supplies. All this support and infrastructure was to maintain the microscopic cells at the heart of the installation; as a result, the room was teeming with life.

The laboratory was planned as a site where we could continue our ongoing research, but also as a theatrical set — a performance space. The performance aspect of *LiveLifeLab* was multifold. First, there was the overarching performance of our attempt to build a functional laboratory by the end of the exhibition. As we were invited to participate in this exhibition on extremely short notice (only three months in advance), we had resigned ourselves to the

likelihood that the lab would not be fully up and running on the day the doors opened. However, we had scheduled a vernissage mid-way through the exhibition, at which the public would be invited to join us in the gallery to view the work, celebrate, and experience first-hand the acquisition of cells from a primary source (bovine bone marrow — *fig.*14) in a functional laboratory environment.

(*Fig.*14.)
Shawn Bailey and Jennifer Willet
BIOTEKNICA: LiveLifeLab
FOFA Gallery, Concordia University
2007

The second order of performance included enacting tissue culture protocols and sterile techniques on a more regular basis during the exhibition, both alone and with small invited audiences. Throughout the duration of *LiveLifeLab*, we conducted two primary cell acquisition protocols from commercial meat products, we performed a defrosting protocol of the 3T3 cell line in the Department of

Biology, we conducted serum distributions and 'feeding' of the cells with the replacement of nutrient solution several times, and we eventually terminated our cell cultures with the addition of bleach to all cell flasks. Twice weekly, and also at random times in between, we suited up and invited viewers to suit up with us and engage in a participatory art/lab ecology called *LiveLifeLab.*

Ironically, the life we cultivated in *LiveLifeLab* was only with us for a short time. In a matter of days, the cells had become contaminated with long, narrow, figure-eight chains of bacteria. I was heartbroken to peer into the eyepiece of the microscope when, only the day before, I had seen fledgling cell cultures, multiplying and growing stronger. The flask was now hosting a second order of visitors — bacteria — which were fatal to the delicate cells. Certainly, there are microfiltration procedures that can, in some cases, cull the unwanted bacteria, but if our suspicions were right about the source of contamination, this procedure would have served little use.

We came to believe that the sterile hood was not, in fact, sterile. Despite the fact that it was originally designed for portable teaching purposes in plant culture and mycology, we were hoping that this hood would suffice for our purposes. Although it was presented to us as a BSL2 workspace, certified earlier this year, its design showed that the hood was actually a BSL1 unit (designed to protect the specimen from contamination, but not the researcher). In addition, the adhesive proof of inspection dated the unit's last certification in 2004. Last, the

access point to the 'sterile' work environment provided no Plexiglas protection against contaminants (which can often come from the user's breath) from entering the workspace. Immediately upon its delivery, we had predicted that the hood would pose significant problems in maintaining sterility. In addition to contaminating our immediate cell samples, we were concerned that the primary storage bottles for the expensive serums, antibiotics, and trypsin may also have been compromised, which would have resulted in the probable disposal of our entire stock of biological supplies. In this instance, working with life required total environmental control over processes that are inherently unruly and susceptible to contamination.

However, contamination aside, *LiveLifeLab* was a resounding success for a number of reasons. Not only was it a great opportunity for us, but it also set new standards in Canada for extending the boundaries of artistic research into the infrastructure and protocols of the hard sciences. We were able to test the boundaries of biological specimen acquisition for non-specialists through two strategies: (1) the use of commercially purchased food products as a primary cell source in tissue culture, and (2) the delivery of an established 3T3 cell line ordered by the Department of Biology, and transferred to our satellite lab. Last, we experimented with (and subsequently failed at) establishing a sterile environment in a high traffic gallery setting.

The title *"LiveLifeLab"* best describes this endeavour in a concrete way. We were interested in the live presentation of life in the laboratory to a non-specialist audience. In conceiving of the title, we choose to deploy the term "life" in a dual manner, referring to both the life in the incubator or under the microscope and also to the primate life — the human life — that shares the laboratory ecology with our microscopic collaborators. This work served to reveal the bodies in biotechnology in a communal and demystified manner — as a sliding scale of the living. It also worked to challenge established perimeters of specialization in the university context, collapsing discrete disciplinary divisions and politely insisting that science belongs to all of us. *LiveLifeLab* challenged entrenched notions of legitimacy and power in the construction of scientific authority over the manipulation of life. We conceived of *LiveLifeLab* as an open-ended installation, allowing the audience to have first-order experience of tissue culture and a BSL1 laboratory without a scripted outcome. The audience was provided with a set of information and experiences and allowed to come to their own conclusions about the efficacy and ethics of non-specialist participation in biotech.

However, what is most significant in a project like *LiveLifeLab* is not necessarily the final manifestation of the gallery installation, but rather what is behind the scenes: the actions, negotiations, successes, and failures of building such a project. With BIOTEKNICA, we were almost more interested in the conversations, persuasions, and manipulations of the status quo that were necessary for us to engage in this type of production than in the production itself.

As a result, an interdisciplinary methodology was necessary to convey all of these complexities to our audiences. Texts like this one work in chorus with the installations, the website and media productions to present all aspects of the project — to reveal what is behind the scenes, so often guarded in biotechnological research and industries. With this in mind, in all of its politicized intentionalities, I will direct the remainder of this text towards breaking down the different hurdles, offices, regulations, and setbacks that were necessarily managed in the production of *LiveLifeLab*. I will divide this analysis into five discrete sections: on-site gallery negotiations, specialized scientific purchasing, establishing a host laboratory, health and safety, and our participation in a Vision TV documentary film shoot about *BIOTEKNICA*. I feel that it is imperative to undermine the veneer of authority that comes with any public presentation of biotechnological protocols with the free sharing of information, as well as with a transparent representation of *BIOTEKNICA* in all its successes and failures.

LiveLifeLab: On Site Gallery Negotiations

In the field of bioart, there is much discussion and debate as to how to prepare and facilitate art galleries, museums, festivals, and institutions towards the successful exhibition of living artworks. There seems to be great interest in exhibiting works from this field in international art circles, but there is also great hesitation, as bioart requires infrastructure as well as both technical and personnel support not typical to most art exhibitions. A few institutions (Exit Art,

Museo Extremeno e Iberoamericano de Arte Contemporaneo), festivals (Ars Electronica, The Biennial Electronic Arts Perth) and curators (Jens Hauser, Antonio C. Pinto) have made ongoing commitments to exhibiting bioart. However, often curators and galleries interested in bioart prefer to host a 'dry' or documentary exhibition. Some artists would argue that bioart only exists when 'wet' life is exhibited in the gallery,[6] and others are prepared to make this concession. Last, there are some institutions that are pleased to make inroads in exhibiting bioart, even though they have little experience working with biology. In this instance, the artist becomes primarily responsible for his or her own technical support, facilitating linkages with the local scientific community and maintaining the installation on site for the duration of the exhibition.

In regards to *LiveLifeLab* and the FOFA Gallery, our experience was the latter; we encountered a gallery director and staff that enthusiastically welcomed the project into their space, but were able to provide little to no support to accompany an exhibition of this scale and complexity. In addition, the FOFA Gallery was a new exhibition site, allowing only a very short production time-line from the date of invitation to the opening of the exhibition. These circumstances put Shawn Bailey and myself into an unusual position where we were left to negotiate a number of complex, internal university measures with a variety of offices (Purchasing, Health and Safety, the Department of Biological Sciences) on our

---

[6] Adam Zaretsky, "The Mutagenis Arts" in *CIAC's Electronic Magazine*, no. 23, 2005. Available online: URL: http://www.ciac.ca/magazine/archives/no_23/en/dossier.htm [date of last access: 04/10/2007]

own — and in a very short period of time. Ideally, if one were doing an exhibition of this magnitude on a university campus, the gallery would serve as a liaison, managing the daily negotiations. However, since we were both employees at Concordia University at the time, we were in the unique position of working directly with our home institution. In addition, this dialogue would normally take at least a year to transpire, in order to ensure that all parties come to a common understanding and agreement. With compressed time constraints and a lot at stake, this exhibit was by far the most difficult endeavour undertaken by BIOTEKNICA in its seven years of production.

LiveLifeLab: Specialized Scientific Purchasing

Purchasing the specialized scientific equipment, disposables, serums, solutions, and live cell samples is also a complex and invested process. There are two reasons for this: industry regulations and university regulations. Industry regulations stipulate that biological specimens (in this case, established cell lines) can only be ordered by certified and registered laboratories even if the specimen is categorized BSL1, indicating that there is no known harm. There was no possibility of us achieving this type of certification in three months for a transient gallery laboratory, so we had to look to other laboratories on campus to gain access to the 3T3 mouse fibroblast cell line with which we wished to work. In terms of university regulations, we were subjected to a series of purchasing policies that we had never encountered before, such as blanket agreements,

purchase orders (<1000.00 CDN), purchase requisitions (<5000.00 CDN), and putting orders to tender, soliciting competitive bids for items over 5000.00.

The academic/scientific purchasing system is not intended to encourage extracurricular interdisciplinary participation. We spent many hours on the phone explaining that we were artists. We had all sorts of questions that I'm sure were unusual. It was difficult to explain that yes, colour was important to us, and that we wished for our purchases to be delivered to a gallery rather than to a lab. Purchasing, in and of itself, is a specialized profession. In industry circumstances, the purchase of any product requires far more negotiation than our typical daily consumer purchases. Price, delivery, invoicing, and payments are all up for negotiation. As we were working on a very tight schedule, we pressed hard for guaranteed delivery, often making sacrifices in terms of price and payment. Labs are rarely built in a period of three months, and it was difficult to ensure delivery in time — and in the instance of some of the larger equipment, it was outright impossible.

We made several attempts at purchasing the required items at a variety of venues before arriving at successful solutions. In the beginning, we contacted local and international companies directly, with little success. We then changed our course of action and approached Purchasing Services at our university for assistance. Unfortunately, the dedicated scientific purchasing agent had resigned earlier that week, and although she was gracious enough to provide us

with industry contacts and a brief description of the purchasing process, we were essentially left to our own devices.

We found that the university has already negotiated a variety of blanket agreements (with reduced pricing) with local distributors, and we learned that, if we followed the protocols correctly, spoke to the appropriate salesperson, carefully filled out the paperwork, and received prompt administrative signatures, we could purchase all of our disposables in a somewhat efficient manner. We met with company representatives from Sarsted and Fisher Scientific and made a series of orders, after ensuring that the items were in stock and could be delivered in time for the opening of the exhibition. This was our first opportunity to stock a lab of our own, and we took full advantage ordering a years supply of {consumables}: disposable lab coats, latex gloves, 5, 10, and 25 mil pipettes, assorted tissue culture flasks, 50 mil vials, racks, beakers, kin wipes, specimen containers, petri dishes, sterilization envelopes, tape, tweezers, scalpels, scissors, and biohazardous waste bags.

Where we encountered real difficulties was in purchasing major equipment, serums, and solutions. In order to keep cells alive outside of the body, you need a lot of the body — the technoscientific body[7] and the actual body — to create a thriving environment. To this end, we chose to purchase some large equipment,

[7] Oron Catts and Ionat Zurr, "The Extended Body" in *Artnodes: Intersections between Arts Sciences and Technologies*, 2006. Available online: URL: http://www.uoc.edu/artnodes/6/dt/eng/catts_zurr.pdf [date of last access: 04/10/2007]

a CO2 incubator, a laminar flow hood, an inverted microscope, and a bioreactor to serve as the technological matrix in the exhibition. Each item incurred a series of size restrictions, price ranges, and functionality (basic models versus specialized additions). Although we had worked with all of this equipment before, we were overwhelmed by the multitude of choices and specifications that we had never encountered before. We found ourselves asking a multitude of questions: what is the difference between an I/R (infrared) and T/C (temperature coefficient) sensor? And what are the benefits of a water-jacketed unit over direct heat? Can you explain that to me again? Ultimately, the results were mixed.

For example, the CO2 incubator was a pricey purchase, but a necessary one. Cells living in vitro require an approximately 5-10% CO2 environment, which controls the osmolality (a measurement of the osmotic particles in a solution) and pH (the measure of the acidity or alkalinity of a solution) levels of the delicate cell cultures. In the past, we had used a hybridization oven stocked with carbon dioxide packs with some success, but we wished to professionalize our equipment for future research and production. We approached Fisher Scientific for a basic model and, after days and weeks of negotiation, we agreed on a model, price, and delivery — only to find our order severely delayed by purchasing services. We were unaware of the tender process, and had to negotiate in order to have the purchase order put through without competitive bids. Once that was completed, the unit we had selected was out of stock, so we quickly substituted it for another model. Though the incubator would not arrive in

time for the opening of the exhibition, we were able to get it in days before the vernissage and live performance event. However, delays with the CO2 regulator and gas supply made for an expensive sculptural object displayed in the corner of the gallery with no functionality.

Other items were accomplished with various levels of success. The laminar flow hood necessary for creating a sterile environment to complete the tissue culture protocols also presented difficulties. Hoods are often manufactured on demand, and delivery was not possible in time for our event. In addition, only one model was narrow enough to fit through the corridor opening to the laboratory. In the short term, it would have sufficed, but we were looking to purchase a more substantial unit to support our ongoing research. Instead, we decided to borrow a portable teaching hood graciously offered by the Department of Biology.

The inverted microscope also posed problems, as the models carried by suppliers with established relationships with our university were research-grade, large, heavy, and inordinately expensive — far outside of our budget. An inverted microscope is a specialized piece of equipment even within the biological sciences. All of the optics are housed under the stage, allowing for flasks containing live cultures to fit on top of the apparatus. This structure enables light to penetrate upwards through the cell membranes, allowing direct focus on the bottom of the tray. We solicited a variety of local labs to borrow one with no success. Eventually, we ordered a simplified model via the Internet from

a supplier in the USA, only to have it caught up in customs. Fortunately, we were able to retrieve it, though a mere one day before the vernissage. This piece of equipment was absolutely necessary, as cellular life is only really visible through a microscope, and all the impact of our project would be lost if our viewers were unable to see the cells for themselves. Otherwise, *LiveLifeLab* could have been interpreted as only a complex story, a sleight of hand relying on the construction of scientific authority — *believe what we tell you, there are living cells in that flask...*

The last piece of large equipment that we required was a bioreactor. A bioreactor serves as a sterile micro-gravity environment best used to grow 3D tissue-engineered sculptures. The adherent cells we worked with are subject to gravity and cling to the bottom of stationary tissue culture flasks. In order to coax the cells to adhere to a 3D scaffold, the bioreactor continuously rotates, providing no stable surface (other then the scaffold) for the cells to attach. Though we had worked with a Synthecon model (originally developed by NASA to carry cells into space) in Australia and received promise of the loan of a stand-alone soft bioreactor from Wave Bioreactor as part of our ongoing *Teratological Prototypes* project, we were unaware of the highly specialized nature of this equipment. We quickly learned that Synthecon and Wave Bioreactor are the only two suppliers of this type of equipment. Since the bioreactor establishes the central aesthetic of the display of tissue engineered sculptures, we sought a device that was different from those previously used in conjunction with Oron Catts and Ionat Zurr of

Tissue Culture & Art Project. We settled on the Synthecon perfusion rotary system for its changed appearance and advanced functionality, which allows for the continuous flow of fresh media into the bioreactor chamber. This feature allows for the bioreactor to be left for longer durations, as it does not require daily replacement of media by hand. In addition, the risk of contamination with this unit is substantially lower, as the vessel is not repeatedly opened and exposed. However, this unit is much more expensive then those we had priced in the past. Fortunately, we were able to negotiate an excellent discount (and a small simplification of the electronic components) through the company representative due to the non-profit nature of our research and the promise of frequent display of the unit in international art exhibitions.

Outside of the large equipment, we were also confronted with great difficulties in procuring the variety of serums and solutions needed to support a functional tissue culture lab. DMEM (Dulbecco's Modified Eagle's Medium) is a vitamin-rich solution which houses and feeds the cells in vitro; FBS (Fetal Bovine Serum) is a product made from the blood of cow fetuses added to the medium to provide the cells with nutrients normally received from the host organism; PenStrep (Penicillin-Streptomycin) is an antibiotic medication added to prevent bacterial contamination as the cell cultures have no immune system of their own; Gluta Max is an essential amino acid; Trypsin is an enzyme extracted from the stomachs of cows, used to break the bonds between cells for redistribution of cell cultures; PBS (phosphate buffered saline solution) is used to wash cells without

damaging their membranes; double distilled water was needed to rinse scaffolds; and Bleach and 70% ethanol were needed for cleaning and sterilization. Suffice it to say that most of these items cannot be purchased at local commercial outlets. After many failed attempts to find a distributor that was interested in dealing with us (and our temporary laboratory location), we directly contacted an international supplier, Invitrogen. Invitrogen ships laboratory-grade serums and solutions on twenty-four hour notice, allowing for us to receive most items in short order.

We were pleasantly surprised to find that they would accept orders and credit card payments over the phone, and that they also seemed to have little restrictions on where they could deliver the supplies. This proved useful for our purposes, although it was also a bit disconcerting. Invitrogen, in their terms and conditions clause, protects themselves from any liability, arguing that the receiver is responsible for providing adequate housing, safety, and personnel (TQI, or Technically Qualified Individual). A TQI is defined by the USA Toxic Substance Control Act as:

> a person or persons (1) who, because of education, training, or experience, or a combination of these factors, is capable of understanding the health and environmental risks associated with the chemical substance which is used under his or her supervision, (2) who is responsible for enforcing appropriate methods of conducting scientific

> experimentation, analysis, or chemical research to minimize such risks, and (3) who is responsible for the safety assessments and clearances related to the procurement, storage, use, and disposal of the chemical substance as may be appropriate or required within the scope of conducting a research and development activity. (CAA Q&A Database, May 1997) II.B.6[8]

At this juncture, it is important to note the irony of our direct dealings with the biotech industry in support of a project intended to encourage critical scrutiny of that industry. Over the years, I have found that it is impossible to engage critically with biotechnology without also becoming a part of its community and infrastructure — and therefore a participating member of that hierarchy. By joining the community, working alongside scientists who were conducting a variety of research, and, with *LiveLifeLab,* economically and conceptually investing in the corporate reproduction of ongoing biotechnological research, we were even further entrenched in the very system we wish to critically analyze. This position furthered our 'gone native' status — as Oron Catts has often said of his own work with Ionat Zurr, "we are embedded reporters," with all the unraveling connotations implied by that position.

---

[8] USA Toxic Substance Control Act, Available online: URL: http://yosemite.epa.gov/oswer/oswer.nsf/1d6b58d5ae9061b8852566da004e5a57/cd5e187f53184afe852569d00072ed02!OpenDocument [date of last access: 04/10/2007]

***LiveLifeLab*: Establishing a host laboratory.**

In order to build a temporary laboratory in a non-specialized environment, we required the support of a host laboratory to gain access to the infrastructure and the acquisition of restricted cell cultures. Unlike the processes discussed thus far, establishing a host laboratory was far more personable, creating an ongoing dialogue with colleagues in the Concordia University scientific community about the nature and intentionalities of *BIOTEKNICA*. We contacted the Department of Biology, requesting technical assistance with *LiveLifeLab*. We were very pleased to receive a response from Dr. James Grant, Chair of the Department of Biology, directing us to their Technical Officer Sonia Ruiz. We met with Ruiz, explained our ongoing research with TC and TE, and provided her with a slideshow of our exhibit in San Jose. We spoke of the democratization of science, biotechnology, and TC and TE; we discussed the ethical and aesthetic implications of bioart, as well as our deep respect for and fascination with the biological sciences. Although she expressed great interest in *BIOTEKNICA*, she informed us that Concordia University houses no ongoing research in mammalian tissue culture.

Though their lack of specialization in our protocols proved to be a small setback in terms of accessibility and equipment, they were fitted with enough infrastructure and expertise in related fields to assist us. Ruiz agreed to provide

technical support in three ways: (1) in the loan of a BSL1 portable sterile hood, (2) the acquisition of the 3T3 cell line directly from ATCC[9] or from a local researcher, and (3) to provide access to the department's autoclaving facilities for sterilization of tools, equipment, and double distilled water. In exchange, we agreed to confirm health and safety approval of the satellite laboratory site before accepting any biological materials from the department and to provide public recognition of support provided by the Department of Biology in the propagation of *LiveLifeLab*.

Although Ruiz was ultimately unable to secure any cell lines from local researchers, she did place an order for the 3T3s to be delivered directly to her laboratory. Unfortunately, the cells did not arrive until the day of our vernissage, preventing us from including them in the installation on such short notice. However, we had planned in advance for this contingency by performing two primary cell acquisitions from commercially purchased cow femurs, both before the vernissage and then in front of a live audience during the opening event. This small setback aside, we were pleased to receive the cells in good condition. A day later, we worked in the department's teaching laminar flow hood to defrost the cells and suspend them in nutrient solution for delivery to the gallery site.

Defrosting cell samples is a delicate process. They are frozen and suspended in an antifreeze solution, which prevents ice crystals from breaking the cellular

[9] ATCC: The Global Bioresource Centre, Available online: URL: www.atcc.org [date of last access: 04/10/2007]

membranes. Though the antifreeze is necessary (and harmless) at -80 degrees Celsius, once the sample is brought up to room temperature, it requires immediate dilution in TC media (DMEM + 10% FBS) to prevent cell loss. The tiny vial was delivered to the site in a box of dry ice. The vial was then removed and its contents were defrosted in a warm water bath. The sample was pipetted up and down to break up the pellet of cells in the bottom of the vial, then transferred to a larger vial containing warm medium. This vial was centrifuged, drawing the cells into a pellet once again, allowing Bailey to draw off the antifreeze and medium, only to be replaced with fresh medium again and transferred into a new tissue culture flask. By this point, the cells had suffered a rather traumatic morning and required a 'rest' in ideal living conditions — at 37 degrees Celsius, surrounded with fresh media, and 5% CO2. The Department of Biology did not have a CO2 incubator, so we immediately transported the cells, double wrapped in biohazard Ziploc bags, to the campus gallery across town. To keep the cells warm, I held them in my sweater next to my stomach, keeping them at body temperature as we road the bus into the city. I couldn't help but to think of the final scene in Mike Nichols' *The Graduate* (1967), where Benjamin and Elaine escape her wedding in the back of a public bus; she is dressed in white, and they are smiling a secret smile to each other. In this instance, however, I am exhaling into the collar of my sweater every few minutes to keep my stomach warm and moist, hoping to mimic ideal tissue culture conditions with self-produced CO2.

In general, our interactions with the scientific community in this capacity were mutually respectful — even delightful and rewarding. From my experience, individual researchers in the hard sciences work in small communities or even isolation (much in the same way that artists work), and are thrilled when individuals outside of their area express interest (or even amateur expertise) in their specialized field. Arguably, the larger institutional culture of overspecialization serves not only to exclude more general audiences from a particular practice or discourse, but also to ostracize the specialist class from external interaction with language barriers and perceived hierarchies. In this instance, the reception of our proposed collaboration at Concordia University was overwhelmingly positive from administrative units, faculty, and particularly from technical staff.

However, it is important to note that some ideological clashes (although they are rarely terminal) result from this type of interdisciplinary cohabitation of the arts and sciences. I can think of many instances of argument and debate that I have encountered over the years between researchers in the two fields. In the instance of *LiveLifeLab*, we did encounter some healthy resistance to our research from the scientific community. While giving the Technical Officer Ruiz a tour of our exhibition after the vernissage, she related to us some concerns she had received about her participation in our project. Apparently, when our exhibition invitation was forwarded to faculty members in the hard sciences, there was some concern regarding our website and the anti-corporatization arguments

made in the writing, imagery, and dissemination of *BIOTEKNICA*. Ruiz was contacted by one professor in particular who had started a biotech company of his own, based on government-funded research he had conducted at the university (a very common practice amongst professors in the sciences). He felt it was unreasonable for the department to support art/science research that worked in opposition to commercialization strategies in the sciences, and held Ruiz accountable for her work with *BIOTEKNICA* based on the content of our website. Of course, my heart sank, as we had never provided Ruiz with a link to the site directly, and had inadvertently put her in a difficult position. However, she concluded that, as Technical Officer, it was her responsibility to support faculty research in the sciences regardless of its content (and outside of her personal opinions), and felt justified in her decision to work with us by providing technical support. In hindsight, I am unsure about what motivated us to avoid directing Ruiz to our website during our first meeting. Did we edit it from our presentation intentionally?

LiveLifeLab: Health and Safety

Possibly the most difficult aspect of successfully launching *LiveLifeLab* was our dealings with the Concordia Health and Safety Office. Conceptually, Bailey and I had always chosen to work within the established channels towards effecting social and political change. We were interested in working towards changing policies at the institutional and governmental levels that prevent open discussion

and dialogue in the field of biotechnology. Because of this methodology, we always worked directly with institutions and, as a result, within their community standards and protocols in activating those behaviors and actions that exist at the periphery of established standards for engagement. To this end, we suggested that the gallery contact the health and safety office (H&S) as soon as we agreed to attempt to build a lab in the exhibition. What we received in response was a curt notification that we were not to complete the exhibit as planned until we had contacted H&S directly and met with an officer to discuss our plans.

We made arrangements to meet with H&S officers immediately and prepared a presentation slideshow that featured our last laboratory installation at ISEA in San Jose. We also prepared a list of questions, as well as a list of probable materials and protocols that would be used in *LiveLifeLab*. At our meeting, we were offered a variety of H&S suggestions, proper disposal containers, and requested to provide an official list of hazardous materials and protocols. We agreed to keep the appropriate MSDS (Material Safety Data Sheets) available on site, mark all hazardous materials, and provide gallery staff with transparent information of the possible harm (or lack of harm) that the exhibit posed to viewers. We also agreed to a full laboratory H&S inspection before the cell line was transferred to our site, and to store hazardous material in appropriate conditions.

However, the conversation took an unusual turn. We were presented with concerns about the 'perception of harm' on behalf of our viewers, and the possible legal ramifications of these fears for the university. We argued that the perceptions of our work were outside of the scope of H&S regulation and, in fact, were solely the domain of artistic freedom. It was explained to us that, although the perception of *LiveLifeLab* was an artistic concern, it was also the role of H&S officers to field questions when employees and visitors to Concordia University perceive themselves at risk. With this understanding, we offered to minimize the perception of risk, with the understanding that H&S officers would fulfill their prescribed job description by making themselves available to any individuals who have questions about the safety of the exhibit.

Our discussions focused a great deal on the presence of household bleach in the laboratory. Bleach was the most harmful substance we proposed to bring into the lab. Bleach is a necessity in TC and TE protocols, as it is powerful enough to kill all biological waste, thus allowing researchers to pour used serums and solutions down the drain as a safe means of disposal. H&S was concerned, as bleach has been banned from campus as a cleaning agent due to its corrosive potential, poison risk, and chlorine odor. The hazards are described as thus:

> Potential Health Effects Eye: May cause irreversible eye injury. Contact with liquid is corrosive to the eyes and causes severe burns. Skin: Causes skin burns. Ingestion: May cause methemoglobinemia, cyanosis

(bluish discoloration of skin due to deficient oxygenation of the blood), convulsions, and death. Causes severe digestive tract burns with abdominal pain, vomiting, and possible death. Methemoglobinemia is characterized by dizziness, drowsiness, headache, shortness of breath, cyanosis (bluish discoloration of skin due to deficient oxygenation of the blood), rapid heart rate and chocolate-brown colored blood. Inhalation: Harmful if inhaled. Causes severe irritation of upper respiratory tract with coughing, burns, breathing difficulty, and possible coma. May cause pulmonary edema and severe respiratory disturbances. Chronic: Chronic inhalation and ingestion may cause effects similar to those of acute inhalation and ingestion.[10]

We were told that the gallery did not have suitable ventilation to accommodate such a substance, and that people might complain of perceived risk if bleach fumes were able to escape their container (or the lab), possibly alarming the university community. We agreed to provide proper containers (with diligent lid coverage) for bleach solutions and to store the bleach at a better ventilated location in the art department when it was not being used on site. In addition, we agreed to dispose of used bleach solutions in a private manner, and not in public washrooms, to again dissuade any possible fears in the general public. We offered the same precautions in the use of 70% ethanol as a cleaning agent, and even went so far as to purchase 95% alcohol from the liquor store as a

[10] MSDS sheet available online: URL: https://fscimage.fishersci.com/msds/91020.htm [date of last access: 04/10/2007]

consumable replacement for industrial ethanol. Later, the suggestion that we transport the bleach and alcohol to a better ventilated storage facility was withdrawn.

The last concern brought to our attention was another surprise. We were informed that a number of university staff unions were on 'work to rule' action against the administration, including the technicians. Certainly, we were aware of this action (and in support of their cause). However, we could not see how this affected *LiveLifeLab*. H&S was concerned that, if they allowed us to open a satellite lab on campus without a paid technician as specified in their collective agreement, there might be a grievance action taken out against us during this time. We were very concerned that poor labour relations on campus might affect the outcome of our exhibit. We made it clear to H&S that an art installation with a laboratory component was distinctly different, and was separate from university policy in managing permanent campus laboratories.

Overall, we were left with the perception that the successful launch of our lab was contingent on approval by H&S officers, with the implication that we may not receive this approval. We went so far as to mention the ramifications of perceived academic and artistic censorship in the event that a common ground could not be reached in this matter. I specifically asked that, if we followed all of the protocols and standards outlined in the discussion and posed no known risk of harm to ourselves and our viewers, would our project approval be given. The

response was a "yes," but it was marked by great hesitation. We left the meeting feeling very discouraged.

In a follow-up email, we outlined the agreements and discussions that had transpired during the meeting to H&S as well as a number of Concordia University administrators. In a written response which we later received, it was made clear to us that H&S was in no position to block the exhibition — but, as we already agreed with the Technical Officer of the Department of Biology, without their approval there was to be no transfer of the purchased 3T3 cell line to our satellite location. The successful completion of the exhibition was, in fact, subject to H&S approval.

After much correspondence, and as the vernissage drew nearer, we booked a walkthrough meeting with the Director of H&S for the final inspection of our lab. The meeting was an unusual one. Unfortunately, I was unable to attend; however, I was informed that suggestions were made about the variety of possibilities that could result in the failure of *LiveLifeLab*. For example, it was proposed that if the gallery electrical grid failed, our specimens would be lost; if an individual were to make a complaint to the appropriate government office, *LiveLifeLab* could suffer a literal lockdown, and the gallery doors would be chained until a full investigation was completed. Bailey assured H&S officials that we were prepared to take all of the appropriate steps to prevent these outcomes with the assistance of their office. He spoke confidently and

competently about the precautions, techniques, and substances present in the lab, dissolving any perceived tension. In the end, a balance was reached, and we made a few minor changes: ensuring our biohazard signs were posted in both French and English, adding some labels to unmarked bottles, and replacing our latex gloves for vinyl ones provided by the H&S office. The end result was H&S approval of our lab in time for the vernissage and the eventual delivery of the 3T3 cell line.

LiveLifeLab: Vision TV Documentary

The last constraint we experienced was self-imposed, and provided us with an excellent opportunity. We had been contacted a couple of months in advance by an associate producer at Vision TV (a Canadian, faith-based television network) who was interested in doing a television documentary on bioart in general and wanted to specifically focus on *BIOTEKNICA*. 360° Vision was a current affairs program that "spotlights spirituality in contemporary Canada."[11] They tackled issues directly concerning organized religion (like gay and lesbian clergy members), as well as current affairs issues form a spiritual perspective (for example, rising gang violence in Canada). Though we did not contextualize *BIOTEKNICA* or evolving biotechnological debates in this regard, we felt strongly that, if we were arguing for the democratization of biotechnology, all perspectives

[11] *Vision 360* from *Vision TV*, Available online: URL: http://www.visiontv.ca/Programs/current_affairs_360.html [date of last access: 04/10/2007]

should be taken into consideration. With this in mind, as well as the quality of previous documentaries produced by the 360° Vision team, we agreed to participate. We invited the producer, Janet Aronoff, and her crew to join us for the three days surrounding our *LiveLifeLab* vernissage. This timing would ensure that cellular life would be in the lab during filming, and also best convey the electric tension of presenting live biological specimens and protocols at a public event. However, this also meant exposing ourselves at a very busy time to a very public recording of our ongoing artistic practice.

The day of our vernissage, we spent the morning conducting interviews in our private residence. Then, the crew followed us to the butcher, slowing every step of the process, as we explained the practical and ethical aspects of our work in minute detail. The crew also became privy to all of the last minute meetings we conducted that week — attending our final Health and Safety inspection, defrosting of cells at the host laboratory, and the vernissage itself. They also arranged meetings with academics and theologians in the gallery for external interpretations of our installation.

During our initial discussions with Vision TV, we were asked if we knew of any detractors of our work. I mentioned Carol Gigliotti, a professor at Emily Carr College of Art and Design who had published texts in opposition to contemporary bioart practices. Unbeknownst to us, Vision TV flew Gigliotti into Montreal and interviewed her onsite about our exhibition the day before our public performance

event. The scrutiny was provocative, well-intentioned, but somewhat uncomfortable and invasive during this stressful time.

The documentary has not yet aired as of April 2007, so I cannot attest to the final narrative that will be presented to 360° Vision audiences. However, I was pleasantly surprised by the recorded reactions from gallery visitors and academics. Though the crew seemed genuinely interested in and supportive of our practice as we presented it to them, they were also searching for controversy. We allowed the producer to interview attendees at the gallery event. They were asked for their reaction to the exhibition, particularly as it pertains to ethics, morality, and spirituality. The producer seemed surprised, and a little disappointed, that those who attended the vernissage were resoundingly in support of our interdisciplinary art/science mandate and production. One individual's response was so positive that he was recorded jumping up and down hollering the merits of our performance.

It is my understanding that Gigliotti did not provide the directly oppositional quotations that they were hoping for. In addition, the theologian that they brought in suggested that our work would only enter the realm of religiously objectionable if we were conducting research on human subjects (as according to the Christian hierarchy of life, which suggests that man's body is divine, whereas the animal body is a resource for human consumption, manipulation, and control). Of course, upon hearing this, we committed our earlier work with the Hackett

(human epidermal) cell line to record, and also recorded our future plans to take skin samples from Shawn Bailey to create our own open source artist cell line. We did not see a categorical distinction between human and animal cell sources — rather, we wished to undermine perceived hierarchies between the human and animal kingdoms and embrace the continuum of bodies mobilized in biotechnology.

Once the filming was over, we were left exhausted, confused, and feeling as though we had been taken advantage of — like minor circus freaks, closely examined by the lens and the masses for horror and entertainment value. We were also discouraged by the producer's continual quest for objections and dissent, particularly as she often attempted to mobilize us to assist her in unearthing controversy. Though our working methodology encourages our viewers to come to their own conclusions about our practice, TC and TE, and biotech, we felt newly responsible to produce a negative feedback loop on demand for the camera. Last, we parted with a new understanding of the level of scripting involved in documentary productions. The subject of documentation often required artificial lighting, repetition, rescheduling, and even reenacting to better serve the lens. This aside, we are glad to have committed to this project, as it serves as an excellent record of an exciting point in our artistic lives and as an extended public interface for *BIOTEKNICA: LiveLifeLab* to perpetuate itself.

In detailing the various administrative, industrial and economic hurdles that we overcame in building *LiveLifeLab*, I am trying to convey an imposing message that we received from various individuals and offices through their actions (and sometimes inaction): research involving scientific protocols is carefully guarded, and outsiders are not welcome. We learned that, without almost superhuman resolve, significant funding, and a persuasive language set, non-specialist participation in codified scientific channels is almost impossible. With the successful completion of this exhibition, we gained new understanding and respect for earlier generations of bioartists working within institutional contexts, such as Joe Davis (MIT), Tissue Culture & Art Project (UWA), Beatriz da Costa (UofCI), Kathy High (RPI), and Natalie Jeremijenko (UCSD). We were very pleased that *LiveLifeLab* established many important precedents at Concordia University and within the greater Canadian community, though we were exhausted, and a little disheartened, by the process.

In a previous paper, "BIOTEKNICA: A Case Study in Bioethics and Human Tissue Culture in Art," we developed a language set to describe the dual intentionalities we experienced that working in the labs as 'double agency.'

> We have entered into a critical/participatory relationship with biotech in general and tissue culture in particular. In this capacity we understand our position to be like that of *double agents*. Not in the Cold War sense of the term, but rather as a participant with dual intentionalities. Here, we are

> welcomed into a highly specialized environment inaccessible to the general public. We are simultaneously engaging collaboratively, respectfully and excitedly with the individuals, protocols and institutional structures of the site – while at the same time, from a different standpoint, gaining outsider insight and observations (and criticisms) that are published in other communities. Often these roles are at odds – sometimes easily synchronized, but always co-present.[12]

With *LiveLifeLab*, I feel that this sense of double agency extended even further into our practice, in terms of the necessary administrative give and take, and compromise that was required of us. In the past, our investment in laboratory certification and functionality was almost non-existent, given our status as visitors in already functional labs. In this instance, the stakes were higher: we were working at our own university, where negotiations were constantly forging new territory and establishing precedents that, as all parties were aware, would have long-term repercussions for *BIOTEKNICA* and Concordia University.

The push and pull we felt in working as individuals in the SymbioticA labs (what to reveal and not reveal of our established critical framework, the slow colonization of the non-specialist perspective) was less systemic and always temporary, lasting only as long as our Australian residency visas. With

[12] Jennifer Willet and Shawn Bailey, "BIOTEKNICA: A Case Study in Bioethics and Human Tissue Culture in Art" in press, 2007.

LiveLifeLab, these forces were at play on a larger scale — compromises were more permanent, deeply effecting the administration of the *BIOTEKNICA* from a structural and managerial perspective.

It is imperative to note that each individual that we encountered during this process was aptly fulfilling their job description (producer, purchasing agent, health and safety officer, technician). The criticism launched here is not aimed at individuals or personalities, but rather at the larger institutional framework — a culture of bureaucratic control — with the goal of supporting North American standards of full disclosure, safety, and responsible spending of tax-payer dollars. Reasonable aims — necessary checks and balances — amassed into a juggernaut machine of administrative and specialized impenetrability. In Hannah Arendt's canonical analysis of the Adolf Eichmann trial for crimes against humanity, she writes of the 'banality of evil'[13] in the individuals that enacted the atrocities of the Second World War, but also of the bureaucratic functionality of these atrocities. I am by no means putting the systematic dehumanization and culling of a people through holocaust measures on equal footing with liberty infringements resulting from the overspecialization of the biological sciences, but I am alluding to the powerful systems of control that a bureaucratic state wields over discourse and actions of individuals and communities in pursuing knowledge outside of normalized (and sanctioned) courses of action. Extreme interdisciplinarity, especially that which infringes on science (which we tend to

[13] Hannah Arendt. *Eichmann in Jerusalem: A Report on the Banality of Evil* (1963). Rev. ed. New York: Viking, 1968.

perceive as the highest order of knowledge, with the greatest potential for harm and profitability), is inherently obstructed by the same bureaucratic institutions that we rely on for its regulated management.

With *LiveLifeLab*, so much of our time and resolve was expended in negotiations, correspondences, and sheer physical and emotional will that the subtle play and reflexive empathic relationship I usually experience with laboratory ecologies played an inferior role in this particular art action. The unwavering forward thrust required on our behalf disallowed our more usual reflexive working strategies. Barbarism might better explain it — replacing cell lines with fresh kill bones, and a rotary power saw wielded to access the interior of the institutional and animal body. We exhausted ourselves in the creation and production of this exhibition, only for our work to be contaminated due to faulty equipment. Bacteria (and unhappy artists) became the only life in *LiveLifeLab*.

In hindsight, I might categorize *LiveLifeLab* as a failed ecology of sorts, where a harmonious balance between life forms (artists, cells, bacteria, and health and safety officers) was attempted but never ever quite achieved. I am reminded of another 'failed' ecology that existed years ago, when I attempted to start my first garden from store bought seeds. I carefully planted, watered, and watched dozens of fragile life forms in my living room window. A couple of months in, as the plants were becoming hearty, and the weather was warm enough to think of moving them outside, we (the plants and I) suffered a massacre, enacted by my

disabled but playful house cat, Bouts. I imagine that he had watched me dote so much attention on the seedling trays that he took it upon himself to pull them all down, crumpled on top of one another on the living room floor. Some of the plants recovered, but most did not. Heartbroken, I wrote to George Gessert for sympathy, a bioartist known for his work with selectively breeding irises. In his response, he reminded me that life is a violent process. "Your cat understands the spirit of gardening, which is messy, and involves random destruction and death. I hope you don't get discouraged. Life thrives in spite of it all."[14] This personal experience helped me to contextualize and understand *LiveLifeLab*. Life is hard — all that is alive dies — and even unwanted contamination equals the successful propagation of another entity with which we share our ecology.

I wish to conclude this case study by addressing arguments presented in earlier chapters to elucidate how these concepts play out in regard to this instance of bioart. *LiveLifeLab* contributes in multiple ways towards my arguments for a shift in the language used in describing biotech in public discourse, a shift in the representation of the biotech specialist towards a more inclusionary interdisciplinary model, and an instance of hands-on education for non-specialists in demystifying and (re)embodying biotechnological protocols.

If we look back throughout this chapter, we can see a specific language set that is deployed in constructing the public representation of *LiveLifeLab*. Phrases like

[14] From personal correspondence with George Gessert, 2005.

'feeding the cells' and giving them a 'rest' permeate *BIOTEKNICA* discourse. I am particularly interested in proposing this installation as a 'laboratory ecology' filled with cells, bacteria, and human bodies, imagining the lab not as an artificial and controlled environment, but rather as another ecological point of interaction amongst multiple species. This point is aptly made in another work of bioart *Workhorse Zoo* (2002) by Julia Reiodica and Adam Zaretsky, in which the artists cohabitated for a week in a laboratory installation with an assortment of organisms including bacteria, yeast, plants, worms, flies, fish, frogs, mice, and humans. The concept of a laboratory ecology, in terms of written and visual language, draws reciprocal attention to the embodied interconnectedness and mutual reliance between researchers and the organisms (and parts of organisms) that cohabitate in biotechnological research labs. Here, specialists are also artists, H&S officers are also bodies, cells are also collaborators, and witnesses/students are introduced to all contributing bodies.

In closing, I wish to relate one specific meeting with a group of student non-specialists in the lab. As I arrived to feed the cells on a Tuesday afternoon, I found a small group of art education students waiting for me in the gallery. They had arranged to meet with their professor and witness the bi-weekly feeding performance. We began with a group discussion in the installation waiting room, but quickly moved to the lab. They seemed surprised when I asked them all to wash their hands, suit up in plastic lab coats, and join me in feeding the cells. A couple of individuals chose to stay outside, only to change their minds and join

us minutes into the performance. We began with a short health and safety introduction, and then moved into hands-on demonstration of cellular microscopy — with ample question and answer. I then proceeded to feed the cells, asking for student assistance and carefully describing each step of the process. The event concluded with group discussion of the ethical complexities of evolving biotechnologies, the processes at hand, and *LiveLifeLab* as a work of bioart.

Once we were finished, the instructor asked the students to analyze the performance strategies deployed by myself in our interaction. One student proposed a pedagogical model — a form of art/science education; another identified my use of colloquial language and self-deprecation as a means of reducing specialist authority; and another student suggested that they needed to question altogether what my motivations and intentionalities were, proposing that they should not allow the white lab coat to prevent themselves from critically engaging with my presentation. At the centre of this small discussion, I felt a warm blush moving across my body as I recognized the resounding success of *LiveLifeLab* in allowing others to enter into a critical participatory relationship with biotechnology, if only in this small instance.

BIO*TEKNICA: LiveLifeLab* was the last major exhibition of the BIOTEKNICA collective. Months later, we wrote about this incarnation of the project in "BIOTEKNICA: Teratogenic Strategies For Critical Bioart Production" as suffering from a consumptive end. The attributes that made *BIOTEKNICA* successful —

particularly our ability to relentlessly push through the necessary chain of command institutional/scientific circles — eventually inhibited the original transformative political spirit of the project, through a process of bureaucratic reification. In hindsight, I can only see it as a slow death by paperwork. Where bureaucracy overcame the desire to make the work.

> These cumulative experiences marked a significant shift in our collaborative practice – away from the mere representation of mutation – and towards a teratomatic interventionist methodology. BIOTEKNICA itself, has been transformed into a teratogenic agent – where instead of analyzing biotechnology from an external position, it begins to infect and produce irrational affect in both scientific and artists communities. BIOTEKNICA has become an un-nameable entity - *organism* - skirting the boundaries of art and science. As James G. Wilson describes in his *six principles of teratogensis*; "Teratogenic agents act in specific ways on developing cells and tissues to initiate sequences of abnormal developmental events."[15] BIOTEKNICA also serves to initiate sequences of abnormal developmental events, at cellular, social, political, artistic and scientific levels. Ironically, and reciprocally, BIOTEKNICA's transmutative effects have also contaminated itself, and the artists/actants who set the process in motion, hypocritically instrumentalizing (devouring and mutating) life forms to propagate it's own robustness – subsuming itself,

[15] James G. Wilson. *Environment and Birth Defects* (Environmental Science Series). London: Academic Pr. 1959.

and it's host organism. BIOTEKNICA, like the cancerous teratoma, is subject to it's own self prescribed vicissitude, and consumptive end.[16]

[16] Jennifer Willet, Shawn Bailey. "BIOTEKNICA: Teratogenic Strategies For Critical Bioart Production" in *Mutamorphosis Conference Proceedings*, CIANT, 2007.

5 | (RE)embodying Biotechnology: Conclusion.

If we are going to work with the P19's we need a different mix of serums in the nutrient fluid. We ordered a bottle of Donor Calf Bovine Serum. It is the colour of a good beef stock. I spent hours alone in the lab today. Defrosting the serum and dividing it into 7.5 ml dosages. Enough to make 100 ml of prepared nutrient solution (along with 5 mil of the usual fetal bovine serum). Serum is an interesting thing. It is the blood of the calf or fetus with all the cells and platelets removed. Horrific actually. And also interesting, we are postulating the ability to grow cells outside of the body - but how much of the body to we need to bring into the lab to create a hospitable 'artificial' environment for the cells to proliferate?

... if I cut of my hand, you say me and my hand.
If I cut off my leg, you say me and my leg.
If I take out my kidney, liver and intestines, you say me and my intestines...intestines.
But if I cut off my head, do you say me and my head or me and my body?...

loosely remembered from Roman Polanski's *The Tenant.*[1]

---

[1] Jennifer Willet. *BIOTEKNICA | ORGANIC TISSUE PROTOTYPES | LABORATORY NOTES*, unpublished manuscript, 2004.

(RE)embodying Biotechnology is an articulation of my own experiences working as an artist and a non-specialist in the biological sciences. This document charts the activities and results of the 'work,'[2] in the sense proposed by Noam Chomsky, that I have engaged in over the last several years. Although they seem to be separate, each chapter contributes to the development of a very simple argument: biotechnology is not separate from life. This statement is true in three senses. First, the processes and protocols that occur in laboratory environments are part of a continuum of human engagement in the manipulation of life. Second, biotechnology is not only defined by its processes and protocols, its metaphors and specimens, but also by its tangled and interconnected relations with society, individuals, communities, and ecologies. Third, biotechnology is a reciprocal technology of the body that engages with multifold instances of life — bacteria, proteins, cells, animals, scientists — as specimens, tools, procedures, and purveyors; when we manipulate life in this manner, we are ultimately manipulating ourselves.

I have proposed a variety of concepts and strategies in each chapter that allow for engagement with these notions, and I now wish to articulate their direct connection with the conception of biotechnology as indivisible from life, as a technology of the body, as ecology. This conclusion, which includes references to phenomenology, cybernetics, and discourse analysis, serves to theorize and

---

[2] Mark Achbar and Peter Wintonick, *Manufacturing Consent: Noam Chomsky and the Media*, 1992. 2:39:15

interpret the 'work' outlined in earlier chapters, but also marks the beginning of my next cycle of research. In chapter 2, I argued for non-specialist participation in the biological sciences with the application of alternative methodologies, community standards, and dissemination of results towards the democratization and transformation of the biological sciences in public discourse. I recounted some of the successes and failures of this proposition, emphasizing the dangers of 'going native'[3] and proposing a critical participatory relationship with biotech. However, my intention is not to suggest that these alternative practices work in didactic opposition to the hard sciences, but rather that they function in a reflexive manner, both critiquing and embracing biotechnology.

Bailey and I explain this threshold position in our paper "BIOTEKNICA: A Case Study in Bioethics and Human Tissue Culture in Art."

> In this capacity we understand our position to be like that of *double agents*. Not in the Cold War sense of the term, but rather as a participant with dual intentionalities. Here, we are welcomed into a highly specialized environment inaccessible to the general public. We are simultaneously engaging collaboratively, respectfully and excitedly with the individuals, protocols and institutional structures of the site – while at the same time, from a different standpoint, gaining outsider insight and observations (and

[3] Bruno Latour and Steve Woolgar, *Laboratory Life: the construction of scientific facts*. (second edition, enlarged) Princeton: Princeton University Press, 1986. P.44.

criticisms) that are published in other communities. Often these roles are at odds – sometimes easily synchronized, but always co-present.[4]

Alternative, non-specialist practices in the biological sciences contribute to this notion of biotechnology as a life science by functioning on a number of levels, primarily through propagating alternative models in public discourse and in the lab to allow for a wider representation of specialists (or non-specialists). A heterogeneous body of practitioners suggests that biotechnology is not necessarily understood from the perspective of rationality and scientific method or from models established through business and industrialization. Biotechnology can also be perceived as an art form — as poetry, as family, as cultivating, as rearing, as sexuality, as care of the self and the other. If we make ourselves available to alternative, non-specialist practitioners of biotechnology, then biotechnology will no longer only be understood as an applied science, but a life practice as well.

This line of argument was resumed in chapter 3 with the investigation of digital metaphors used to describe biotechnology in public discourse, which I argue serves to virtualize the field in its ethics and representation. I propose that we look to the metaphors in the visual and written language put forth by the bioart

---

[4] J.Willet & S.Bailey. *"BIOTEKNICA: A Case Study in Bioethics and Human Tissue Culture in Art." From* Louise Poissant and Ernestine Daubner, eds. *Critical Issues: Art of the Living* (Submitted to Washington University Press.) 2006.

community to create a more embodied language set or, ideally, a plurality of language sets in describing biotechnology.

In Chapter 4, I present an account of the intricacies — the successes and failures — of presenting biological artworks in public forums within the context of my own collaborative work *BIOTEKNICA* with the goal of inviting other non-specialists into a temporary art/laboratory environment. It may have been a wiser choice to present a chapter recounting a different threshold — my own passage into biotechnological specialization. However, because the rest of *(RE)embodying Biotechnology* is already so invested in this narrative, I chose to elucidate the deeply entrenched rules, regulations, guidelines, and languages that work against interdisciplinary art/science practices. Cornerstone ideologies are arguably slow to change, and disciplinary notions of specialization in the hard sciences is no exception. Conversely, however difficult it is to accomplish in a practical sense, we are working in a time where it is possible to effect this sort of change; the canon of disciplinary boundaries is waning, and a return to 'pre science'[5] models for production and reproduction of biotechnology — of life — is becoming possible once again. My intention in this chapter is to provide a detailed account of the hurdles and negotiations that are achieved behind the scenes of a bioart exhibit, and illustrate the ways in which they are central to and necessary for creating the conditions in which the individual non-specialist viewer

[5] Thomas S. Kuhn, *The Structure of Scientific Revolutions* (second Edition, enlarged) Chicago: The University of Chicago Press, 1970.

can interact directly with the orders of life in the biotechnological laboratory. In this instance, biotechnology is presented not only as a life science, but as a function of cultural life, procedural life, administrative life. It is presented as a pragmatic retelling of the bureaucratic 'work' component of manipulating and presenting life in a context outside of the hard sciences — as transformative, embodied, political art.

Through these chapters, I want to argue for a critical participatory approach towards understanding biotechnology that is indivisible from life — as a technology of the body, a technology of your body. Ironically, I can't help but to notice the connections between this reciprocal model of biotechnological embodiment and earlier feedback models proposed under the term cybernetics — linked to electronics, mathematics, and computation — in defining our relationship to biotechnology.

Norbert Wiener and related thinkers developed the field of cybernetics[6] in the 1940s. It was originally posited as a science associated with electrical engineering in the analysis and development of non-linear electronic circuits called statistical mechanics. Statistical mechanics is a system that describes and predicts the function of an electronic circuit as a self-regulating entity, one that performs operations of analysis, synthesis, and automatic self-adjustment.

---

[6] Norbert Wiener, *Cybernetics: or Control and Communication in the Animal and the Machine.* Cambridge: The MIT Press, 1965.

Essentially, statistical mechanics was established to imagine machines that, on a primary level, could self-learn new functions. The key element, developed by Wiener, was the insertion of the functional feedback into the electrical circuit. With this function, non-linear circuits could not only direct electronic pulses (or code, or information) across a string of nodes, but each node possessed the ability to produce new impulses or modify original impulses based on the particular attributes, functions, and external variables of the individual node. With this model, each node is able to monitor the impulses it receives for inconsistencies, static, or degradation of the original signal, and self-modulate or notify the larger system if systematic equilibrium is disrupted, thus creating a contingent and self-regulating circuit.

This notion of a contingent, self-regulating circuit has been applied to the scientific process itself, as charted by Katherine Hayles in her analysis of the Macy Conferences,[7] with the inclusion of the 'observer' (or the scientist) in a cybernetic loop with what is observed. With this ideal for interpreting scientific study, the observers are included in the system rather than looking at it from the outside.[8] In other words, the very presence of the scientist, as well the process of observation, changes both the observer and what is observed. This observation is useful for articulating reciprocal, embodied notions of biotechnology in that it directly implicates all of us in its continued propagation.

---

[7] Katherine Hayles. How We Became Post-Human: Virtual Bodies in Cybernetics, Literature, and Informatics. Chicago: University of Chicago Press, 1999. p.99.

[8] *Ibid.* p.74

However, in order to circumnavigate the problematically sterile, computational, and mathematic underpinnings of Wiener's cybernetics, we need to merge the language of embodiment with cybernetic models to avoid the dangers of virtualizing metaphors in describing this process.

Katherine Hayles would agree, as she addresses this issue herself:

> The problem with this (*Wiener's cybernetic*) approach lies not so much in the analogical relations that Wiener constructed between living and mechanical systems as in his tendency to erase from view the very real differences in embodied materiality, differences that analogies did not express. Confronted with two situations, he was much more inclined to move easily and quickly to an abstract level, where similarities in patterns became evident, than to remain attentive to the particularities that made each situation unique. No doubt his own lack of involvement in the nitty-gritty work of the lab was a contributing factoring his elision of embodied materiality.[9]

The desire to integrate notions of embodiment into the cybernetic model of the observer leads me to consider phenomenology in describing our relationship to biotechnology, particularly Maurice Merleau-Ponty's writings on vision in *The Visible and the Invisible*. Here, he argues for the viscosity of the human body as it permeates itself with the world — and the world with itself — creating a concept

[9] *Ibid.* p.99

of the flesh of the world. He writes, "The thickness of the body, far from rivaling that of the world, is on the contrary the sole means I have to go unto the heart of the things, by making myself a world and by making them flesh."[10] He proposes that the embodied, tactile thickness of the human body — your body — is the inescapable measurant of all the perceived dimensions of the world.[11]

Returning to the scientific/cybernetic notion of the observer, Merleau-Ponty incorporates embodiment in the observational process as he describes vision as a palpitation of the flesh world. He writes, "If we now turn to the seer, we will find that this is no analogy or vague comparison and must be taken literally. The look, we said, envelops, palpates, espouses the visible things."[12] Like the cybernetic observer, the embodied, palpitating observer proposed here is reciprocally seen (and arguably changed) by what he or she observes:

> Thus since the seer is caught up in what he sees, it is still himself he sees: there is a fundamental narcissism of all vision. And thus, for the same reason, the vision he exercises, he also undergoes from the things, such that, as many painters have said, I feel myself looked at by the things, my activity is equally passivity – which is the second and more profound sense of the narcissism: not to see in the outside, as the others see it, the contour of a body one inhabits, but especially to be seen by the outside, to exist within it, to emigrate into it, to be seduced, captivated, alienated by

---

[10] M. Merleau-Ponty. *The visible and the invisible* . Evanston, IL: Northwestern University Press, 1968. p. 135.
[11] *Ibid.* p.249
[12] *Ibid.* p.133.

> the phantom, *so that the seer and the visible reciprocate one another and we no longer know which sees and which is seen.*[13]

And yet, there is a distinct difference between the models proposed by Werner and Merleau-Ponty and the proposed model of bioart as I have described it to you. With *(RE)embodying Biotechnology*, I am not only asking for the recognition of the presence of one's body as inextricable in the observation of other bodies, particularly in a complex laboratory ecology, but also to manipulate those bodies and reciprocally and effectively manipulate your own body. I am proposing a proactive model in order to connect oneself to the processes of life — eating, sleeping, reproducing, killing, dying — through the hands-on manipulation of life in the lab. The models set forth by Wiener (1965) and Merleau-Ponty (1968) predate contemporary incarnations of biotechnology and the post-1980s super-stellar rise of molecular biology as the most celebrated branch of biotechnological research.

Evelyn Fox Keller charts this shift in the biological sciences in its earliest incarnations (from observational models to practice-based models) in her book *A Feeling for the Organism: The Life and Work of Barbara McClintock*:

> Up until the end of the nineteenth century, biology had been primarily an observational science; biologists had sought to capture the mysteries of

[13] *Ibid.* p.139. (my emphasis)

> nature by documentation and description, rather then by a priori explanation. The early twentieth century saw the transformation of biology into an experimental science. But for many researchers, commitment to the integrity of the organism, and a reverence for the opulent variety of nature, remained. Not until the advent of Molecular Biology did the final break with earlier tradition occur. The long-standing tension between the organism as a whole and its constituent physico-chemical parts appeared at last to be relieved. Biology could now be seen as a science of molecular mechanics, rather than of living organisms, or even of "living machines."[14]

I am proposing a conceptual and practical integration of observational, holistic, and naturalist models with biomechanical experimental models. This integration would result in a perspective in which the organism and its constituent parts are regarded simultaneously, moving away from reductionist models and towards more inclusive, ecological ones. This allows for the application of biological models to understand and interpret the human perpetuation of biotechnology. The interpretation and practice of biotechnology from this perspective allows for two significant shifts in our perception of the biosciences: (1) a renewed regard for all the life forms present in the biotechnological ecology is made possible, and

---

[14] Evelyn, Fox-Keller. *A Feeling for the Organism: The Life and Work of Barbara McClintock.* New York: Henry Holt and Company, 1983. p. 181.

(2) human biotechnologies can be seen as indivisible from life in the natural world – and also from our own lives. As Lewontin writes:

> So, we must put away the notion that out there is a constant and fixed world that human beings are alone disturbing and destroying. We are certainly changing it, as all organisms do, and we certainly have a power that other organisms do not have, both to change the world extremely rapidly and, by willful activity, to change the world in various ways we may think beneficial. Nevertheless, we cannot live without changing the environment.[15]

From an ecological perspective, we can see biotechnology as bodies manipulating bodies, species manipulating other species as well as themselves and their environment, in a reciprocal, reflexive, and reactive (though not always conscious) manner. Another way to imagine an ecological model for biotechnology is through the application of proprioceptive models to the biological sciences and, more specifically, in describing our relation to the bodies in biotechnology, as well as the extended body[16] in the technoscientific sphere. Historically, the biological sciences have placed great emphasis on the exeroceptive senses (particularly sight) as observation, as if the subject of

---

[15] Richard Lewontin. *Biology as Ideology: The Doctrine of DNA.* Canadian Broadcasting Corporation, Massey Lecture Series, 1991. p. 89.

[16] Oron Catts and Ionat Zurr, "The Extended Body" in *Artnodes: Intersections between Arts Sciences and Technologies*, 2006. Available online: URL: http://www.uoc.edu/artnodes/6/dt/eng/catts_zurr.pdf [date of last access: 04/10/2007]

biotechnological research is inherently separate and therefore observable to the scientist (and, by extension, humanity). However, with the ecological understanding of biotechnology that I am proposing, proprioception may serve as a more accurate and articulated model for understanding the production of knowledge and life in this field. Proprioception is the sensory perception of the relative positioning of the body in its environment, comprising of directly linked sensorimotor functions that allow the body to move through space.

The term was coined by C.S. Sherrington in 1906 in his article "On the proprio-ceptive system, especially in its reflex aspect." He describes a reciprocal and reflexive relationship between the internal organism and its external environment: "But the organism itself, like the external world surrounding it, is a field of ceaseless change where internal energy is continually being liberated, whence chemical, thermal, mechanical, and electrical effects appear. It is a microcosm in which forces which can act as stimuli are at work, as in the macrocosm around."[17] Proprioception relies on a deep field of neurological receptors that are subject to both internal and external stimuli.

> *Therefore, a character of the stimulations occurring in this deep field is that the stimuli are traceable to actions of the organism itself,* and are so in much greater measure than are the stimulations of the surface field of the organism. Since in the deep field the stimuli to the receptors are delivered by the organism *itself,* the deep receptors may be termed *proprio-ceptors,*

[17] C.S. Sherrington, "On the proprio-ceptive system, especially in its reflex aspect." *Brain*, 1906, 29: p.471.

and the deep field a field of proprioception.[18]

A proprioceptive model, as opposed to an exeroceptive model, allows us to conceive of biotechnology as a science of the body and the ecology simultaneously — a science of our bodies in interaction with other bodies. In the proprioceptive model for imagining biotechnology, I am most drawn to Sherrington's view that the internal organism, like the external world, is teeming with life and energy, moving towards always shifting equilibriums. This model opens up our understanding of our position in the biotechnological era.

Moving away from a hierarchical understanding of the scientist — the specialist — allows us to manipulate life in a way that enables life forms to engage with one another in a multitude of ways. In addition, the proprioceptive model allows for the concept of prosthesis to enter into the equation. The proprioceptive system is able to accommodate the addition of external objects, tools, and instances of life into the proprioceptive system of an organism. Not only do the tools of biotechnology (the sterile environments, pipettes, beakers) become incorporated into the notion of a body moving through time and space, but the billions of bacteria housed within that body — and, by extension, the billions of life forms in the laboratory — become incorporated as well.

[18] *Ibid.* p.472.

As I have argued throughout *(RE)embodying Biotechnology*, the best strategy for mobilizing proprioceptive and ecological models in the practice of biotechnological protocols is through a critical, participatory methodology, where individual non-specialists participate directly in the practice of biotechnology, whether by breeding plants, activating yeast, making yogurt, or cultivating mammalian cells under sterile conditions. These small incursions are significant in both transforming the field and in actualizing a proprioceptive relationship with the bodies in biotechnology in a personal and embodied manner. Here, I am asking other non-specialists to join me in performing bioethics; I am inviting you to manipulate life, embrace life's violent processes, and gain new understanding and gratefulness for the small sacrifices, tragedies, and miracles that occur in the laboratory every day.

In regard to this notion of a practice-based bioethics, I can provide an example from the bioart community. In April 2007, I was witness to and photographer of an avian embryology lab at The Art and Genomics Centre at The University of Leiden lead by bioartist Adam Zaretsky.[19] As a component of his Vivo Arts course, the students, as well as several visiting artists and scholars, were given fertile pheasant eggs and instructed to manipulate the embryos for aesthetic purposes through a variety of measures.

---

[19] see Jeanette Groenendaal and Zoot Derks. "Dangerous Liaisons" 2007. Video; available online: URL: http://video.google.com/videoplay?docid=4579567496694967354&q=&hl=en [date of last access: 07/01/2008]

> The lab gives students the tools and skills they need to interact through the humanities with their four day incubated and windowed eggs. The students are offered microsurgical, teratological and naked plasmid injection as developmental embryology tinkering tools. In this lab the students are given a chance to make their first transgenic vertebrate, an embryonic pheasant. [20]

Part scientific lab and part Viennese actionist happening, participants were each provided with a fertile and incubated egg (between 4 and 7 days old) and were taught how to open up the egg in such a manner so as not to kill the developing embryo, allowing them to view its beating heart and articulated limbs. Next, the participants were asked to transform the embryonic body through physical manipulation with tools, the injection of a contaminate or mutagen, or though genetic manipulation. Some refused to participate at all and stood in the hallway for the duration of the procedure; others excitedly asked for more eggs so that they could attempt a number of manipulations. The range of responses varied widely. Once the procedures were completed, the eggs were returned to the incubator to allow for continued growth, with the understanding that they would have to be put to death before hatching in order to meet the standards of local animal research ethics.

---

[20] Adam Zaretsky. "Birdland: Avian Developmental Embryology Arts Project", abstract for artist talk, *The University of Exeter*, May 14 2007. available online: URL: http://www.exeter.ac.uk/research/networks/information/Bioartdescription.shtml [date of last access: 07/01/2008]

However, the full ramifications of this lab in practical animal ethics would not be revealed until one week later, when Zaretsky asked each participant to determine the manner in which their embryo was to be killed. Some were killed with an excess of valium, some were pulverized, one was cooked in the autoclave; all were considered to be ethical actions by the animal research ethics committee at the university.

The participants grew uneasy with their actions — group mentality and the festivities of the day encouraged young artists to commit actions and deaths that some later deemed unethical — and remorsefully critiqued and mourned their own actions. Robert Zwijnenberg (Director of The Art and Genomics Centre) later described the event as truly a hands-on lesson in ethics: holding a life in one's hands and determining its fate.[21]

> In the name of transgenic art, fledgling artists are utilizing lab technique as a new medium to produce living and often mutant living art forms. As these 'sculptures' live and die, often at the whims of the artistic investigator, the personal, non-repeatable moments take on a ritual air. What kinds of rituals do interdisciplinary Art and Biology practices entail? How do they reveal the implicit rituals of science? What new performative rites come out of mixing ethics and esthetics in the laboratory? Scientists also have their methodologies of creative flourish and humane sacrifice.

[21] Robert Zwijenberg in personal conversation with Jennifer Willet April, 2008.

But, scientific and artistic play is often based on different paradigmatic reading of *what the act of experimentation is.* As artists learn laboratory technique, the rituals of science and new rituals of sci-art unfold, decouple and reconfirm magical thinking in both arenas. How does animal research relate to the history of animal sacrifice? What is the role of subjectivity in developmental embryology? Is transgenic protocol also a ritual for the cultural production of liminal monsters. And how does mutagenesis impede or coerce the imaginary in the lifeworld? Through an analysis of artists confronted with the responsibility of ending the life of transgenic pheasant embryos, (which they had altered with plasmids in the name of art,) I hope to show living rituals for new biotechnological processes as they are invented.[22]

What is to be learned from a critical participatory model for engaging with biotechnology? What have I learned as an individual entering the specialized site of the laboratory? I have learned that science is not the purely objective, truth-seeking methodology that is it is held to be in public discourse. Although it is a very good methodology, science is not exponentially more successful in describing and manipulating the natural world over all other methodologies in regard to the acquisition knowledge in our society. Regardless, the fundamental

---

[22] Adam Zaretsky. "Birdland: Avian Developmental Embryology Arts Project", abstract for artist talk, *The University of Exeter*, May 14 2007. available online: URL: http://www.exeter.ac.uk/research/networks/information/Bioartdescription.shtml [date of last access: 07/01/2008]

divide between nature and culture that underwrites the modernist scientific project is a fiction.

Bruno Latour writes of this same notion in his canonical text, *We have Never Been Modern*. He argues that the modernist project for imagining nature and culture as distinctly separate — the idea that one is capable of separating oneself from that which is observed — is not possible, and has never been successfully achieved. He writes, "How could we be capable of disenchanting the world, when every day our laboratories and our factories populate the world with hundreds of hybrids stranger then those the day before?"[23] "How could we be chilled by the cold breath of the sciences, when the sciences are hot and fragile, human and controversial, full of thinking reeds and of subjects who are themselves inhabited by things?"[24] From my experience, he is correct. The lab is a site teeming with multiple orders of life; the scientists are fallible, confused, poetic, and inspiring individuals who are just as driven by subjectivity, instinct, training, and specialized methodology as the rest of us. And how can I separate myself, a radical, political artist working in the laboratory, a non-specialist participating with scientists in the reciprocal manipulation of life, from what is observed? Arguably, it is through this process of a critical, participatory engagement with biotechnology that I have become enchanted with the practices of science — in addition to the bodies in biotechnology — as hot and fragile.

---

[23] Bruno Latour, *We Have Never Been Modern*. Catherine Porter Trans, Cambridge, Mass: Harvard University Press, 1993. p. 115.
[24] *ibid.*

Whether it is Oron Catts' model of the 'embedded reporter'[25] or more typical accusations of the anthropologist 'gone native,' the outcome of several years of working in laboratory environments (and all that this experience entails, methodologically and practically, in the instrumentalization of life) has given me the ability to view biotechnology, in a complex and reciprocal sense, as a life practice. This perspective has offered me great insight, great harm, as well as potential for new understanding, for fraternity, and for total annihilation.

Before this time of experience, embodied knowledge, horror, and disillusionment, it was easier to critically refute science and, more specifically, biotechnology for their barbaric, unethical, and unnatural manipulations of life from the perspective of theoretical textual analysis. But this strategy offers no resolution, according to Latour:

> Demonizing may be more satisfying for us because we will remain exceptional even in evil; we remain cut off from all others and from our own past, modern at least for the worst after thinking we were modern for the best. But totalization participates, in devious ways, in what it claims to abolish. It renders its practitioners powerless in the face of the enemy,

[25] Oron Catts. "Hands on Emersion" from Visual Culture and Bioscience virtual symposium hosted by *The National Academy of the Sciences*, J.D. Talasek and Suzanne Anker edts. available online: URL: http://visualcultureandbioscience.blogspot.com/2007/03/catts-hands-on-immersion-for-oron-catts.html [date of last access: 07/01/2008]

> whom it endows with fantastic properties. ... A past from which we are forever separated by radical epistemological breaks cannot be sorted out again by anyone at all.[26]

I want to illustrate the ways in which my perspective as an artist, an academic, and a practitioner of biotechnology allows me to provide answers in regard to an ethical evaluation of evolving biotechnologies. As I stated in the introduction to *(RE)embodying Biotechnology*, my goal is not to simplify and provide measurable responses to the problems we face in the biotechnological age, but rather to complicate the discourse surrounding this field, and allow individuals to come to their own conclusions — to do their own 'work.' I am unabashedly maintaining a position against the continued corporatization and industrialization of the life sciences. My research / creation practice is aimed towards a more democratized, embodied, reciprocal, and grateful model for perpetuating biotechnology. However, I am aware of the ways in which this position might be viewed as untenable or unachievable, in light of the deeply entrenched nature of economy as a cornerstone of our society and the undeniable benefits of the current market economy model with the successful development of therapeutic biotechnologies.

---

[26] Bruno Latour, *We Have Never Been Modern*. Catherine Porter Trans, Cambridge, Mass: Harvard University Press, 1993. p. 125.

However, this text, as well as my artistic practice, illustrate the possibility (on a very small scale) of alternative incursions and practices in the biological sciences. It is possible that my assertions may be read as naïve or dangerously utopic in our current social, political, and economic climate. Although I would agree that, in all likelihood, both the direct effect of this thesis and my continued bioart production will not result in any immediate or revolutionary change in the state of affairs, I do believe in the 'trickle down effect.' The history of art, particularly the long-term repercussions of avant-garde art, provides many instances in which radical or objectionable forms of artistic production have permeated mainstream society and the production of meaning. In the instance of bioart, I look to the writings of George Gessert for justification and understanding of bioart and my own transgressions in the lab:

> Do artists cross the line when they breed plants or animals, or use the tools of biotechnology? Scientists routinely cross the line. So do farmers, business people, 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 casually as we breath, 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 favors awareness, the more artists who cross the line the better.[27]

I am not offering any immediate, concrete solutions. Applied resolutions to specific and universal ethical problems that are prevalent in the biotech era are not the function of art. From my perspective, art is about asking questions — aesthetic questions, ethical questions, political questions, questions of meaning. How do we choose to value life, whether it is our own lives, the life of a sick child, an embryo, a lab rat, a cell line, or bacteria? Where do we draw the line? Art occupies a unique position, in which it can perform these questions (and propose new critical methodologies) outside of traditional, rational intentionalities and produce meaning in a multitude of ways.

As a result, this text, like my artwork, functions in the realm of dialogical criticism, conflating a symphony of polyphonic voices of signs and meanings both in the moment of authorship and in their interaction with the observer. Dialogism, as argued by Mikhail Bakhtin, provides three methodological components in its analysis of a text or utterance, which proves useful for my purposes: (1) in locating the object of analysis in its historical and critical context, (2) in observing a wide range of traditions in the analysis of a given text and maintaining

---

[27] George Gessert, "Notes sur l'art de la selection végétale" in *L'art biotech'.*, Jens Hauser, ed. (Nantes, France : Le Lieu Unique, 2003), p. 47 Catalogue from the exhibition *L'art biotech'* (authors' translation).

interdisciplinarity, and (3) in deploying and seeking polyphonic heterogeneity in the analysis and content of texts and objects.

Bakhtin describes the dialogical phenomenon as it applies to characters in a polyphonic novel in *Problems of Dostoevsky's Poetics*: "Dostoevsky, like Goethe's Prometheus, creates not voiceless slaves (as does Zeus), but *free* people, capable of standing *alongside* their creator, capable of not agreeing with him and even rebelling against him."[28] He continues, "What unfolds in his works is not a multitude of characters and fates in a single objective world, illuminated by a single authorial consciousness; rather a plurality of consciousnesses, with equal rights and each with its own world, combine but are not merged in the unity of the event."[29] Through dialogue and characterization, the polyphonic novel manifests a multi-voiced examination of an idea, arriving at several complementary and contradictory conclusions. This description of the extended possibilities of performing literature — literature as a site of multiple intentionalities interacting with one another — is a helpful tool for reading *(RE)embodying Biotechnology*, for reading *BIOTEKNICA*, and for interpreting bioart as a performed experiment, an experimental methodology where outcomes are never assured.

---

[28] Mikhail Bakhtin, *Problems of Dostoevsky's Poetics*. Trans. Caryl Emerson. Minneapolis: U of Minneapolis P, 1984. p.6.
[29] *Ibid* p.6.

Instead of concrete solutions, I want to offer the analysis I have provided in proposing bioart as a productive form of interference and, reciprocally, an analysis of the interference I experienced as an artist in the laboratory manipulating life towards artistic ends. I suggest that we look to Michael Foucault's *The Order of things.* There is a passage in the preface in which he describes his reaction to reading Jorge Luis Borges' *The Analytical Language of John Wilkens*, including an unusual taxonomy of animals. He writes:

> This book first arose out of a passage in Borges, out of the laughter that shattered, as I read the passage, all the familiar landmarks of my thought – *our* thought, the thought that bears the stamp of our age and our geography – breaking up all the ordered surfaces and all the planes with witch we are accustomed to tame the wild profusion of existing things, and continuing long afterwards to disturb and threaten with collapse our age old distinction between the Same and the Other. This passage quotes a 'certain Chinese encyclopedia' in which it is written that 'animals are divided into: (a) belonging to the Emperor, (b) embalmed, (c) tame, (d) sucking pigs, (e) sirens, (f) fabulous, (g) stray dogs, (h) included in the present classification, (i) frenzied, (j) innumerable, (k) drawn with a very fine camelhair brush, (l) *et cetera*, (m) having just broke the water picture, (n) that from a long way off look like flies'. In the wonderment of this taxonomy, the thing we apprehend in one great leap, the thing that, by means of the fable, is demonstrated as the exotic charm of another

system of thought, is the limitation of our own, the stark impossibility of thinking that.[30]

I remember laughing the first time I read this passage. However, years later, after having traversed the threshold of the biological sciences as an artist and non-specialist, my reaction is much different.

I am not sure if I admire Foucault's ability to laugh with the realization of the complete social constructedness of established orders and the collapse of our age old distinction between the Same and the Other — or if I believe that laughter is a possible response to a complete denaturing of the philosophical and ideological precepts around which one chooses to construct their existence. From my experience, it is entirely crushing, particularly when this knowledge comes about through an embodied and participatory involvement with a radically different order of things. Barbara Herrnstein Smith aptly describes this uncoupling, when our perceived relations with other species is disrupted:

> The impulses in question are deeply corporeal and, accordingly, when disturbed by sudden or dramatic domain crossings ... likely to elicit that complex – jointly psychic and bodily – set of responses we call *cognitive dissonance*: that is, the sense of serious disorder or wrongness – and, with it, sensations of alarm, vertigo, or revulsion – that we experience

[30]Foucault, Michel. *The Order of Things: An archaeology of the Human Sciences.* Trans. Unknown. New York: Vintage Books, 1994. p. xvi

when deeply ingrained cognitive norms are unexpectedly violated.[31]

I was reminded of Foucault's prologue again recently as I was reading a scientific paper, "Magnetic Resonance Microscopy of the Adult Zebrafish."[32] The first sentence of the article reads: "Magnetic resonance microscopy (MRM) is an imaging modality that allows for noninvasive acquisition of high-resolution images in intact opaque animals."[33] "Intact opaque animals" is a category of animal that I had never conceived of before — a category so far outside of my experience (before setting foot in a laboratory and working with such animals) that it still upsets my attention today. This term serves as an indicator, a reminder of the horror[34] of attaining real, embodied knowledge and participation in another, radical universe where the instrumentalization of life is so normalized that one forgets that life is a violent process. This term is also a reminder of the horror that I myself have experienced over the years through ever further induction into the biotechnological field.

This unnerving collapse of taxonomy, knowledge, and experience is also described in the writings of Kira O'Reilly, a performance artist from the United Kingdom, who also was initiated into laboratory practices at SymbioticA in 2004.

---

[31] Barbara Herrnstein Smith, "Animal Relatives, Difficult Relations," in *Differences: A Journal of Feminist Cultural Studies* Vol.15, No1, 2004. pp 2-3.
[32] Samira Kabli, A. Alia, Herman P. Spaink, Fons J. Verbeek, and Huub J.M. De Groot "Magnetic Resonance Microscopy of the Adult Zebrafish" from *Zebrafish* Volume 3, Number 4, 2006 © Mary Ann Liebert, Inc.
[33] *Ibid.*
[34] Joseph Conrad. *Heart of Darkness*. 1902; available online: URL: http://www.gutenberg.org/etext/526 [date of last access: 07/12/2008]

She wrote a performative lecture entitled "Marsyas – running out of skin," that was presented at the Biennial Electronic Arts Perth (2004). "Marsyas" is a provocative work of art and academic research. Through cruel language, inner voices, and cold analytical turns, she elucidates the turmoil she experienced working with living systems in the name of art. In this text, O'Reilly argues for ambiguity in understanding and performing embodied art practices. She publicly presents the power and importance, as well as the harm and humility, in instrumentalizing living systems. While practicing the harvest of primary cells, O'Reilly witnesses the institutional sacrifice of a pig for another experiment at the university. After the scientists have harvested from the pig, she begins her exploration of the animal's body. She writes, "When my clumsy blade accidentally tears her gut I see pigs breakfast spill. In my minds eye I see my breakfast spill. Following the pig biopsy I feel deeply ashamed. You stupid, stupid cow."[35] This work becomes about the disillusionment of the non-specialist — about induction. The artist is horrified with herself. The audience is horrified with the frank retelling of animal sacrifice procedures enacted in scientific laboratories every day. O'Reilly serves as a stand-in, as our stunt double, allowing us to witness those aspects of scientific research that are often closed to the public gaze. I am drawn to this body of writing, as it eloquently and accurately expresses the sensations that I experienced as a non-specialist practicing a variety of laboratory procedures involving the manipulation of life; her work is a description of both standing witness and participating in a fascinating

[35] O'Reilly, Kira. "Marsyas – running out of skin" presented at the *Bio Difference* conference, *Biennial of Electronic Arts Perth*, Sept. 11, 2004, p.7.

an horrific set of practices that we call the life sciences.

The denaturing process that Foucault describes in recognizing other taxonomies of the world is helpful in explaining my experience of gaining a new understanding of the sliding scale of life in the laboratory (and, by extension, in external ecologies). Foucault's description is also useful in terms of understanding the direct affront that bioart poses to contemporary definitions of art. The "slow, crushing dance"[36] that O'Reilly describes (and performs) in relation to the pig can also be applied in relation to the shift in art practices, intentionalities, and outcomes that is necessary when an artist chooses to manipulate life in the parallel universe of the lab. With induction comes the transformation of, or interference[37] with, all the fundamental rules, precepts, and understandings of art production.

This transformation occurs on a number of levels. The accepted norms, methodologies, benefits of specialization, strategies of display, and deep investment in representation are all turned on their side. This shift is a catastrophic taxonomical event for someone who has invested a decade of their life in firmly securing these notions of art at their conceptual centre. When an artist moves from the studio in to the lab, the fundamental rules of practice change significantly. Community standards that are widely accepted in the arts,

---

[36] *ibid.*

[37] Edward Said. "Opponents, Audiences, Constituencies, and Community" from *The Anti-Aesthetic: Essays on Postmodern Culture*. Hal Foster edt. (New York: The New Press, 1998), p. 62.

such as histories of performance, nudity, and self-experimentation, become impeded, if not prohibited, for reasons of health and safety, and respectful practices (such as respect for the dead and respect for other scientific research trajectories occurring in the same lab). Methodologically, the artist must adjust to a concrete, experimental, practical mode of production that has less room for play, accidents, spilling, and seepage. In terms of specialization, the artist is also forced to relinquish their specialized skill set in an environment where their skills have little currency, again learning the most basic of concepts and procedures. Normal strategies of display and presentation of artwork are also useless when most of the research that is undertaken in the lab cannot be removed from the specialized, sterile, and regulated environment. In instances where removal is possible, bioart often also necessitates the transfer of the laboratory infrastructure, the technoscientific body,[38] and the fragile artwork into the gallery setting. What I have found to be the most overwhelming experience, however, is the total annihilation of notions of representation when practicing in a field where practices and outcomes reside firmly in the realm of the real — in life.

In response to the denaturing of our conceptions of life, bodies, the relationships between bodies, biotechnology, and art, and in the spirit of enabling a critical participatory methodology for performing bioethics in the biotech era, I wish to end with a quote from a short essay by Barbara Herrnstein Smith:

---

[38] Oron Catts and Ionat Zurr, "The Extended Body" in *Artnodes: Intersections between Arts Sciences and Technologies*, 2006. Available online: URL: http://www.uoc.edu/artnodes/6/dt/eng/catts_zurr.pdf [date of last access: 04/10/2007]

> Such questions cannot be answered simply or finally and, in a sense, cannot be answered at all. Rather, they restate the fundamental difficulties involved in any attempt to determine in a formally principled or univocal way – whether scientific or philosophical, naturalistic or humanistic – our relations to other creatures. This is not in my view, a despairing observation. On the contrary, what it indicates in the necessary openness of these questions to ongoing address. When all the arithmetic is a priori and the conclusions all forgone, there is no intellectual or ethical activity at all, just the animation (so to speak) of a set of mechanical (so to speak) procedures. In operating without fixed or formal principles, one is confronted, of course, with the need for continuous attention and responsiveness: for investigating and registering, remembering and imagining, comparing and assessing, and deciding under conditions of essential uncertainty and, in a sense incoherence. These requirements, however, could seem to constitute the very activity of responsible reflection, to define the very conditions of what we – some of us, anyway – call ethical judgment and action.[39]

(RE)embodying Biotechnology charts an example of the continuous attention and responsiveness that Herrnstein Smith calls for in perpetuating our relations with other species on this planet. As I have stated repeatedly throughout this text, I am not suggesting that we cease animal research, eating flesh, or domesticating

---

[39] Barbara Herrnstein Smith, "Animal Relatives, Difficult Relations," in *Differences: A Journal of Feminist Cultural Studies* Vol.15, No1, 2004. P.14.

and breeding life forms. I am, however, suggesting that we recognize our own inherent hypocrisies, particularly the ones that are initially difficult to perceive. I suggest we choose *to look our meat in the eye* – and see ourselves, and recognize that we are manipulating, farming, and consuming ourselves when we manipulate, and farm, and consume life.

Bibliography:

Abir-Am, Pnina G. "The Politics of Macromolecules: Molecular Biologists, Biochemists, and Rhetoric" in *Osiris*, 2nd Series, Vol. 7, Science after '40. 1992. pp. 164-191.

Achbar, Mark and Peter Wintonick. *Manufacturing Consent: Noam Chomsky and the Media*, 1992. 2:39:15

Adleman, Leonard. "Molecular Computation of Solutions to Combinatorial Problems" in Science, New Series, Vol. 266, Nov.11, 1994. pp. 1021-1024.

Allmendinger, Ulli. "One small hop for Alba, one large hop for mankind," in *NY Arts Magazine*, Vol.6 No. 6 June 2001. Available online URL: http://www.ekac.org/ulli.html [date of last access: 06/15/08]

Anker, Suzanne, and Dorothy Nelkin. *The Molecular Gaze.* New York: Cold Spring Harbor Laboratory, 2004.

Anker, Suzanne. "The Bio Blurb." on *WPS1 MoMA Art Radio.* Available online: URL: http://www.wps1.org/include/shows/bio_blurb.html [date of last access: 09/01/2006]

Arendt, Hannah. *Eichmann in Jerusalem: A Report on the Banality of Evil* (1963). Rev. ed. New York: Viking, 1968.

Bakhtin, Mikhail. *The Bakhtin Reader* , ed. Pam Morris London: Edward Arnold, 1994.

_____. *The Dialogic Imagination: Four Essays by M.M. Bakhtin.* Ed. Michael Holquist. Trans. Caryl Emerson and Michael Holquist. Austin: U of Texas P, 1981.

_____. *Problems of Dostoevsky's Poetics.* Trans. Caryl Emerson. Minneapolis: U of Minneapolis P, 1984.

Barry, I., Ed. *Paradise Now: Picturing the Genetic Revolution.* Saratoga, The Tang Teaching Museum and Art Gallery, 2001.

Begley, Sharon. "The Science Wars", in *Science and Gender*, London and New York: Routledge, 2001. pp. 114-118.

Bell, David and Barbara M. Kennedy. Edts. *The Cybercultures Reader.* New York: Routledge, 2000.

Boisvert, Anne-Marie. Edt. "bio-art" edition of *Magazine électronique du CIAC*, no 23 2005. available online: URL: http://www.ciac.ca/magazine/archives/no_23/index.html [date of last access: 09/01/2006]

Booth, Wayne. *For the Love of It: Amateuring and Its Rivals*. Chicago: University of Chicago Press. 1999. P.14

Boucher, Marie-Pier. *Métaformation: prolégomènes à l'exo-sphère*, thesis in progress,2007.

Britton, Sheilah and Dan Collins. Edts. *The Eight Day: The Transgenic Art of Eduardo Kac*. New York: D.A.P. / Disrtibuted Art Publishers, 2003.

Brodwin, Paul E. (edt) *Biotechnology and Culture: Bodies, Anxieties, Ethics*, Bloomington and Indianapolis: Indiana University Press, 2000.

Bud, Robert. *The Uses of Life: A History of Biotechnology*, Cambridge: Cambridge University Press, 1993.

Bunting, Heath. "Amateurs and Hobbyists" from *Creative Biotechnology: A User's Manual*; available online: URL: http://www.locusplus.org.uk/biotech_hobbyist.html [date of last access: 08/01/2005]

Bureaud, A. "The ethics and aesthetics of biological art." Art Press 276: 38-9.

Burk, Dan L. "Lex genetica: The law and ethics of programming biological code"" from *Ethics and Information Technology 4*, Netherlands: Kluwer Academic Publishers, 2002. pp. 109-121. Available online: URL: http://www.student.cs.uwaterloo.ca/~cs492/papers/biocode.pdf [date of last access: 02/01/2009]

Catts, Oron ed. *The Aesthetics of Care?* Nedlands, Australia: School of Anatomy and Human Biology, University of Western Australia, 2002. (Proceedings of the first international symposium on ethical issues involved in BioArt.)

Catts, Oron, and Ionat Zurr. "Are the Semi-Living semi-good or semi-evil?" in *Technoetic arts: an international journal of speculative research.* Issue 1, 2003

_____. "Growing Semi-Living Sculptures" from *Leonardo Magazine*, MIT Press, Issue 35:4, August 2002.

_____. "Big Pigs, Small Wings: On Genohype and Artistic Autonomy." In

Culture Machine; available online: URL: http://culturemachine.tees.ac.uk/frm_f1.htm [date of last access: 09/01/2006]

_____. "The Art of the Semi-Living and Partial Life: Extra Ear – ¼ Scale" by Oron Catts & Ionat Zurr in Art in the Biotech Era, Adelaide international Arts Festival (catalogue), 2003.

_____. "The Extended Body" in *Artnodes: Intersections between Arts Sciences and Technologies*, 2006. Available online: URL: http://www.uoc.edu/artnodes/6/dt/eng/catts_zurr.pdf [date of last access: 04/10/2007]

_____. "The Ethical Claims of Bioart: Killing the Other or Self-Cannibalism." In *Australian and New Zealand Journal of Art: Art & Ethics* Vol 4, Number 2, 2003, and Vol. 5, Number 1, 2004. pp.167 – 188.

_____. *The Tissue Culture and Art Project*, artist website; available online: URL: http://www.tca.uwa.edu.au/ [date of last access: 09/01/2006]

Clark, Michael. "Genetic theames in Fiction films" from *The Welcome Trust.* Available online: URL: http://genome.wellcome.ac.uk/doc_WTD023539.html [date of last access: 02/15/2009]

Collins, Francis S. Eric D. Green, Alan E. Guttmacher and Mark S. Guyer, "A Vision for the Future of Genomics Research." *Nature*, Vol. 422, No. 6934, April 24, 2003, p. 835-847.

Conrad, Joseph. *Heart of Darkness.* 1902; available online: URL: http://www.gutenberg.org/etext/526 [date of last access: 07/12/2008]

Cook, Gareth. "Cross hare: Hop and glow," in The Boston Globe. Sept. 17, 2000. Available online URL: http://www.ekac.org/bostong.html [date of last access: 06/15/08]

Critical Art Ensemble. *Electronic Civil Disobedience: And Other Unpopular Ideas.* Brooklyn: Autonomedia, 1996.

_____. "Flesh Machine" Available online URL: http://www.critical-art.net/books/flesh/index.html [date of last access: 06/15/09]

_____. *The Molecular Invasion.* Brooklyn: Autonomedia, 2002.

Cros, Caroline, Laurent Le Bon, and Vivian Rehberg. Edts. *Orlan: Carnal Art.*

Trans. Deke Dusinberre. Paris: Flammarion, 2004.

Daryl Slack, Jennifer. "Contextualizing Technology" from *Rethinking Communication vol. 2 Paradigm Exemplars.* Brenda Dervin, Lawrence Grossberg, Barbara J. O'Keefe, and Ellen Wartella edts. Bervily Hills: Sage Publications, 1989. p.339.

Daubner, Ernestine. "Natalie Jeremijenko's Clones and Robots: Repitition/Diffrence and other subversive Representational strategies." in *Parachute.* Issue 112, Fall 2003.

_____. "Manipulating Genetic Identities: The Creation of Chimeras, Cyborgs and (Cyber-)Golems." in *Parachute.* Issue 105, Winter 2002. pp. 84-91.

_____. "Stranger than Fiction: Biotech XX Artists Manipulate Life." In *DPI: la revue électronique du Studio XX*, available online: URL: http://dpi.studioxx.org/index.php?id=56 [date of last access: 09/01/2006]

Emmeche, Claus. *The Garden in the Machine: The Emerging Science of Artificial Life.* Steven Sampson Trans. Princeton: Princeton University Press, 1994.

Foucault, Michel. *The Order of Things: An Archaeology of the Human Sciences.* Trans. Unknown. New York: Vintage Books, 1994.

_____. *The Birth of the Clinic: An Archaeology of Medical Perception.* Trans. A.M. Sheridan Smith. New York: Vintage Books, 1994.

Fox-Keller, Evelyn. *A Feeling for the Organism: The Life and Work of Barbara McClintock.* New York: Henry Holt and Company, 1983.

Franklin, Sarah. "Life Itself: global nature and the genetic imaginary", 2000. Available online: URL: http://www.comp.lancs.ac.uk/sociology/soc048sf.html [date of last access: 09/01/2003]

_____. "Culturing Biology: cell lines for the second millennium", 2001. Available online: URL: http://www.comp.lancs.ac.uk/sociology/soc084sf.htm [date of last access: 09/01/2003]

Garber, Marjorie. *Academic instincts.* Princeton, N.J.: Princeton University Press, 2001. p. 20.

Gessert, George. "A History of Art Involving DNA." In *Ars Electronica 99 – Life Science.* Edited by Gerfried Stocker and Christine Schopf . Vienna, New York: Springer, 1999.

_____. "Anthropocentrism and Genetic Art" currently in publication.

_____. "Naming Life: Notes on Live Art and Plant Names." presented at *The Biennial of Electronic Arts Perth* 2004. Avaliable online: http://www.beap.org/2004/index.php?z=conferences/bio_papr&h=bio [date of last access: 09/01/2006]

_____. "Notes on Genetic Art," *Leonardo* Vol 26, No. 3 (1993).

_____. "Notes sur l'art de la selection végétale" in *L'art biotech'.* Jens Hauser, ed. (Nantes, France : Le Lieu Unique, 2003), p. 47 Catalogue from the exhibition *L'art biotech'* (authors' translation).

_____. *Scatter*, (Green Light Press, 1993).

Grahm, Paul. "What Business Can Learn from Open Source" presented at the *O'Reilly Open Source Convention* (2005) available online: URL: http://www.itconversations.com/shows/detail657.html [date of last access: 05/04/2006]

Gigliotti, Carol. "Leonardo's Choice: the ethics of artists working with genetic technologies." In AI & Soceity: The Journal of Human-Centred and Machine Intelligence. Avaliable online: URL: http://www.eciad.bc.ca/%7Egigliott/gtanimal/CGIGLIOTTI.htm [date of last access: 09/01/2006]

Gould, Stephen J. *The Mismeasure of Man.* New York: W.W. Norton & Co., 1981.

Groenendaal, Jeanette & Zoot Derks. "Dangerous Liaisons" 2007. Video; available online: URL: http://video.google.com/videoplay?docid=4579567496694967354&q=&hl=en [date of last access: 07/01/2008]

Grosz, Elizabeth. *Volatile Bodies: Towards a Corporeal Feminism.* Australia: Allen & Unwin 1994.

Hayles, Katherine N. *How We Became Post-Human: Virtual Bodies in Cybernetics, Literature, and Informatics.* Chicago: University of Chicago Press, 1999.

Haney, Daniel Q. "Designing Baby: Scientists on Verge of Manipulating Human DNA" Associated Press, March 5, 2000. Available online: URL: http://www.genetics-and-society.org/resources/items/20000305_ap_haney.html [date of last access: 08/01/2005]

Hacking, Ian. *The Social Construction of What?* London: Harvard University Press, 1999.

Hauser, Jens. "Animals, Art and Technology." as presented at the conference *New Species – Break 2.3 Festival 2005.* Ljubljana, Slovenia. 2005.

_____. *L'art biotech.* Exhibition Catalogue. Nantes, France: *Le Lieu Unique*, 2003.

_____. "Bio Art – Taxonomy of an Etymological Monster" from Hybrid living in paradox: Ars Electronica 2005. Christine Schöpf, Gerfried Stocker. Edts. Ostfildern-Ruit, New York, Hatje Cantz: D.A.P. Distributed Art Publishers, 2005.

Haraway, Donna. *Crystals, fabrics, and Fields: Metaphors that Shape Embryos.* Berkeley, California: North Atlantic Books, 1976, 2004.

_____. *Simmians Cyborgs, and women: The Reinvention of Nature.* Routledge: New York, 1991.

Herrnstein Smith, Barbara. "Animal Relatives, Difficult Relations," in *Differences: A Journal of Feminist Cultural Studies* Vol.15, No1, 2004. pp 1-23.

Heuser, Stephen. "*What is Biotechnology?*" From *The Boston Globe* website; available online: URL: http://www.boston.com/business/technology/biotechnology/articles/2007/05/06/what_is_biotechnology/ [date of last access: 10/10/2007], May 06, 2007.

High, Kathy. *Embracing Animal*, artist website; available online: URL: http://embracinganimal.com [date of last access: 09/15/2005]

Hillman, Jeffrey D. "Genetically modified Streptococcus mutans for the prevention of dental caries"in *Antonie van Leeuwenhoek* 82 (1-2) : 361-366 August, 2002.

Howe, George and Anne Hollister. "Were You Born That Way" in *LIFE Magazine*, Apr98, Vol. 21, Issue 4.

Holtzman, Neil A. "*Are genetic tests adequately regulated?" Science*, 286 (4539), pp. 409-410, 1999.

Huxley, Aldous. *Brave New World.* London: Penguin Books, 1968.

Jeffcoate, T.N.A. *Principles of Gynaecology.* London: Butterworths, 1962. p.643

Jeremijenko, Natalie. 'Amateurity and Biotechnology' from *Creative Biotechnology: A User's Manual*; available online: URL: http://www.locusplus.org.uk/biotech_hobbyist.html [date of last access: 08/01/2005]

Jeremijenko, Natalie and Heath Bunting. *The Biotech Hobbyist.* Available online: URL: http://www.irational.org/biotech/ [date of last access: 09/01/2006]

Johansson, Linda, Gafvelin, Arner Guro, and S.J. Elias. "Selenocysteine in proteins - properties and biotechnological use" in *Biochimica et Biophysica Acta* 1726 (1) Oct. 30, 2005. pp. 1-13.

Kac, Eduardo. "Transgenic Art," *Leonardo* 32, No. 4 (1999). Available online: URL: http://www.ekac.org [date of last access: 09/01/2008]

_____. "*GFP Bunny,*" *Leonardo* 36, No. 2 (2003).

Kevles, Daniel J. *In the Name of Eugenics.* New York: New York Knopf, 1985.

Knebusch, Julien. Moderaitor. "Exhibiting Bioart" an online discussion hosted by *Yasmine: Your Arts Science Mediterranean International Network*; avaliable online: URL: http://www.media.uoa.gr/yasmin/viewtopic.php?t=775 [date of last access: 09/01/2006]

Kristeva, Julia. *Desire in Language: A Semiotic Approach to Literature and Art.* Ed. Leon Roudiez. Trans. Thomas Gora, Alice Jardine, Leon Roudiez. New York: Columbia UP, 1980.

_____. *Revolution and Poetic Language.* Trans. Margaret Waller. New York: Columbia UP, 1984.

Kroker, Arthur. *The Will to Technology & The Culture of Nihilism: Heidegger, Nietzsche, & Marx.* Toronto: University of Toronto Press, 2004.

Kuhn, Thomas S. The *Structure of Scientific Revolutions* (second Edition, enlarged) Chicago: The University of Chicago Press, 1970.

Lakoff, George and Mark Johnson. *Metaphors We Live By.* Chicago: Chicago University Press, 1980.

Latour, Bruno and Steve Woolgar. *Laboratory Life: the construction of scientific facts.* (second edition, enlarged) Princeton: Princeton University Press, 1986.

Latour, Bruno. *We Have Never Been Modern.* Catherine Porter Trans. Cambridge, Mass: Harvard University Press, 1993.

Lewontin, Richard. *Biology as Ideology: The Doctrine of DNA.* Canadian Broadcasting Corporation, Massey Lecture Series, 1991.

_____. *It Ain't Necessarily So: The Dream of the Human Genome and other Illusions.* New York: New York Review Books, 2001.

_____. *The Triple Helix: Gene, Organism, and Enviroment*, Cambridge: Harvard University Press, 2000.

Lykke, Nina. "Between Monsters, Goddesses, and Cyborgs: Feminist Confrontations with Science." from *Between Monsters, Goddesses, and Cyborgs: Feminist Confrontations with Science, Medicine and Cyberspace.* London: Zed Books Ltd, 1996. pp 13-29.

Merleau-Ponty, M. *The visible and the invisible* . Evanston, IL: Northwestern University Press, 1968.

W.J.T Mitchell. *The Last Dinosaur Book: The Life and Times of a Cultural Icon.* Chicago: The University of Chicago Press, 1998.

Munster, Anna. "Why is Bioart Not Terrorism?: Some Critical Nodes in the Network of Informatic Life » in *Culture Machine*; avaliable online: URL: http://culturemachine.tees.ac.uk/frm_f1.htm [date of last access: 09/01/2006]

Nirmalan, Niroshini, Paul F. G. Sims, Hyde, and John E. Hyde. "Quantitative proteomics of the human malaria parasite Plasmodium falciparum and its application to studies of development and inhibition" in *Molecular Microbiology* 52 (4), May 2004. pp. 1187-1199.

Nottingham, Stephen. *Screening DNA: Exploring the Cinema-Genitics Interface.* DNA Books, 2000. Available online: URL: http://ourworld.compuserve.com/homepages/Stephen_Nottingham/DNA1.htm [date of last access: 02/15/2009]

Nussbaum, Martha C., and Cass R. Sunstein. Edts. *Clones and Clones: Facts and Fantasies about Human Cloning.* New York: W.W. Norton & Co., 1998.

O'Reilly, Kira. "Marsyas – running out of skin" presented at the *Bio Difference* conference, *Biennial of Electronic Arts Perth*, Sept. 11, 2004.

Pasko, Jessica M. "Bio-artists use science to create art," in USA Today, March 5, 2007. Available online URL: http://www.usatoday.com/tech/science/ethics/2007-03-05-bio-art_N.htm [date of last access: 06/15/08]

Probyn, Elspeth. "Theorizing Through the Body" in *Women Making Meaning.* Lana Rakow edt. New York: Routledge, 1992. P. 83-99.

Reodica, Julia. *Vivo Labs.* Available Online: URL: http://www.vivolabs.org/ [date of last access: 09/01/2006]

Rifkin, Jeremy. *The Biotech Century: Harnessing the Gene and Remaking the World.* New York: Tharcher/Putnam, 1998.

Sacks, Oliver. *An Anthropologist on Mars: Seven Paradoxical Tales.* Toronto: Vintage Canada, 1996.

Samira Kabli, A. Alia, Herman P. Spaink, Fons J. Verbeek, and Huub J.M. De Groot "Magnetic Resonance Microscopy of the Adult Zebrafish" from *Zebrafish* Volume 3, Number 4, 2006 © Mary Ann Liebert, Inc.

Sandhana, Lakshmi. "Careful with that Petri dish," in *Wired Magazine.* Aug.16, 2004. Available online URL: http://www.wired.com/science/space/news/2004/08/64577 [date of last access: 06/15/08]

Sandhana, Lakshmi. "Jacket grows from living tissue," in *Wired Magazine.* Oct. 12, 2004. Available online URL: http://www.wired.com/science/discoveries/news/2004/10/65248 [date of last access: 06/15/08]

Said, Edward. "Opponents, Audiences, Constituencies, and Community" from *The Anti-Aesthetic: Essays on Postmodern Culture.* Hal Foster edt. New York: The New Press, 1998.

Schrodinger, Erwin. *What is Life?* Cambridge: Cambridge University Press, 1944. Available online: URL: http://faculty.washington.edu/lynnhank/LIFE.doc [date of last access: 02/15/2009]

Sherrington, C.S. "On the proprio-ceptive system, especially in its reflex aspect." *Brain*, no. 29, 1906. pp. 467-482.

Shildrick, Margrit, and R. Mykitiuk Edts. *Ethics of the Body: Postconventional Challenges*, Cambridge and London: The MIT Press. 2005.

Singer, Peter. "All Animals are Equal... or why supporters of liberation for blacks and women should support animal liberation too." In *Animal Liberation.* Norfolk: Lowe and Brydone Ltd, 1976. pp. 1- 26.

Sontag, Susan. *Illness as Metaphor and Aids and It's Metaphors.* New York: Doubleday, 1990.

Stacey, Jackie. *Teratologies: A Cultural Study of Cancer.* New York: Routledge, 1997.

Stengers, Isabelle. *Power & Invention: Situating Science* Paul Bains *trans.* Minneapolis, London: University of Minnesota Press, 1997.

Stocker, Gerfried and Christine Schopf. Edits. *Hybrid living in paradox: Ars Electronica 2005.* Ostfildern-Ruit, New York, Hatje Cantz: D.A.P. Distributed Art Publishers, 2005.

_____. Edits. *LifeScience: Ars Electronica 99.* New York: Springer-Verlang, 1999.

Melissa Suran, "Jurassic Park in Millennium Park? Penn State prof says it could happen." from *Medill Reports*, Chicago: Northwestern University, Feb. 4, 2009. Available online: URL: http://news.medill.northwestern.edu/chicago/news.aspx?id=114307 [date of last access: 02/15/2009]

Talasek, J.D. & Suzanne Anker. Edts. *Visual Culture and Bioscience* virtual symposium hosted by *The National Academy of the Sciences*, available online: URL: http://visualcultureandbioscience.blogspot.com/ [date of last access: 07/01/2008]

Thacker, Eugene. « A Biotech Hobbyist » from *Creative Biotechnology: A User's Manual*; available online: URL: http://www.locusplus.org.uk/biotech_hobbyist.html [date of last access: 08/01/2005]

_____. *Biomedia.* Minneapolis: University of Minnesota Press, 2004.

_____. "Data Made Flesh: Biotechnology & the Discourse of the Posthuman", Cultural Critique 53. 2002.

_____. *The Global Genome : Biotechnology, Politics, and Culture.* Cambridge: The MIT Press, 2005.

_____. "The Thickness of Tissue Engineering: Biopolitics, Biotech, and the Regenerative Body." Ed. by Gerfried Stocker and Christine Schöpf. *Ars Electronica 99: LifeScience*, Vienna, New York: Springer, 1999, p 180-188.

Thompson, Clive. "How to Farm Stem Cells without Loosing your Soul" in Wired Magazine, Issue. 13.6, 2005; available online: URL: http://www.wired.com/wired/archive/13.06/stemcells.html [date of last access: 15/07/2007]

Thompson, Nato. Edt. *Becoming Animal: Contemporary Art in the Animal Kingdom.* North Adams: Mass MoCA Publications, 2006.

Thompson, Nato and Gregory Sholette. Edts. *The Interventionists: Users' Manual for the Creative Disruption of Every Day Life.* North Adams: Mass MoCA Publications, 2004.

Tratnik, Polona. "37°C: From the Inside of a Being to the Thin Line of Life" in *Leonardo: Journal of the International Society for the Arts, Sciences and Technology.* Vol.38 No. 2, 2005. pp. 103-108.

_____. Edt. *New Species - Festival Break 2.3* catalogue Ljubljana. 2005.

Watson, James D. and Andrew Berry. *DNA The Secret of Life.* New York: Alfred A. Knopf Press, 2004.

Weibel, Peter. "About Genetic Art." from online archives of Ars Electronica 1993. Available online: URL: http://www.aec.at/en/archives/festival_archive/festival_catalogs/festival_artikel.asp?iProjectID=8828 [date of last access: 09/01/2006]

Wiener, Norbert. *Cybernetics: or Control and Communication in the Animal and the Machine.* Cambridge: The MIT Press, 1965.

Wilmut, Ian, Keith Campbell, and Colin Tudge, *The Second Creation: Dolly and the age of Biological Control.* Cambridge: Harvard University Press, 2000.

Willet, Jennifer. "Bodies in Biotechnology: Embodied Models for Understanding Biotechnology in Contemporary Art." "Wild Nature and the Digital Life" Special Issue, Leonardo Electronic Almanac Vol 14, No. 7 - 8 (2006). 30 Nov. 2006 ; available online: URL: http://leoalmanac.org/journal/vol_14/lea_v14_n07-08/jwillet.asp [date of last access: 05/01/2008]

_____. *BIOTEKNICA | ORGANIC TISSUE PROTOTYPES | LABORATORY NOTES*, unpublished manuscript, 2004.

Willet, Jennifer & Shawn Bailey. *"BIOTEKNICA: A Case Study in Bioethics and Human Tissue Culture in Art." From* Louise Poissant and Ernestine Daubner, eds. *Critical Issues: Art of the Living* (Submitted to Washington University Press.) 2006.

_____. *BIOTEKNICA: Corporate Art for a Corporal Public*, artist website; available online: URL: http://www.bioteknica.org [date of last access: 05/01/2008]

_____. *BIOTEKNICA: LiveLifeLab*, exhibition statement, 2007.

_____. *BIOTEKNICA: Teratologies Aminima no. 19* Barcelona, Spain. 2007

_____. "BIOTEKNICA: Organic Tissue Prototypes" in*The State of the Real: Aesthetics in the Digital Age*. Damian Sutton, Susan Brind, Ray McKenzie. Edts. London: I. B. Tauris. 2006.

Wilson, James G. *Environment and Birth Defects* (Environmental Science Series). London: Academic Pr. 1959.

Wilson, Stephen. *Information Arts.* (MIT Press: Cambridge, Mass. and London England, 2002)

Youngs, Amy. "The Fine Art of Creating Life." in Leonardo, Vol. 33, No. 5, 2000. Pp. 377 – 380.

Adam Zaretsky. "Birdland: Avian Developmental Embryology Arts Project", abstract for artist talk, *The University of Exeter*, May 14 2007. available online: URL: http://www.exeter.ac.uk/research/networks/information/Bioartdescription.shtml [date of last access: 07/01/2008]

_____. *Emutagen*, artist website; available online: URL: http://emutagen.com/index.html [date of last access: 08/01/2005]

_____. "The Mutagenic Arts" in *CIAC's Electronic Magazine* no. 23, 2005. Available online: URL: http://www.ciac.ca/magazine/archives/no_23/en/dossier.htm [date of last access: 09/01/2006]

_____. "Posthuman Temptation, Eros and Mutagenesis" from *Subtle Technologies Conference Procedings*. 2001. Available online: URL: http://www.subtletechnologies.com/2001/zaretsky.html [date of last access: 09/01/2006]

Zaretsky, Adam and Julia Redioca. "The Workhorse Zoo Art and Bioethics Quiz." From *Emutagen*, artist website; available online: URL: http://emutagen.com/index.html [date of last access: 08/01/2005]

Websites:

Advanced Cell Technology, *Press Release: Researchers Develop Specialized Cell Types From Embryonic Monkey Stem Cells,* Advanced Cell Technology corporate website; no longer available online URL: http://www.advancedcell.com/press.htm [date of last access 02/05/2002]

ATCC: The Global Bioresource Centre, Available online: URL: www.atcc.org [date of last access: 04/10/2007]

Bios Previews, Available online: URL: http://scientific.thomson.com/products/bp/ [date of last access: 06/01/2008]

Canadian Food Inspection Agency – Resource Centre "How Does Biotechnology Work?" Available online: URL: http://www.inspection.gc.ca/english/sci/biotech/gen/canadae.shtml [date of last access: 02/01/2009]

Center for Disease Control (CDC), "Biosafety in Microbiological and Biomedical Laboratories, BMBL 4th Edition" Available online: URL: http://www.d.umn.edu/ehso/biosafety/bsl1.html [date of last access: 04/10/2007],

Harvard Science Medicine + Health, "DNA-scanning technology finds possible sites of cancer genes in chromosomes of lung cancer cells," June 30, 2005. Available online: URL: http://www.harvardscience.harvard.edu/medicine-health/articles/dna-scanning-technology-finds-possible-sites-cancer-genes-chromosomes-lung- [date of last access: 02/01/2009]

Health Canada. "*About Biotechnology*." From Health Canada website; available online: URL: http://www.hc-sc.gc.ca/sr-sr/biotech/about-apropos/index_e.html [date of last access: 10/10/2007]

Material Safety Data Sheets (MSDS) from Fisher Scientific, Available online: URL: https://fscimage.fishersci.com/msds/91020.htm [date of last access: 04/10/2007]

Medical News Today, "Determining How 'Gene Switch' Works: Using Tuberculosis Bacteria To End 25-Year Quest." Feb. 9, 2009. Available online: URL: http://www.medicalnewstoday.com/articles/138280.php [date of last access: 02/15/2009]

SymbioticA: The Art and Science Collaborative Research Laboratory institutional website; available online: URL: http://www.symbiotica.uwa.edu.au/ [date of last access: 01/01/2008]

Organization for Economic Co-operation and Development, "*Statistical Definition of Biotechnology*." From OECD website; available online: URL: http://www.oecd.org/documentprint/0,3455,en_2649_34537_1933994_1_1_1_1,00.html [date of last access: 10/10/2007]

The Cartagena Protocol on Biosafety, "*Article 3. Use of Terms*." From The Convention of Biological Diversity website; available online: URL: http://www.cbd.int/biosafety/articles.shtml?a=cpb-03 [date of last access: 10/10/2007]

The National Institutes of Health, Biomedical Information Science and Technology Initiative Available online: URL: http://www.bisti.nih.gov/CompuBioDef.pdf [date of last access: 06/01/2008]

The President's Council on Bioethics, "WHITE PAPER: Alternative Sources of Pluripotent Stem Cells." Available online: URL: http://www.bioethics.gov/reports/white_paper/text.html [date of last access: 10/10/2007]

United States Code: Title 18, Part 1, Chapter 10, § 175. Prohibitions with respect to biological weapons; as recorded by the *Legal Information Institute*, available online URL: http://www4.law.cornell.edu/uscode/18/175.html [date of last access: 06/15/05]

USA Toxic Substance Control Act, Available online: URL: http://yosemite.epa.gov/oswer/oswer.nsf/1d6b58d5ae9061b8852566da004e5a57/cd5e187f53184afe852569d00072ed02!OpenDocument [date of last access: 04/10/2007]

Wikipedia: The Free Encyclopedia. available online: URL: http://en.wikipedia.org/wiki/Hacker [date of last access: 05/04/2006]

Vision 360 from *Vision TV*, Available online: URL: http://www.visiontv.ca/Programs/current_affairs_360.html [date of last access: 04/10/2007]

Appendix 1
BIOTEKNICA | ORGANIC TISSUE PROTOTYPES | LABORATORY NOTES
Jennifer Willet, Unpublished Manuscript, 2004.

Jan 09/06

Have been in Australia for three days.
Stressed about working on the BIOTEKNICA ethics paper for MIT. But simultaneously having a hard time mustering enough angst (after so much relaxation in Thailand) to accomplish this.

BIOTEKNICA Ethics Paper

- Exploring Bioethics from an artistic standpoint.

I.e.
Who owns the body?
digital metaphors / "genohype"

- We have written about these aspects of our project extensively, and we will continue to do so.

However, in a complex / reciprocal (mobius-strip) based body of research - rooted in plurality - and phenomenology - and engaging in the very technologies it is interested in understanding/critiquing. *BIOTEKNICA* too is subject to ethical evaluation. Often on the part of our viewers. i.e. animal research ethics - and misconceptions "cloning". On the part of ourselves, but also on the part of academic institutions and research committees.

Now usually this aspect of an artwork is never discussed in the public sphere. How was it made - in terms of who were the participating funding bodies, institutional partners, committee chairs. But with a work like *BIOTEKNICA* focused at the very nexus of the technoscoientific complex. This aspect (the administrative hurtles and business practices) involved in making this work becomes a significant aspect of the artwork itself. And so today - we are not going to focus on the ethical rationalization of the biotech industry - but the process of ethical rationalization for bioart production through a case study of our project: *BIOTEKNICA: Organic Tissue Prototypes.*

LAB NOTES:

First day back at *SymbioticA*. We returned to the UWA campus - via the salt-water river - looking for dolphins. It was a beautiful day. So many familiar faces. Boo, Jane Coakley, Gary Crass, Oron Catts, Ionat Zurr, Guy Ben-Ary. New faces Paul Vanouse and an Italian scientist who's name I forgot (Antonio?)

The office still has the feel of a club house/tree house. Up on the third story. The floor is hollow - so the sound resonates as you walk across the wood. With it's sloped ceilings and cranky door/floors. Pets - dolls and assemblages. A Barbie in a glass container of mould.

"Expect the unacceptable" written on the white board.

I am not sure if I am reading too much into it. But I saw a 'real' researcher in the hallway shoot us a disapproving glance - walking by with Ionat.

Lastly: looking around corners for Kira. Kira O'reilly was an artist in residence during our first residency. She became a central character in my experience at SymbioticA, and although I know consciously that she is a resident of the United Kingdom, subconsciously I expect to hear her voice here at any moment.

Jan. 10/ 2006

Walking tour with Ionat.

Check out Opti Cell.
Cell culture system
www.opticell.com

We are encouraged to freeze a sample of all the cells we are working with at an early generation. It is described to be as the equivalent of backing up your hard drive.

We meet:

Dr. Steve Parkinson
in charge of the tissue culture labs.
also a source of information in histology.

Greg Cozens
Autoclaving

Sue Hishes
Health and safety

Check P19 Protocols.
Check availability of P19 Cells

Jan. 11/06

P19 Specifications:
ATCC The Global Bioresource Centre
http://www.atcc.org

ATCC Number: CRL-1825
Price: $203.00
Designations: P19
Depositors: MW McBurney
Biosafety Level: 1
Shipped: Frozen
Medium and Serium: See Propagation
Growth Properties: adherent
Organism: Mus muusculus (mouse)
Morphology: epithelial
Source: Organ: embryo
Disease: teratocarcinoma; embryonal carcinoma

Applications: transfection host
Cytogenetic Analysis: n=40; XY
Strain: C3H/He
Genter: Male
Comments: The P19 line was derived from an embryonal carcinoma induced in a C3H/He mouse. The line can be cloned at high efficiency in medium containing 0.1 mM 2-mercaptoethanol. The cells are pluripotential. The cell can be induced to differentiate into neural and glial like cells in the presence of 500 nM retinoic acid. In the presence of 0.5% to 1.0% dimethylsulfoxide (DMSO) the cells differentiate to form cardiac and skeletal muscle-like elements, but do not form neural or glial like cells. In the presence of both DMSO and retinoic acid, the cells differentiate as in the presence of retinoic acid alone.

Propagation: ATCC Complete Growth Medium: Alpha minimum essential medium with ribonucleosides and deoxyribonucleosides, 90%; bovine calf serum, 7.5%; fetal bovine serum, 2.5% Temperature: 37.0C

Subculturing:

Protocol: Do not allow the cells to become confluent. Remove and discard culture medium. Briefly rinse the cell layer with 0.25% (w/v) Trypsin- 0.53 mM EDTA solution to remove all traces of serum which contains trypsin inhibitor. Add 2.0 to 3.0 ml of Trypsin-EDTA solution to flask and observe cells under an inverted microscope until cell layer is dispersed (usually within 5 to 15 minutes). Note: To avoid clumping do not agitate the cells by hitting or shaking the flask while waiting for the cells to detach. Cells that are difficult to detach may

be placed at 37°C to facilitate dispersal. Add 6.0 to 8.0 ml of complete growth medium and aspirate cells by gently pipetting. Add appropriate aliquots of the cell suspension to new culture vessels. Incubate cultures at 37°C.

Subcultivation ratio: A subcultivation ratio of 1:10 every 2 to 3 days is recommended

Medium renewal: Add fresh medium at least every 48 hours

Preservation: Freeze medium: Complete growth medium, 95%; DMSO, 5%
Storage temperature: liquid nitrogen vapor phase

Related Products: recommended serum: ATCC 30-2020
recommended serum: ATCC 30-2030

However, the last time we were here we used another brand of medium (rather then ATCC). So I ordered this one instead:

JRC Cat No 51451-500M
Minimum Essential Medium, Alpha Modification
w/ 2.0 mml Glutamine
w/o Deoxyribonucleosides
w/o Ribonucleosides

Jan. 17/06

Yesterday was our first day in the labs.
Unlike last time. Day 1, Oron had us trypsinizing cells. Scarring the shit out of us. I remember that I pretended that I understood all he was talking about. He was playing a number on us.

This time was less auspicious. We were still lunching with the French at Matilda Bay when Ionat slipped off to the labs. We caught up with her half an hour later. Inventory. *SymbioticA* does not have any active projects growing at the moment. But that is about to change. So we need to make an inventory - and order the necessary supplies for ourselves / for the first tissue culture workshop - on next Monday and Tuesday / and Chandra, and Boo also just commencing some TC lab work.

Ionat calls out: "you passed the test" when I enter the lab. Washing my hands immediately upon entering the P2 Certified Laboratory.

Rummaging through the cupboards and fridge.

Ionat sits on the floor pulling confused piles of supplies out of the *SymbioticA* cupboard. With her crazy hair - and bright yellow print shirt. She sits cross-legged with piles of keeps and rejects. Sterile containers. Dissection Kits. All over the floor. Miss matched to the austere environment. At the same time a "real" in his T-shirt and T-VAS stands nearby tossing old samples into biohazard waste containers with great bravado. Like basketball shots - crash / clang / bang. Glass vials break. Not the careful laboratory procedure we are advised to follow.

We empty the fridge and cupboard of expired liquids, un-sterile utensils and non-sterile water. Shawn carefully washes the jugs. We find some of the P19 medium in the fridge with BIOTEKNICA written on it from our last stay a year and a half ago. Cheers!

Then we meet Steve Parkinson head manager of the 2nd floor tissue culture facilities and the same man who lent us his defunct incubator during our last residency. He cringed with the notification that two more artists would be working in his labs. Insisted that we take health and Safety protocols very seriously.

Upstairs we rooted in the cryogenics fridges. Looking for SymbioticA samples. - 80 C

We met Greg - in charge of autoclaving. Got balled out by the computer technician.

Evening spent at *SIGGRAPH.* Lecture by Pill Dench. 3D Scanner. Possible *BIOTEKNICA* opportunity. However, we arrived to find that his mandate was pretty corporate (Hollywood movies) and his scanners were actually not that great. Ten-year-old technology. I fell asleep. (only for a short while) But we did meet Mark Walters. Doctor/Pediatrician who works in plastic surgery to reconstruct child cranial deformities. Very Nice Man. He is scanning for Stelark. Possibly for us now too.

Will visit his lab in the next few weeks.

Missing Bouts terribly.

Jan. 20/06

Friday meeting. Preparation for Sydney conference. Lead by Stuart Bunt.

RISK / Failure / Legitimacy

BIOTEKNICA: Soft Experiments from the Laboratory

Really focused on the fields of art and science.
Are artists are doing good science? Are scientists are making good art?

Agreed: pressure on researchers to produce results. Publish.

Journals - Nature / Science
Charging Laboratories for publishing. In Nature: photos are more.

Overall a very didactic discussion.
"Is bioart helping the field or regressing the field"

Jan. 21/05

Nearing the end of the month already.

This Friday meeting was a discussion lead by Stuart Bunt on Risk/Failure/Legitimacy in the art/science environment. It went completely off topic. Towards scientists falsifying results. Stuart made a very sexist comment - which I tried to draw his attention to and everyone ignored. There is an air of sexism in the school (in Australia in general) and it is difficult 'feeling like a woman' because that is usually not the case for me. I only feel like a woman when someone treats me this way. It will have to be a project.

Otherwise, still not in the lab yet. The workshop begins tomorrow. We are quite privileged.

This weekend has been spent catching up on the website, MIT paper, brochure text. Working days / Relaxing nights.

Last night was quite lovely. We roasted a whole chicken with rosemary and twelve dollar stuffing with cranberries and walnuts in it. We got drunk on good Australian wine (five judges chardonnay) and danced to Latin music.

Jan. 23 and 24/06

Tissue Engineering Workshop for Artists
(by: Oron Catts, Ionat Zurr & Dr.Stuart Hodgetts)

This is a very exciting opportunity for us. As an extension of the SymbioticA

Workshops developed by Oron and Gary Cass - they are now developing a specialized two-day workshop in Tissue Engineering for artists (and presumably for other cultural workers and non-specialists). I am really interested in this series of events as it ties into my arguments supporting non-specialist hands on experiential knowledge of biotechnology. This week we are doing a dry run of the workshop - to test the curriculum - and make any suggestions/changes for future events.

What follows is a transcription of the notes I took during these two days and any comments and suggestions I might have in hindsight for the organizers:

Practical Tissue Culture (TC) / Tissue Engineering (TE) course.

Safety in the labs.

Types of contamination: Bacterial / Fungus / Viruses / Spores / Yeast / Micro Plasma

(why is contamination bad? How come all contaminated specimens need to be disposed of? Some artists might be interested in contamination? In fact - if I were to develop another project with TC in the future - I might intentionally contaminate my samples..... In my own private incubator of course!)

HEPA Filters - looked at a number of filters.

Discussed Aseptic Technique in handling cell cultures.

Aseptic Technique
Taken from:
http://www.protocol-online.org/prot/Detailed/1912.html

Aseptic Technique
Author: Nanci Donacki
Source: Contributed by Nanci Donacki
Abstract: Aseptic techniques used by Cell Culture specialists in handling products from and/or mammalian cells.
Date Added: Tue May 14 2002
Date Modified: Wed Apr 28 2004

Purpose

To describe aseptic techniques used by Cell Culture specialists in handling products from and/or mammalian cells.

Safety

Protect eyes, mucous membranes, open cuts and wounds from contact with biohazard material. Use gloves, goggles, mask, and protective clothing as necessary.

Equipment

Laminar flow or biological safety hood as appropriate to the hazardous nature of the project.

Materials

Wipes, lint-free.
Disinfectant, or quaternary ammonium.
Alcohol. 70% ethanol.
Pipets, sterile, of appropriate size.
Aid-Aid, or equivalent.
Biohazard waste container.
Procedure

Carry out all culturing operation is a laminar flow hood.
Disinfect all surfaces prior to use with a disinfectant solution.
Swab down the working surface liberally with 70% ethanol.
Periodically spread a solution of 70% ethanol over the exterior of gloves to minimize contamination. Replace them if torn.
In case of any spill, spread a solution of 70% alcohol and swab immediately with non-linting wipes.
Discard gloves after use and do not wear them when entering any other lab area.
Bring into the work area only those items needed for a particular procedure.
Leave a wide clear space in the center of the hood (not just the front edge) to work on. Do not clutter the area to prevent blockage of proper air flow and to minimize turbulence.
Swab with 70% alcohol all glassware (medium bottles, beakers, etc.) before placing them inside the hood.
Arrange the work area to have easy access to all of it without having to reach over one item to get at another (especially over an open bottle or flask).
Use sterile wrapped pipets and discard them after use into a biohazard waste container.
Check that the wrapping of the sterile pipette is not broken or damaged.
Inspect the vessels to be used:
T-flask - Must be free from visible contamination or breakage, or lack container identification. The plastic covering the flask must be intact.
Bottles - Check for cracks, expiration dates.
Spinner flasks - Check for cracks, expiration dates, and proper assembly.
Discard any biohazard or contaminated material immediately.
Never perform mouth pipetting. Pipettor must be used.
When handling sterile containers with caps or lids, place the cap on its side if it

must be laid on the work surface.
Make sure not to touch the tip of the pipette to the rim of any flask or sterile bottle.
Clean the work area when finished by wiping with 70% alcohol.

Oron started with a social/political/cultural analysis of tissue culture called:

Tissues, Cultures, Engineering.

1/ Life as raw material?
HG Wells 1895 - Life as plastic material.

Life as a resource.
Growing gap between cultural understanding of life and scientific understanding of life.

A brief history of TC:

1913 **Alexis Carrell** begins a cell line, taken from the heart of a chick embryo, which is propagated by Albert H. Ebeling for 34 years
1885 **Wilhelm Roux** shows that embryonic chick cells can be maintained alive in a saline solution outside the animal body.
1907 **Ross Granville Harrison** cultivates amphibian spinal cord in a lymph clot, thereby demonstrating that axons are produced as extensions of single nerve cells.
1951-52 **George Otto Grey** and colleagues establish a continuous line of cells derived from a human cervical carcinoma, which later become the well-known HeLa cell line.

Immortalization techniques? Cell lines.

"The Culture of Organs" by Carrel and Lindenburg

"Babies in Bottles" Susan Merrill Squier - she postulates a collapse of gender, race, species, and time when tissue culturing cells of a variety of sources.

"The Science of Life: a summery of contemporary knowledge about life and it's possibilities." HG Wells.

Previously tissue culture is a science in and of itself.
In the 1950's TC serves as a model for the body.

and burgeoning mover towards "Regenerative Medicine"
and now we are utilizing TC for non-medical ends.

Vladimir Mironov.

Medical University of South Carolina.
"organ printing" Rapid prototyping directly with cells.
Computer aided tissue engineering onto thermo gels and collagen.

Tissue Culture in Art.

Paul Perry "The long Voyage"
Christine Barland "Hela"

Self-critical of the role of artists in TC and TE.
Oron says " We believe there is a need for phenomenological experience with biology."
and he tells us a beautiful story about one of his workshop experiences.

Verena Kaminiarz: As part of their Bioart artist workshop they ask artists to bring in a primary cell line source. The plan is to take a dissection from each sample and utilize it in the tissue culture component of the workshop. Most people bring in a steak. Verena brought a living worm. They discussed as a group what to do with the worm. Some said to kill it and take the sample - no questions. Some suggested they cut the worm in half - and utilize on half for the experiment - and set the other half free. Some suggested they set the worm free. When a decision had been reached - they would split the worm in half - Verena brought out the worm - and almost on quew - one end of the worm stood up - as if acknowledging the crowd. The decision was changed. No one had the heart to cut this worm in half - utilizing a portion for an experiment.

In other words - *biology is different in person.*

He also tells us about a company called "New Harvest" who are actually interested in tissue engineering protein based food products. They contacted Oron and Ionat looking for information about their "Victimless Steak".

Then we move into a more technical description of Tissue Culture and Tissue Engineering - and the procedure we will be trying today. I know most of what we are talking about - but it is an excellent refresher at the beginning of our second residency. In Fact, knowing this was coming up - we held off cell work until today - comfortable - like an old friend.

Three new bits of information:

Suspension cells.
Trypsin - is an enzyme found in cow guts.
Primary Cell Line: Hay Flick Limit - 50 - 55 passages before cells stop dividing.

Afternoon: Tissue Culture demonstration in the lab!

We are using a human cell line Hackett. Some sort of connective tissue. I ask Stewart Hodgets about the cell line origin - and he doesn't know what I mean. From the freezer? From ATCC? But I mean - what type of tissue specifically - from whom? Under what circumstances? when? He doesn't know - and looks a little puzzled that I am asking.

Feb. 03/06

Afternoon: at the large animal facility on UWA Campus. The building is typical in it's construction. The main entrance (though hidden off to one side) states "Large Animal Facility" for public view.

The entrance is security locked. We need to be buzzed in. The internal lobby looks harmless enough. Contemporary design. Rubber floors. Licenses displayed in the front office window. And rows of color-coded garments and towels in stacked cubby wholes. The facility maintains a high level of sterility and any who wish to pass through the barrier must change all their clothes into the appropriately color coded garments. We are not invited past the barrier, and therefore do not need to change.

Busy, colorfully costumed, workers pass up and down the hallways. They look tired.

We congregate in a small lunch/seminar room.

One half of the class stays here for more discussion - while the other half is introduced to some introductory animal handling techniques. We stay for the seminar.

We are introduced to a dowdy British woman who's name I did not catch. She specializes in veterinary medicine for research environments. She has never worked with companion animals.

She plans to discuss with us two things; (1) recognition of pain and distress in animals, and (2) "Care and use of animals in Scientific Procedures". But mainly she refers to the manual, which she asks us all to read, to better understand the regulations involved.

Australian code of practice for the care and use of animals for scientific purposes 7th edition 2004

After her introduction, she asked that we play a role-playing game - to better understand the concerns of the Animal Ethics Committee (AEC). We were asked

to chose to be one of the four type of representatives that is mandated to sit on such a committee; (1) Veterinary Medicine practitioners, (2) Scientific Advisors, (3) Animal Rights Groups, and (4) lay people. We are asked to select a position that is farthest from our usual stance. Everyone jokes that we are all scientists. Shawn and I choose Veterinarians. Visitors from another animal facility on campus decide to be the scientists, and all the scientists divide themselves between lay people, and animal rights activists.

We are provided with a scenario where we are under pressure from the president of the university to pass an application, for research that has already commenced, and is about to be presented at a press conference in one hour. We read the application. It is poorly, and inaccurately filled out. The researchers are developing a new rabbit poison, and wants to test dosages in a natural environment. He prefers not to use laboratory grade animals, as his final subject is wild rabbits. He wishes to lace a grain with the poison in different dosages, and leave it out in the wild. He proposes that a scientist/observer will hide in the trees, and observe the prey as they consume the feed. Once the specimens are clearly about to die (and the researcher can account for the consumed a fatal dose) he/she will sacrifice the rodent with a sniper rifle, preventing any further suffering. The carcasses will be buried in the local environment.

Clearly, this was the most insane Animal Ethics Committee application we could possibly imagine. It hardly produced a healthy debate on the subtleties of the cost verses benefit ratio in the ethical evaluation of proposed projects.

Immediately we made a list of reasons why this may be a dangerous and unethical research methodology. The scientists joked about having to pretend to be "bleeding heart animal rights activists" - and argued aggressively about the mistreatment of the research specimens involved. All in all we agreed that we would not pass this application. We were assured by the lecturer that we made the right decision, and that in real committee situations, there is never pressure from upper admin to quickly approve applications. This was a case study in what not to do.

However, at no point did anyone in the room question the larger research goals of the proposed project. Why do we want to develop rabbit poison? Are there more ethical alternatives. I asked if this might be part of the ethical review process. The vet said of course. I asked if there was a rabbit problem in Western Australia. They all agreed there was, and it was hurting the farming community financially. I asked if economic return was considered a valuable attribute in evaluating the ethical status of a particular application. I was told that economy, did not contribute to the ethic of a project, but certainly factored into the cost/benefit ratio that committees consider.

We had a coffee break - some cookies, and then it was our turn to gain introduction to the animals. Rabbits, Mice, and Rats. Awfully small animals for a

large animal facility.

We enter one of the primary viewing laboratories, and are asked to leave our belongings outside in a set of cubicles. It is beautiful green on green design. Reminds me of institutional Eastern European design. Three stations are set up for the newbies. One table with cloaks and gloves and informational documents. One with trays of mice cages, and one with rat trays. We are asked to dawn white cloaks, and latex gloves.

Shawn and I are paired off with two women who manage another animal facility on campus. We begin with the rats. The rat handler is a nice young attractive man, who immediately tells us he prefers to work with rats as they don't bite as much. He immediately begins telling us all about the breed of rats, bread right on UWA campus. He lifts one out of a cage by its tail. It squirms. He says to hold onto it a third away from the rump, firmly but carefully, as sometimes the tail can be ripped off. He states that this can be a very upsetting experience for both the rat, and the handler. The rat is placed on his hand, with tail still in grasp. It immediately urinates all over his sleeve. Yellow spilling into white cotton. He allows the rat to hide its head in the crook of his arm.

We are taught how to sex the animals. The male's genitals are farther from the anus then the females. Two rats are presented to us ass up. Then we are introduced to the mother with newborn pups. We are each given a small pup to hold. They are translucent, purple and pink skin, with organs, and stomach full of milk visible through the shin. The small rat pup splays still in my gloved hands, breathing, and heart visibly pumping. Vibrating. Trying to stay still with still closed eyes. I am holding life in my hands. Instrumentalized life in the biosciences takes on a new more concrete understanding in this moment. I am silent; I can't hear anything in the room for a few pregnant moments. I deliver the rat back to it's mother quickly, so as not to be bitten - and we are told never to handle pups without gloves on as the mother will immediately kill the pup if she smells our sent on the animal.

Next we are greeted by an enthusiastic ausi bloke in charge of rabbit handling. He is a very generous man, and clearly enjoys his job, and cares deeply for his animals. We are taken into another lab where two stacked rabbit cages present themselves beside a handling table covered in green cloth. In the cages are two of the most magnificent rabbits I have ever seen in my life. Big, healthy, with thick soft fir, and deep red eyes. Albinos.

This station is most difficult for me, as I had rabbits for pets as a child. (companion verses research animals) On the table are a series of syringes, a plastic rabbit restraint box and some other implements. The blood drains from my face. I am terrified we are going to have to do injections on the rabbits. I feel a little dizzy, and begin counting in my head. (a little game my sister taught me for when she thinks she might cry but would prefer not to....1.2.3.4.5.4.3.2.1.)

I am trying to keep my cool while he describes the breed of rabbit. He takes us over to the cages to show us how to hold them, and get them in and out of the cage. I don't get close enough - and I think my eyes are getting red. He stops talking and asks me if i am okay. Busted. Double agent spy cloak detected. I am trying to act as if I truly belong here, and he sees my discomfort. He tells me to "come on over, they won't bite." Shawn makes a joke about my childhood pets. Everyone laughs an uncomfortable laugh. He asks about what type of animals I will be working with - Rabbits? I explain that we are using tissue culture in our work and that I am just here for training purposes.

We continue with the demo. Taking the rabbits out of the cages. Placing them in the box with ears exposed for blood letting (they call it bleeding.) I am still terrified he will cut or inject one of the animals, and I convince myself that I will faint for sure if this occurs. He tells us about how to kill the rabbits when the work is done, and assures us that when the time comes he will help anyone who is unsure about the process. He is concerned that we will not do it correctly and cause the animal undue suffering. He says that it is the most difficult part of his job, but it is important that it is done properly. I like this man very much - he understands the two-sided coin.

I am taught how to pick us the animal by the scruff of the neck - tucking its head in the crook of my arm. It is so soft and beautiful. And anxious. He warns that these animals are new, and assigned for PAWS training - so they are a little skittish this time, but will relax with experience. His voice trails off in describing what happened to the last demo rabbits that got a little too old and unruly for training purposes.

He asks me to come to him for extra help if my research ever leans towards the use of rabbits. I assure him it won't - but that I would be sure to contact him before ever handling a rabbit in a laboratory context.

We leave the room after 15 min. My head is spinning. I need a drink.

Last is the Mice. The mouse handler came in to watch the rabbit demo. She is eyeing me pretty close. I can tell she is prepared to catch me if I "go down." I think this happens some times with new graduate students taking the course in preparation for their first animal experiments.

She is also lovely. In fact they all seem to care deeply for the animals. Very reassuring. But strange. How everyone focuses on not causing the animals harm, when really their fates usually involve vivisection, injection with all sorts of drugs and virus. It seems to be a given that these animals will suffer research and disease, but not mishandling.

The mice demo is very similar to the rat demo. We are taught how to sex the

animals. We each hold a baby specimen. Their vulnerability is astonishing. Where this differs is in how to hold the animal for injection. The mouse is grasped on the back of the neck, pulled tight with head forward, and tail between your fingers exposing it's flat belly. The handler shows us three injection sites, in actuality performing two in the torso - but leaving tail injections to our imagination.

Before we finish, the handler reminds us that they are here to help us. That we can ask all the stupid questions we want, and they will help us with animal procedures as much as we like so as not to cause undue harm. I guess in the past there was more of a rift between the researchers and animal staff - but they are trying to mend that.

We reach the end of our day. Thank the handlers. And walk back to SymbioticA in the hot afternoon sun where the Friday meeting is taking place. Shawn and I contribute little to the discussion. Drinking three glasses of wine each, contemplating quietly.

Friday Feb. 10, 2006

Marie Pier Boucher - a researcher completing her masters degree at University of Montreal arrived yesterday. We were not in the city to greet her, but we did today. She will be living with us for the first three months of her residency. She is enrolled in the communications program where she works with Thierry Bardini and Brian Massumi. Her thesis focuses on the grotesque, cancer, the body and technology - specifically on the notion of the artificial uterus. She describes her purpose here as an anthropologist. I will have to remind her that our personal life, though shared with her in the capacity of roommates, is not up for analysis and publication. But she can have carte blanche with our professional lives.

While Oron and Ionat are away, they have asked us to meet biweekly with Chandra (last name?). I don't know much about his work, and he is rather elusive when you ask him, but he seems brilliant. From what I understand he is engaged in radical body modification, and he is working as a resident at SymbioticA researching how to grow plant and mammalian tissue culture together in the same environment. He has just completed six months working with Carry Cass in Agricultural Sciences, and now he is beginning his stint in the School of Anatomy and Human Biology.

We descend to the lab with Chandra, his wife, and Marie Pierre in tow. I remember my first day in the labs, and I am thrilled to introduce these others. I also remember how helpful Kira O'reilly was, and I am happy to pass on the favor.

There is a lot of prep work to do today. We are out of everything. New medium, plus gluta max, and penicillin. Defrost and distribute the FBS into 50 small vials, 5 ml each. This takes so long, we decide not to trypsinize Chandra's cells. Only to feed them. Then we feed our own, and prepare enough medium for next week blitz of trypsoinization. HACKET cells.

Tuesday, Feb. 21, 2006

Today is Shawn's birthday. We have to feed the cells today. But we have to celebrate also.

I go into the labs in the morning with Marie Pierre. We take the bus, as I don't have a driver's license, and she hasn't practiced driving on the wrong side of the road yet. It is a beautiful - hot hot hot - Perth summer day. The sky is blue - with dynamic white cloud patterns. The River (which looks more like a lake) is a bit rough. We look for dolphins on the way in. The bus snakes around the curves of the highway/river. I'm starting to think the dolphins are a hoax - or at least an aberration. When we arrived in 2004 - everyone told us to look carefully at the river - in case we see them. Now, two years later - I am still looking. To no avail.

At SymbioticA: no one is there when we arrive. I've been away for a week - working on our paper for the *New Constellations Conference* in Sydney. Feeling a bit sheepish about my absence - but clear on the necessity of this. I can't write in public. Even if there is air-conditioning.

Oron returns from Spain looking very sick and jet lagged. Jane has taken a few days off. We are only in for a couple of hours.

I love working in the lab alone. No noise - distractions - quietly - systematically - feeding the cells. It looks so cold in it's representation - but Tissue Culture is a lot like cooking in actuality. Oron and Ionat often said this to us. However, I never really got it. As I have a lot of experience cooking - I understand the basic principles. I enjoy relaxing and cooking. Up until now - TC was so riddled with anxiety for me. Fear of fucking up - that I could never see the connection. But today - it was like a warm bath. I wanted to put some jazz on.

I am starting to batch process the vials. Trying to save pipettes. The pipettes are beautiful long slender glass tubes with volume indicators down the side. They fit into the pipette guns - and allow for the sterile addition and removal of fluids from small neck containers with ease and efficiency. The guns are a little violent looking - even though they are made of plastic. But the pipettes are only elegant. And disposable. Each time you reach down into a single vial - and withdraw fluid from the cells' environment - you toss the contaminated pipette into the biohazardous garbage. If you were to re use the pipette - even in retracting

the fluid from an identical tissue culture sample - the chances of spreading contamination is high. So for every action the pipette is tossed. Hundreds a day for every lab - all over the world. So, when I am feeling confident - I often try to batch process the feeding - filling the pipette almost full - and carefully without touching the neck of any of the flasks - depositing the new nutrient solution into a number at one time. Saving a few pipettes a day.

The cells are incredibly healthy. Confluent. Will have to trypsinize them on Friday.

I'm off to the beach.

Tuesday, Feb. 28, 2006

Donor Calf Bovine Serum

If we are going to work with the P19's we need a different mix of serums in the nutrient fluid. We ordered a bottle of Donor Calf Bovine Serum. It is the color of a good beef stock. I spent hours alone in the lab today. Defrosting the serum and dividing it into 7.5 ml dosages. Enough to make 100 ml of prepared nutrient solution (along with 5 mil of the usual fetal bovine serum. Serum is an interesting thing. It is the blood of the calf or fetus with all the cells and platelets removed. Horrific actually. And also interesting, we are postulating the ability to grow cells outside of the body - but how much of the body to we need to bring into the lab to create a hospitable 'artificial' environment for the cells to proliferate.

... if I cut of my hand, you say me and my hand.
If I cut off my leg, you say me and my leg.
If I take out my kidney, liver and intestines, you say me and my intestines...intestines.
But if I cut off my head, do you say me and my head or me and my body?...

loosely remembered from Roman Polanski's *The Tenant.*

additionally, I trypsonized the HACAT cells again. No contamination. We now have twelve healthy vials. Some will be frozen. Some will be utilized in Ionat's Bioart class for the tissue culture demo - and some will serve as our first test cells in the bioreactor environment.

I filmed the entire procedure today. Filled a DV mini tape. However, what I am really hoping for - is a capture of the conversations going on around me. Though I was working alone, two senior graduate students were teaching a new recruit tissue culture protocols in the next hood over. It was very interesting. The new

student is from Germany. He speaks with a thick accent. I introduced myself, and explained a bit of what I was doing. He seemed very interested. Asking all sorts of questions. The new guy doesn't know the politics yet. Don't mix with the artists.

I have become good friends with another PhD Candidate, Maria. She is also from Europe, Portugal. She is very open to artists working in the labs. She says that in Europe artists are a valuable part of society. She attends all the Friday meetings at SymbioticA. She was over at our house last weekend, and we spoke about her experiences at the UWA. I think she is having a lot of problems. Not a good mix. One of the points she addressed - was distrust on the part of her fellow students for her involvement with SymbioticA. They feel it is a waste of her time and dangerous. It seems the group is ostracizing her. I am sure it is for other reasons as well - but her involvement with the artists is frowned apron.

Anyways....

Monday March 06, 2006

National Holiday - Labor Day. Not working at the university today. But spent 8 hours in the sweltering heat responding to emails. Growing frustrated with the business distracting me from the writing.

Three dead frogs today. I think I might have killed them. We have a fishpond in the front courtyard. Shawn and I have taken to the fish. We feed them twice a week - keep the water aerated, and top it up when it evaporates too much. Paul told us that the sign of a healthy pond is the frogs. We have had frogs since we arrived. They make rumbling noises all night long. Guy says they keep him up a night. I like them. They serve as a foil for the work we are doing in the labs. Care. So yesterday I topped up the pond - with added de-chlorinator. We did it a month ago and it was fine. This morning - three floaters. Dead Frogs. I am ashamed.

Thursday March 09, 2006

Defrosting P19 cells.

1 - immediately start to defrost vial of cells in warm water.
2 - Prepare a vial with melted cells - top up to 5ml with PBS.
3 - Make a twin vial with 5 ml of water. (make sure both vials have exactly the same amount of fluid in them to balance the centrifuge)
4 - Set Centrifuge - 36 degrees Celsius - 1600 rpm - 5 min.
5 - with the pipette remove as much fluid as possible without disturbing the pellet of cells.
6 - then refill to 5 mil with medium.

7 - repeat centrifuge process two more times, each time replacing the medium in the vial.
8 - pipette final cells into TC dish, and top up with medium.
9 - place in incubator.

Thursday March 30, 2006

Their fate seems sealed. Oron escorts us down to the labs. Marie Pier asks if she can come. We say no. "There will be nothing to photograph." But what I really mean is - I might cry. And I'm not sure I want the visiting anthropologist to document our failures. It's not a crisis - just the usual mid residency artist slump. I happens to everyone.

Oron confirms our concerns. Not only are the P19 not really establishing themselves - but they seem contaminated as well.

Three months of work - and we have little to show for it,

Plan B: Defrost the last vial of P19 from Marlyin - and purchase some more for back up (and to replace the ones we are borrowing) from ATCC.org.

Tuesday April 4, 2006

I stayed home working on my job applications. Bad news from the labs though. Shawn trypsinized the cells without diluting the trypsin. Hackett. They came off in sheets. Cell death. We really have nothing now.

Friday April 7, 2006.

Death and rebirth. Today I disposed of all the old dead cells. A small ceremony was watched by the science students. They think I am a bit strange. I drew dead stick men on the flasks, and did a photo shoot in the lab. On the floor - in the hood. They turned out beautifully - only in hind sight I should have drawn a dead mouse on the P19 cells. More accurate - less anthropomorphizing.

We also defrosted the last vial of P19 cells in the school. Ionat came along for emotional support. Oron ridiculed us from afar all day - until I asked him to stop. All in jest - but it hit a cord.

So we were in the freezer room - waiting for Marlyin - and I started to hyperventilate a bit. A bit nervous - and hung over from last nights activities. Ionat was touched that I was upset about the cells - rather then the exhibition etc... Downstairs - Shawn performed the task - I was jumpy, but took amazing photographs to document the dead rising. Or the seeping awaking.

Tuesday April 18, 2006.

Easter weekend is over.

We come into SymbioticA after a beautiful long weekend. Primarily working in the office. Website update is taking a long time, and a major investment on Shawn's part. Oron sitting in the corner - taking jabs at us. "aren't you going to check your cells" again, again, again.

We say yah, yah, we'll get to it. Of course he has already checked them himself.

Nearly all dead. Four days is too long.

Thursday April 20, 2006.

A beautiful day in the labs.

Today we worked with Paul Thomas. He is a lovely man - an art professor from *Edith Cowan University* and artistic Director for BEEP (*Biennial Electronic Arts Perth*). He is a very tall man - with very fair skin - a dermis transplantation on his forehead - and very British. Though he can seem imposing when you first meet him - he is actually a very kind, gentle, self-effacing man - and a good friend.

Paul has been working for years on the human/technology interface in his art practice. Today he is interested in seeding some cells in fabric so that he can photograph with electron microscopy the area of adherence between cell and fabric in the dish. He has four pieces of silk that have been autoclaved, and soaked in 70% ethanol for some time. I think they are silk rose petals. Oron asks us if we can donate some of our Hackett cells - and help Paul with the process.

We take him downstairs. Though he has observed before - it is his first time working hands on in the lab. He is very nervous - and does not appreciate the audience.

We wash the petals four times in PBS (Phosphate Buffered Solution)

Wash the Petri dish with 70%ethanol.

Soak the petal sin prepared nutrient solution.

Transfer petals to Petri dish.

Trypsonize the Hackett cells placing 1/3 in the dish.

Place dish in the incubator for 24 hours.

Shawn Starts first. Washing the Petri dish. I talk to him about his family - to distract him/ relax him. Take a few pictures. Then it is Paul's turn. We are very careful to discuss conditions for maintaining sterility. He is a bit wobbly - but excellent. We are all a bit wobbly the first time - with sweat running down the back of your neck. He rinses the petals - and soaks it in prepared nutrient solution.

I think he touches the outer edge of the NS container twice. This is probably grounds for contamination. I want to be supportive - but when it comes time to trytpsonize the cells - we switch back to steady hand Shawn and I throw out the remains of the solution. I tried to do it casual - but Shawn held me up - asking why I was disposing of perfectly good (and very expensive solution). I have to say I think it might be contaminated - and Paul's feelings are hurt. I feel bad. I give him the camera, and he takes a few shots while Shawn works.

It was a funny passaging. The Hackett cells took 10 minutes to come off the dish.

We complete the protocol - and I take some lovely photographs of Paul with the wide-angle lens.

Moments later - after Paul has left we trypsonize the P19's - they peal off in 20 seconds. Shawn is running to neutralize the process in time. He thinks he has caught it - but as always we are feeling haggard - and excitement - and adrenalin. You'd think we were competing in a sporting event - the way tension rises - and pulses flair. Nothing to do but wait till tomorrow to see the results.

Cultivating life is hard. Oron makes it look so easy - and teases us almost cruelly when we slip up - but balancing administrative responsibilities, artistic impulses, international travel, with an extremely delicate and sensitive scientific protocol - is a treacherous and exhausting undertaking. I'm sleeping this weekend for sure.

Friday April 21, 2006.

Funny afternoon. Double lab duty.

Shawn is working on the website. I go in to the labs to check cells. Beautiful. Absolutely Beautiful. Trypsinization was very successful! Each flask (both p19 and Hackett) has approximately 50% coverage of adherent cells. I decide to feed the P19's only a day after trypsinization. The solution looks depleted in color, and as we are coddling them - trying not to kill them again. It will be three days before we can get to them again.

It seems I have just enough of almost everything to accomplish this. Just enough

pipettes - ten drops of bleach, and the last of prepared P19 nutrient solution. I take all steps - humming a little - glad the cells are thriving in four flasks. (The first trypsinization in the most crucial - the move from one flask - to two, or three, or four, greatly enhances your chances of successful proliferation. This way you have back ups. You can freeze some cells - for another day. You can maintain multiple flasks, in case some are contaminated, and so on.) But as I reach the end of the protocol - I realize that I am a few milliliters short of prepared nutrient solution. Two flasks get three milliliters (rather then five). I close up - It's Friday and I want to get on to the meeting,

Upstairs, I mention to Shawn the low levels of nutrient solution. He reminds me that the cells will have to last three days - and we have experienced cell death before. I should open shop - and over fill each flask. I already knew this - and the goose chase begins.

Replacement pipettes down from *SymbioticA* office.

Hunt down bleach (mental note bleach and ethanol are stored by the sink in the autoclave room).

Print out P19 Protocols.

Defrost Fetal Bovine Serum, and Donor Calf Serum.

Prepare two 50 mil vials of P19 Nutrient Solution.

Then top up each vial with a few extra mils of new solution.

I'm twenty minutes late for the meeting. Too bad it was interesting.

Monday April 24, 2006.

Heading into the labs. Testing to see if our new P19 strategy is working. They prefer to be fed every 48 hours. This is not really possible over the weekend - Though we are considering signing up for after hours access. On Friday I gave them an abundance of nutrient solution - and hoped for the best. So coming in today and seeing then healthy and confluent is a relief. There is some debris floating in the solution - but I seen 90% adherence rate - nuclei in full view. I love the microscope. It is amazing - that with the intervention of a mediating device, I can observe my cells more closely - and in fact feel more connected and in tune with the cells - then if I only related to them with my eye. I confidently feed the cells - and wrap up quickly.

Now that we have four healthy flasks - we are ready to start microscopy protocols. I head over to the IAAF and meet with Guy's replacement. I must get

her name. She agrees to help us with both still and time laps microscopic photography of the P19's. I make an appointment for Thursday - 1:30 - and two weeks in advance for the video work.

We are still behind - but moving ahead. Life is a slow process.

Thursday April 27, 2006

IAAF - or whatever it is called - Image Analysis and Acquisition Facility - Renamed: Cell Central.

Today we are doing still optical microscopy - with digital documentation.
I did this last time in 2004 - but have forgotten everything. A complicated procedure - but strangely familiar - with our experience in scanning and digital photography.

Friday April 28, 2006

Feeding, feeding, feeding. "Feed me Seymour, feed Me!"
The cells are always hungry. Particularly the P19 - every 48 hours at the latest - But that is just too much over the weekend. We missed on Wednesday - they went three days - a little worse for ware because of that. Lots of dead clumps. So Today I take a look - enough still living - and top each vial up to 7ml.

I wish microscopy had been today - yesterday held little life.

I am always surprised by how dirty the labs are. Do they have cleaning staff? Everything is dusty - implements everywhere - pipette tips strayed from the garbage, litter the floor - and stains, bleach, ethanol, and something brown - that looks like rust.... Someone leaves these very old very dirty looking containers in the fume hood. How is this sterile? My kitchen is cleaner? - (well not really).

Hope they make it through the weekend.

May 03, 2006.

Lab Fatigue. That is the only way to describe it. The fatigue that one experiences when working in the laboratory for more then a couple hours a session - particularly linked to ongoing laboratory work - day in and day out for several months (if not years) in a row. The laboratory is not a hospitable place for human beings. I can only describe our lab, and my experiences there - but most can liken it to working intensely on a computer for several hours - so that the back seizes - the eyes dry - and the user is struck with a pangs of an emergency bathroom trip - as they have been so engrossed in their work - that all early warning signs of a full bladder and possibly even bowel movement have

been ignored. I am frequently experiencing migraines during this residency. (If I think back I did as well last time - though I had dismissed these symptoms as resulting from personal stress - rather then directly related to my work here.) Often after a day in the lab I go home to a hot bath, dark room, and varying quantities of Advil. My migraines are stress related - though I also have some dietary triggers (i.e. red wine). In that I experience migraines after moments of extreme concentration - performance - stress. The migraine never interferes with my ability to perform, but comes at the moment after the stress is removed, and my body relaxes, quickly expanding the veins in my head and neck, bringing on full visuals and crippling pain.

Lab Fatigue.
That is how I feel today.

Last night was a two-hour conference call until midnight with my doctoral committee. Though leaving that experience elated - the performance was exhausting - and a bad start for a busy day in the labs with Shawn.

The light in room is distinctly yellow. There is continual low-level noise - a hum, and rhythmic hydraulic sighs coming from the incubator. Today Luis is in introducing a new German graduate student to a tissue culture protocol. Though I have only heard Luis speaking rarely - it has always been in English. The flow of German utterances is very comforting in a soundscape dominated by machinery. The room is kept very dry - this is excellent in retarding the spread of bacteria - but hard on the body.

Additionally, we feel a bit surveyed in this environment. Not in the penal sense - but in the sense that we understand our place in the labs is open to opposition. When working along side scientists - I find myself constantly apologizing and asking if we are in the way. This probably has more to do with my own insecurities then a requirement of our residency. However, what is real, is an expectation that we will work quietly, respectfully - and not disturb 'real' research with our antics/amateurism. I am terrified of dropping a vial on the floor - or leaving the microscope lamp on - or somehow contaminating others research because of my inexperience. On the other hand - as I gain more experience - that is less likely to happen, and I am becoming more confident in my actions. This said. Strange mistake today - and still fearing the consequences. The fluid in the pipette touched the filter during an extraction. If this fluid passed the pipette filter - and entered the filter in the gun - it is a very expensive replacement. We have no way of telling. So we tell no one. This could prove fine - or contaminate the entire lab's experiments. Hold our breath - and see on Friday. I tend to overreact to these things - and Shawn assures me that the liquid did not enter the pipette gun.

We did a lot of work today. Probably too much.
We ran out of everything. Started stocking the lab with tissue culture flasks,

pipettes, bleach, and 70% ethanol. Defrosted three vials of trypsin, and one Fetal Bovine Serum. Calf Serum was already available in the fridge. Then I prepared the new nutrient solution batches. 100 ml for the P19's - and 100 ml for the Hackett cells. This involves measuring out small amounts of the serums in vials - and topping up with 45 ml of Nutrient solution. Making two 50 ml vials of prepared solution. This solution exhausts itself over time and with exposure to light. So we only prepare 100 ml at a time - lasting anywhere from one week to one month depending on the volume and number of flasks one is maintaining. We were low on PBS - and needed to subdivide a large glass container into a couple more *BIOTEKNICA* vials.

Then we needed to trypsonize all the cells - four vials of P19 - into 12 flasks - and two vials of Hackett into six. Lastly we plated three small circular sheets of glass with p19 cells in Petri dishes - reducing the final number of flasks to 9.

We were working with the small hood. And once we got everything in there (15 flasks, three Petri dishes, several sterilized implements bags, pipettes, the pipette gun, bleach, two containers of nutrient solution (one for each cell type), several small vials containing serums, and several large vials for prepared nutrient solution, three vials of trypsin, the large PBS container - and three large vials of PBS... I think that's it) the fume hood was so full - that it was difficult to work.

Shawn trypsonized the Hackett cells first.

Once that was completed we prepared the glass plates for video microscopy. This is a delicate process. The plates are very fine, and very fragile. They have been sterilized and stored in a sealed paper bag. So have various implements. Shawn uses sterile tweezers to place a glass plate in the centre of each Petri dish. Then we trypsonize one vial of P19's - dividing the suspended cells into three and seeding them on the plate of glass. Then each Petri dish is topped up. Of course we were doing a photo shoot at the time - adding to the tension. The dishes don't seal up like the vials - so they are very awkward - and prone to spillage and contamination. The dishes are documented and stored in the incubator. We trypsonize the remaining P19's. They were very confluent - and starting to die as they were clumping up in the vials.

Hours later - on the way home in the car - raging migraine. And three friends are having an opening. It would be dismissive of their work not to attend. I make an appearance - and return home early for a long sleep.

Friday, May 05, 2006

Video Microscopy.

A good day! Two days ago we seeded glass plates with our p19 cells. Now we will insert them into a heated chamber with nutrient solution and leave them in the microscope for the weekend. Every ten minutes - a photograph will be taken, making a data set of stop motion video stills.

Guy is still away at his Atlanta residency - so we will do the procedure with his temporary replacement Mika.

We had no idea she was so inexperienced. She was very nervous. She had seen the procedure performed once before - and collected a protocol from Guy - but she was pretty much flying solo with no experience.

We headed into the TC labs together and I could tell immediately that something was off. She had no knowledge of sterility procedures. And kept opening the autoclaved packages up outside of the hood. Even dropped one component on the laboratory floor - which we subsequently cleaned with 70% ethanol. She had difficulty operating the pipette gun - waiving it wildly through the air - touching the tip to random surfaces. Hands shaking.

Assembling the infrastructure is a delicate process. Each piece is autoclaved, and stored in the protective paper pockets. The pockets are brought down to the lab - and the undercarriage is assembled in the sterile hood. Then one of the seeded glass plates is inserted into the carriage (utilizing tweezers, so as not to contaminate the cells.) - and the negative space filled with new medium. There are external flow pipes built into the infrastructure to allow for constant replenishment of media - however IAAF dose not have the facilities to support this function - and we plug up the pipes with plastic caps. Mika - sweating visibly - is finding it difficult to fill the carriage with medium - sealing it without air bubbles. We are trying to calm her down. We live with the bubbles.

Once the device is fully assembled - we walk it over to the IAAF.
There is a bit of a struggle attaching it to the microscope - but not as much. Mika is a young talented technician. She is really at her best with the microscope. She was just nervous - doing a complicated protocol for the first time, with an audience to boot.

We get the settings straight. I am taking pictures all the time. This entire trip is marked by photography.

Cross our fingers and wait till Monday to see what we get.

Monday, May 8 2006.

Cell death. That's all we captured.

Guy mentioned that he had been having some problems with the focus.

Apparently - setting the focus is contingent on the room temperature.

Thursday, May 18, 2006.

waiting, waiting, waiting....

We come in today - to feed the cells, prepare the trypsin - and seed Paul Thomas's mika. He is doing an electron microscopy project - taking very detailed images of the bonds between cells and inanimate objects.

No luck with any of this.

It is Shawn's turn to feed the cells. But he is pretty tired, entertaining my folks - and obsessively engaged in his genealogy research. So I finally concede - I'll feed the cells. I head down to the lab to find it entirely full. Two students working - one at each hood - and Luis - forming a third station at the counter. Hushed discussion - they are at a critical point. It has never been explicitly said to me, but I know to - "stay out of the way of the scientists."

I head down to the second floor lab every half an hour - peaking my head through the porthole window - only to find they are still there. 5:00 rolls around - Jane is leaving soon - the school is about to go into lockdown. I never picked up an identification card - so I have to borrow Jane's - to make it through the security doors after hours. 6:45. The lab clears out. No time for monkey business. Trypsin and Paul's cells are left to another day.

Only feeding. With a small set back. We have run out of medium - and Jane has forgot to order more. Only expired medium left from our last visit. It expired Jan 2005. I am nervous about using this serum. I rely heavily on the current batch. With three vials remaining of P19 - I mark the canisters with (old medium) and use the expired stock.

We'll see how it goes.

The cells are looking fairly haggard. They are to be fed every 48 hours. 4 mil. I do that on Monday, Wednesday, and Friday. Over the weekend - I give then each 7 mil - to make it over the third day. Only this week. On Wednesday - we were so tired - from having visitors - we skipped that feeding - only allowing for 4 mill of nutrient solution over three days. Are we delinquent parents? Irresponsible artists? Tired? Who knows? But we are loosing cells like crazy these days. I hope we can keep a full stock until the end of our residency.

Friday, May 19, 2006.

Visitors.

My dad and his wife Teala have been visiting. Worlds collide - and not. Strange it has been a pleasure to meet in a foreign country - where warren is not a father - and I am not a daughter. We were able to meet as friends. Today is the day - To finally introduce my family to the exactitude of what I do. I imagine they will be impressed - but you never know.

Stuart gives an excellent demonstration of the School of Anatomy and Human Biology. Only I feel bad - first day back after dual trips to Dubai and Adelaide. He seems a bit haggard. He takes us through the labs - explaining all the technology - showing us TC&A art works, and discussing the evolution of their art production. He explains the nature of pure aesthetic engagement in the biological sciences - illustrative approaches, and embedded critical approaches. He explains the difficult terrain of sci/art exhibition - and the dangers of 'science education' in the gallery. It is a beautiful talk.

We head down to the labs at 2:00 - and unfortunately we run into the same problem as yesterday. Mass lab production! I am going to cry. Dad and Teala have traveled all this way - and it is their last day - and I might not be able to show them our lab work! I check and check again and again. No luck. Finally, I ask the scientists if I can bring some visitors bye - and show them our cells under the microscope. They agree - and the problem is half solved. They look through the lens - and see. Teals is surprised - she can't see the cells moving.

An hour later Shawn is presenting his copyright lecture at the Friday meeting - and I slip away unnoticed - to feed the cells. Bad timing. Only 30 minutes difference and they could have seen it all.

The entire school is closed at 5:00 pm today. Locked until 9 am. They are cutting off power to the phone lines (as part of the new small animal facility construction). And health and safety says people are not allowed to work in the building if the phones are out. They have the most rigorous health and safety I have ever encountered.

Thursday, May 25, 2006.

Working at home today. Growing more concerned about our inability to generate a digital 3D prototype in the remaining five weeks. So we agree to move to plan B. Cast meat sculptures. We are having a hard time accessing the necessary technology to complete this aspect of the work here in Perth. We tried opening the 3D files we generated in Adelaide on Oron's computer a few weeks ago. It is too old and slow. We bought new Lightwave software (ironically they had a copy laying around the shop that someone ordered two years ago and never picked up. ha ha ha It was Shawn. He ordered it last time we were here and then we

ran out of funds so he never picked it up. So Oron wandered over asking if they could order in a copy - and they gave him this one at a vastly reduced price.) Unfortunately the computer they have driving the 3D printer is far too slow to deal with the new software - and the huge file sizes of the scans. So my thought is that we will make the digital prototypes upon our return to Montreal. We have excellent 3D rapid prototyping facilities affiliated with Hexagram.

We purchase the meat today - and I was going to get right on it - however I also got a bit fanatic looking for my lost notebook. Finally found it under my suitcase??? I've been looking for that for two weeks - and I was starting to think it was really gone. So a new path... Transcribe all my lab notes into digital copy. I am afraid of loosing the book again - with all this precious information. Plus it is fun going back over our residency. Most of the lab notes were entered directly into the computer after work. But sometimes I took notes on the spot - and they are all in my book.

Stressed. Not going to finish all our plans in time. 5 weeks left! I am starting to have that sick to my stomach feeling - like this might be the last time I do this... or that. But I am also getting really home sick.

Friday June, 09, 2006.

Having a hard time keeping up with the notes. So much is happening so fast - I am running out of time. Three weeks left!!!!

Today is packed. Tagny's first day at the lab. What a pleasure/privilege to be able to introduce her to this place. I can see the wonder/excitement - and feel it again myself.

We come in for the afternoon. Check in with Guy to see how our last microscopy has gone. Strange - well. It seems that the cells we thought were dying - are transforming. We have captured this process in our last movie. It is very interesting - strange.

The P19 cells seem to be reacting poorly with the process/carriage needed for microscopy. Every time we insert the plate into the apparatus - we look down the lens to see them "dying." They begin all healthy and stretched out. Then immediately begin to shrink up - ball up - as if they are being trypsonized - wiggling. We kept thinking the cells were dying - until one day last week Stewart Hodgets happened to come into the lab while we were looking at the video. He suggested that they were not dead at all. That they were transforming. He said the P19 cell line is not inherently cancerous. That a process of transformation is required.

Monday, June 12, 2006.

Very strung out today. Incredibly busy weekend. Shannon Bell is in town. We went to parties - had dim sum meetings - and went to the beach.

Tagny came in early with me today. 8:30 am arrival. Still sleeping. Lost keys - locked out of *SymbioticA*. So we coffeed - and talked - and cried we were laughing so hard. It is a pleasure to have such a close friend here - and to see *SymbioticA* through her eyes.

Then early start. Guy was on the move. Another run at the P19's in video microscopy. Guy is a pro. He has the entire carriage assembled in two minutes. And under the lamp. I say I am to tired to take pictures - and Tagny offers to document - then I do the documentation. The pictures are good.

But more interesting. Oron and I meet to take the next step with the polymers. On Friday - Shawn poured the silicon over the wax moulds. Today it is set. Oron pulls them out of the mould - beautiful white rubbery - fleshy constructs. The teratomas are beautiful. The molds took well. Well enough. Each one had a small bubble. But it only adds to the design - so we decide to move ahead on them.

Before we get started - we take another teratoma sculpture out of the freezer - and get it started on the 3D scanner. A little frozen piece of meet - stuck in play dough - placed carefully on a moving surface. It should stink. But it doesn't. It is beautiful.

Then we prepare the polymers.

We are using the P4HB polymer. A bioasorbable polymer. Apparently it is produced by a genetically modified organism. Strange how interconnected all the biotech products are. You can't trace every connection - ethical reflexitivity is impossible - we are working in another universe - with protocols and materials of a different order.

This polymer is carefully measured out. 5% polymer - 95% acetone.

The scale is extremely precise.

The dilution is made - and sealed in a glass bottle. And warmed in a dish of hot water. The warming allows for the dissolve reaction to occur.

This afternoon - we will start pouring the polymers - and feeding cells - and plating more cells for Microscopy.

Tonight - Lecture at *SIGGRAPH*.

Appendix 2
BIOTEKNICA | ORGANIC TISSUE PROTOTYPES | PROTOCALLS

Tissue Culture Laboratory Protocols – Passaging (3T3 Mouse Fibroblast Cells)

SymbioticA – The University of Western Australia
Jennifer Willet
June 01, 2004

The following information was gathered during demonstrations and work sessions with Oron Catts and Ionat Zurr from SymbioticA in the School of Anatomy & Human Biology at The University of Western Australia.

General Safety Information

01 Wash hands carefully when entering or exiting the laboratory
02 Wear disposable lab coat, and latex gloves when working with biological materials
03 Assume all biological materials are hazardous
04 No eating, drinking, smoking, or kissing in the laboratory
05 Clean all work surfaces with 70% ethanol solution before and after all work
06 All waste should be disposed of properly (i.e. Autoclave disposal)
07 All liquid wasted should be treated with bleach before disposal
08 Wash gloved hands with 70%ethanol solution before working in fume hood environments

Work Station Preparation (Level II Fume Hood)

01 Turn on UV Light for twenty minutes in advance of utilizing fume hood
02 Turn off UV Light
03 Open Hood
04 Turn on light and air flow
05 Clean work space with 70% ethanol solution

General Pipette procedure information

01 never directly touch the pipette unless it is for disposal purposes
02 Open one end of sterile packaging and insert pipette into gun before fully removing package
03 Never over fill a pipette allowing liquids to enter into the gun filter
04 Pre-loosen all caps of containers, careful not to touch the inside of any cap
05 Do not allow pipette to touch external surfaces of any containers used

06 Do not cross-contaminate with pipette, use a new pipette for every solution

Preparation of Nutrient Solution for Storage

With all forms of tissue culture a nutrient solution must be prepared to maintain the nutrient needs of dividing cell lines.

01 Prepare work station with the following materials

500ml Bottle of DMEM Dulbecco's Modified Eagle's Medium
5ml Gluta Max (Amino Acid)
5ml Penicillin
Pipettes, and disinfected pipette gun
Permanent Markers
Bleach Solution

02 With Pipette add 5ml Gluta Max to DMEM
03 With new pipette add 5ml of Penicillin to DMEM
04 Write your name on the bottle
05 Store in refrigerator when not in use

Preparation of Nutrient Solution for Dailey Use

01 Prepare work station with the following materials

500ml of DMEM + Glu and P/S
5ml vial of FBS Fetal Bovine Serum
Pipettes, and disinfected pipette gun
Styrofoam vial holder – disinfected with 70% ethanol
Sterilized 50ml vials
Permanent Markers
Bleach Solution

02 With Pipette deposit 5ml of FBS in a sterilized 50ml vial
03 With a new pipette add 45ml of Prepared Nutrient solution
04 Mark Vial as 10% FBS, date, and your name
05 Store in Refrigerator when not in use, but only for a short time

Passaging (Stage I: From Primary Cell Line Container)

3T3 – Mouse Fibroblast
Connective tissue cell line established in early 1970's from a Swiss mouse

Passaging is the protocol where a healthy cell population is further divided into a larger number of containers, encouraging the cells to further divide and grow in

numbers. The basic premise being, that healthy cells will continue to divide until they become confluent (flowing together, overlapping, fully populated). Once the entire surface within the tissue culture flask is confluent with 3T3 Cells – passaging will allow you to divide those cells among three identical flasks, ostensively tripling your cell population.

01 Prepare the workstation with the following materials

50 ml prepared Nutrient Solution
10 ml defrosted Trypsim
Bottle of PBS Cleaning Solution
Pipettes, and disinfected pipette gun
Styrofoam vial holder – disinfected with 70% ethanol
Sterilized culture flasks
Permanent Markers
Bleach Solution

02 With pipet remove depleted nutrient solution from tissue culture flask, and dispose in bleach solution.
03 With a new pipette draw 5 mills of PBS solution, and deposit in Tissue Culture Flask. Swish the solution along the bottom of flask ensuring full cellular coverage. Remove PBS Solution and deposit in bleach.
04 Repeat step two again with a new pipette.
05 With a new pipette, draw 3 mills of Trypsin (an amino acid) and deposit in Tissue Culture Flask. This will break down the cellular bonds.
06 Place flask in the incubator for one minute (or less).
07 Check under microscope to see that cells are freed from the flask surface, and floating in the Trypsin.
08 If not agitate the flask
09 Once the cells are free floating, with a new pipette add a predetermined amount of prepared nutrient solution. (Amount depends on the number of flasks you are dividing to.) (These last three steps should be done quickly; as if you over expose your cells to Trypsim they will die.)
10 Use a new pipette to stir cells into the nutrient solution.
11 Divide the final solution into designated number of flasks.
12 Return flasks to incubator.

Appendix 3
Concordia University – Human Research Ethics Application
Shawn Bailey (and Jennifer Willet)
2004

Concordia
UNIVERSITY

Summary Protocol Form

- ***For faculty and staff research:*** *Submit to the University Human Research Ethics Committee (UHREC), c/o the Office of Research, GM 1000.*
- ***For graduate or undergraduate research:***
  - *For projects covered under a faculty member's previously approved SPF, no new SPF is required.*
  - *For new projects which are supported by external (e.g. Tri-council) or internal (e.g. CASA or FRDP) funds, the supervising faculty member must submit a new SPF on behalf of the student to the UHREC, c/o the Office of Research, GM 1000.*
  - *For new projects which are NOT supported by external (e.g. Tri-council) or internal (e.g. CASA or FRDP) funds, the student must submit a new SPF to the relevant departmental or faculty ethics sub-committee.*

For more information on the above, see http://oor.concordia.ca/REC/human_research.shtml.
If using the MS Word form, please tab between fields (do not use the enter key) and click on check boxes.
If not using the MS Word form, please TYPE your responses and submit on a separate sheet.

Date: May 28, 2004

What type of review do you recommend that this form receive? Expedited ☐ or Full ☒

Part One: Basic Information

1. Names of Researchers:

Principal Investigator: Shawn Arthur Bailey, Associate Professor.
Department/Program: Studio Arts, Faculty of Fine Arts
Office address: VA Building
Telephone number: 4647 E-mail address: sabailey@alcor.concordia.ca

Names and details for all other researchers involved (e.g., co-investigators, collaborators, research associates, research assistants, supervisors – please specify role):

Jennifer Willet
BIOTEKNICA Co-Investigator, Collaborator
Part Time Faculty Member, Studio Arts, Concordia University
4758 Des Erables Ave.
Montreal, Quebec CANADA
H2H 2C9
jwillet@sympatico.ca

Jennifer Willet is a professional artist, a part time faculty member in Studio Arts at Concordia University, and a PhD student in the interdisciplinary humanities program at the

same institution. She completed a BFA at The University of Calgary in 1997 and a MFA at The University of Guelph in 1999. Her work explores notions of self and subjectivity in relation to biomedical, bioinformatics, and digital technologies with an emphasis on social and political criticism. She has traveled, exhibited, and presented her research extensively across Canada and internationally.

Oron Catts
Director, SymbioticA Research Group
The School of Anatomy and Human Biology
Mailbag Delivery Point M309
The University of Western Australia
35 Stirling Highway
Nedlands WA 6009
AUSTRALIA
oron@symbiotica.uwa.edu.au

SymbioticA is a research facility located in The School of Anatomy & Human Biology at The University of Western Australia that is dedicated to artistic inquiry into new knowledge and biomedical technologies. Groups and individuals who are interested in exploring new possibilities neglected by mainstream science or art are conducting the research at SymbioticA. In order to facilitate the research SymbioticA has created a Research Group (SARG), which consists of the core researchers in Symbiotica and artist-researchers who are invited exclusively on project-by-project basis.

For the purposes of the University of Western Australia's internal ethical approval process Professor Catts will be listed as principle investigator. This is necessary due to internal regulations.

2. Title of Research Project:

Bioteknica: 3D Organic Tissue Prototypes: Soft Sculptures

3. Granting Agency, Grant Number and Title OR Contractor and Contract Title (if applic.):

Hexagram - Institut De Recherche & Creation En Arts & Technologies.
Grant Account Number: QH0022
Project Peroid: April 01, 2004 - March 31, 2005

4. Brief Description of Research:

For funded research, please include one-page summary; otherwise, include a brief overall description. Include a statement of the benefits likely to be derived from project. You can address these questions by including the summary page from the grant proposal.

BIOTEKNICA | ORGANIC TISSUE PROTOTYPES | ABSTRACT

BIOTEKNICA is a five-year artistic/scientific/research project, currently in its third year, conducted between collaborators, Jennifer Willet and Shawn Bailey. BIOTEKNICA is a fictitious corporation, which explores notions of reproduction and self/other distinctions in relation to evolving biotechnologies.

BIOTEKNICA projects its viewers into the future, where within our virtual laboratory designer organisms are generated on demand. However, the organisms produced by BIOTEKNICA do not adhere to the structures and functionality normally manifest in nature. Similar to mutations depicted in *The Fly* and *Aliens* our specimens are irrational and grotesque. They are modeled on the Teratoma, an unusual cancerous growth containing multiple human tissues like hair, skin and teeth. Monstrous as this seems, scientists today are conducting research on the Teratoma with the goal of developing future therapeutic cloning technologies. BIOTEKNICA both embraces and critiques these technologies, considering the contradictions and deep underlying complexities of contemporary biotechnologies role in the future of humanity.

In the past, BIOTEKNICA has been a Multimedia production, however, we seek to bring our theoretical specimens out of their virtual environment. We are currently working as Research Fellows at the Symbiotica Art/Science Laboratories at The University of Western Australia over the summer of 2004, where we will grow organic prototypes that will serve as new representations of our product line. We seek to develop soft sculptures that tip the scales between representation and reality, based on tissues cultivated under the supervision of biotechnologists and geneticists further contributing to the fascinating complexities and social discourses that arise from our project.

BIOTEKNICA | ORGANIC TISSUE PROTOTYPES | STATEMENT OF BENEFITS

BioArt and GeneArt (Transgenic) forms are an emerging field of contemporary art production where the artistic media is organic cell structures, and where the boundaries between art and science are permanently blurred. In April 2003, we presented BIOTEKNICA at *The European Media Art Festival* congress (which was entirely dedicated to BioArt practices) where we met some of the most successful and provocative contemporary BioArtists including: Eduardo Kac (Chicago Art Institute), Joe Davis (MIT Media Lab), and the SymbioticA Research Group (University of Western Australia). There is a very pressing need for artists to engage innovative new technologies. Contemporary technological evolution is often dependant upon the potential for commercial development, particularly with expensive new technologies whose ethical and cultural application is uncertain. Artists are increasingly the leaders in exploring new technologies, and creating social and cultural discourses around their application. BIOTEKNICA mobilizes an array of specialized technologies (both biological and computational) for purposes which they were not originally intended. It creates a site for cross-disciplinary communication between artists, new media specialists, and scientists – spanning international borders and making connections between several reputable universities and research centers.

BIOTEKNICA | ORGANIC TISSUE PROTOTYPES | SIGNIFIGANCE

We see the proposed BIOTEKNICA Organic Prototypes as engaging in several critical social and theoretical terrains. These include: redefining notions of self/other, reproduction, representation, gender and genetic identity, self-experimentation, reality and the virtual, ethics and the biosciences, and interdisciplinary – or cross specialization in contemporary research. Upon completion, the BIOTEKNICA Organic Prototypes will be presented in conjunction with a series of papers and presentations providing a complex analytic context for interpretation.

Symbiotica is of particular interest to us as a venue where non-scientists can enter the laboratory and contribute intellectually to the application of contemporary tissue engineering technologies. BIOTEKNICA is directly concerned with creating a site for non-specialists to participate in (virtual) scientific investigations. To bring BIOTEKNICA researchers – and thus BIOTEKNICA content – into a functional laboratory will only heighten our original intentions with this project.

5. Scholarly Review of Proposed Research:
Complete the Scholarly Review Form (SRF) if you are conducting non-funded or contract bio-medical research or any other non-funded or contract research involving more than minimal levels of risk.

N/A. Project is fully funded and housed within appropriate facilities designed for such purposes.

Part Two: Research Participants

1. Sample of Persons to be Studied:

Shawn Bailey has volunteered to donate a sample of his own tissue to the BIOTEKNICA Project, and the sample will be submitted to the SymbioticA Organic Tissue Database for future art/science research purposes as part of an artist tissue database. The donation on our part is entirely voluntary and involves very minor surgical procedure (skin tissue samples). In no way would we be denied access to the SymbioticA facilities, if we chose not to make a contribution. This procedure is minimally invasive and carried out by medical professionals. All protocols will be conducted in accord with level 2 safety and under direct supervision by, and medical advice will be sought if necessary after the biopsy. Cultures will be maintained and documented but following the research they will be fixed or frozen (according to existing cryogenic or plastination protocols) and archived for documentation purposes in a safe and legally transportable format.

The artists (Bailey, Willet) are licensed by the University of Western Australia to practice human anatomy research within the school, and are currently undergoing training in animal ethic protocols for the purpose of enhancing sensitivity to animal care and tissue cultivation protocols involving the use of animal cellular culture lines. Both artists are receiving training in tissue cultivation techniques utilizing existing "immortal" cell lines drawn from animal research trials. No animals are utilized or harmed in the research conducted by Willet and Bailey.

2. Method of Recruitment of Participants:

The artist and principle investigator has volunteered to undergo this clinical procedure.
No other human subjects will be involved in the proposed research.

3. Treatment of Participants in the Course of the Research:
A brief summary of procedure, as well an account of the training of researchers/assistants:

SHAVE BIOPOSY PROCEDURE:

A shave biopsy is a quick and simple method for removing appropriate Karitonitye cells from a healthy subject characterized by fast-healing, minimal pain and minimal risk of infection. The tissue will only be sampled through to the dermis with a maximum surface area of 5 mm X 3 mm to a depth of 1.5 mm.

Procedure for Excisional Biopsy (Shave Biopsy):

1 The skin will be infiltrated with anaesthetic to raise a wheal under the area to be excised. A 30-gauge 1/2-inch needle is ideal. The skin will be cleaned with an appropriate disinfectant.

2 A razor blade or scalpel will remove a split-thickness graft to a maximum depth of dermis sample.

The sample will be packed in dry ice under sterile conditions and transported from the plastic surgeons office to the University of Westerns Australia for subsequent tissue cultivation Techniques.

Instructions for Wound Care after a Skin Biopsy:

1. **Remove the Band-Aid after 24 hours.**
2. **Clean the site daily with soap and water. Apply a small amount of Polysporin and cover with fresh Band-Aid.**
3. **Do not allow a scab to form. Do not expose the wound to direct air, as this will delay healing.**
4. **Continue wound care until healed, approx. 5-7 days.**
5. **If any problems are encountered the plastic surgeon will be contacted.**

Source: The Yale Dermatologic Surgery Unit.

Part Three: Ethical Concerns

Indicate briefly how research plan deals with the following potential ethical concerns:

1. Informed Consent:
Written consent form or written draft of oral protocols must be attached: see instructions and sample.

Please see attached signed consent forms.

2. Deception:

The researcher must both describe the nature of any deception and provide a rationale regarding why it must be used to address the research question – i.e., is it absolutely necessary for the design? Deception may include the following: deliberate presentation of false information; suppression of material information; selection of information designed to mislead; and selective disclosure.

There will be no deception involved in the gathering of tissue samples for the purposes of completing the BIOTEKNICA tissue culture sculptures.

3. Freedom to Discontinue:

The artist/researcher acknowledges that he is free to discontinue the procedure at any time of his choosing.

4. Assessment of Risks to Subjects' Physical Wellbeing, Psychological Welfare, and/or Reputation:

This includes low-level risk or any form of discomfort resulting from the research procedure and how it will be dealt with. When it is called for, you should indicate arrangements that have been made to ascertain that subjects are in "healthy" enough condition to undergo the intended research procedures. You should be able to indicate clearly the kinds of risks that may be involved and the action to be taken if someone is unexpectedly put at risk as part of the research efforts.

It is the view of the artist/researcher that the minor discomfort resulting from the procedure is akin to standard and socially acceptable consensual procedures, such as biopsies on healthy athletes, routine cosmetic surgery procedures, and a host of "cosmetic" appearance enhancing procedures such as tattooing, body piercing or other mainstream "cultural" body modification art forms. In the case of muscle biopsies on healthy athletes to examine elite performance, the risk from the minor surgical procedure is far greater than from a simple cutaneous skin biopsy proposed in this instance.

A full medical history will be obtained by the surgeon before the skin biopsy is performed, and the primary risk involved is minor infection. A follow up visit with the doctor will ensure that no complications have arisen, and if any complications do arise, medical advice will be sought immediately.

5. Protecting and/or Addressing Participant "At Risk" Situations:

The primary "at risk" situation that arises from the proposed research is the risk of infection from the surgical procedure. The artist will seek appropriate medical counselling in the event that the routine procedure for caring for the surface wound results in infection.

The psychological aspects of this work are of central interest to the researchers in this project and careful documentation from a scientific and subjective perspective will be an integral part of exhibited dissemination materials. The research project seeks to highlight the ethical, social and political impact of new technologies applied to the human body. Both Willet and Bailey have been extremely involved in the discussion of new art forms relating to Biotechnologies, contemporary art practices, and the exhibition of works utilizing these protocols.

Both Willet and Bailey have lectured extensively and internationally on these topics.

6. Post-Research Explanation and/or Debriefing:

This will not be necessary, as the researcher /subject is intrinsically involved in developing the research protocols and therefore will possess full knowledge of the research intentions before any procedure is enacted. The subject is free at any time to discontinue the project.

7. Confidentiality of Results:

The research will be presented in public forums and the subject has consented to have his name attached to the artworks with full credit for his participation.

8. Data Handling:

Please describe the path of your data from collection to storage to its eventual destruction/disposal. Include specific details on data handling, data storage (format and location), who will have access, and disposal/destruction method.

At all stages of production we will be documenting the laboratory processes with digital and microscopic photography, and digital video with the intention of producing a series of oversized digital prints, a documentary video and an intensive website programmed in multimedia authoring software.

Primary cells and generated tissue cultures will be stored at the Department of Human Anatomy and Biology at The University of western Australia. in a Level II Laboratory with appropiate incubation. fume hood, and waste disposal services (autoclaved waste disposal, and approved liquid waste disposal). Access to this labatory is restricted to approved faculty and graduate students. Upon Completion, the tissue sculptures will be documented with digital microscopic cameras, avaliable in the same facility, and properly stored in containment units called bioreactors (as developed at The University of western Australia). These bioreactors protect the sculptures from external contamination, and are suitable to present in gallery settings. The Organic Prototypes pose no threat whatsoever to external enviroments, or people. The greatist risk of contamination in fact lies with the sculptures themselves - so vunerable to external contingiencies. We have confirmed exhibition venues in Western Australia for this work, however we may also make inquiries with the Canadian Department of Foreigh affairs for possible future laboratory - to - laboratory shipping of final sculpturs to a university venue in Canada. However, this aspect is unconfirmed, and would require further research and development.

Cultures will be maintained and documented but following the research they will be fixed or frozen (according to existing cryogenic protocols) and archived for documentation purposes at The University of Western Australia.

9. Other Comments:
Bearing in mind the ethical guidelines of your academic and/or professional association, please comment on any other ethical concerns which may arise in the course of this research (e.g., responsibility to subjects beyond the purposes of this study).

We have no other comments at this time. Thank you for your time and attention in this matter. Please feel free to contact us if you require further information.

Signature of Principal Investigator: _____

Date: June 1, 2004

CONSENT FORM TO PARTICIPATE IN RESEARCH

This is to state that I agree to participate in a program of research entitled BIOTEKNICA, being conducted by *Shawn Bailey, Associate Professor of Studio arts of Concordia University* (514.848.2424 (4647) email sabailey@alcor.concordia.ca), in conjunction with his collaborator Jennifer Willet, Part Time Professor of Studio Arts at Concordia University, and The SymbioticA Research Group in the School of Anatomy and Human Biology at The University of Western Australia.

A. PURPOSE

BIOTEKNICA is a five-year creative project, currently in its third year, conducted between collaborators. Jennifer Willet and Shawn Bailey. BIOTEKNICA is a fictitious corporation, which explores notions of reproduction and self/other distinctions in relation to evolving biotechnologies. In conjunction with SymbioticA Art/Science Laboratories at The University of Western Australia we will grow organic prototypes through approved tissue culture protocols that will serve as new representations of our BIOTEKNICA product line.

I have been informed that the purpose of the research is to donate a skin sample through biopsy procedures with local anesthetic under clinical settings at a designated and licensed plastic surgeon in Perth, Western Australia. The tissue sample will subsequently undergo passaging and cellular division and introduced into 3d polymer scaffolds at the Department of Medicine and Human Anatomy at the University of Western Australia.

For the purposes of BIOTEKNICA Research and Creation you are donating, of your own free will, and without financial or other remuneration, a dermal tissue sample that will be cultivated in the tissue engineering laboratory of The University of Western Australia and later exhibited in life and reproduction as a component of the BIOTEKNICA project.

You are free at any time to withdraw consent to further participation without prejudice in any way. You need give neither reason nor justification for such a decision. In such cases, any record of you as a participant is to be destroyed, unless otherwise agreed by you.

I (the participant) have read the information provided and any questions I have asked have been answered to my satisfaction. I agree to participate in this activity, realizing that I may withdraw at any time without reason and without prejudice. (Or where applicable - without prejudice to my future medical treatment).

I have been advised as to what data is being collected, what the purpose is, and what will be done with the data upon completion of the research.

I agree that research generated from my donation may be published and exhibited by BIOTEKNICA researchers in both academic and artistic settings.

B. PROCEDURES

Indicate in this section where the research will be conducted and describe in non-technical terms what the subjects will be required to do: the time required to do it; any risks or discomfort involved; and any special safeguards being taken to protect the confidentiality or well being of the subject.

The skin sample will be collected in a plastic surgeon's office local to Perth and The University of Western Australia. The Subject will be required to spend about 30 minutes at the doctor's office, with a follow up examination seven days later. The subject will undergo local anesthetic, and minor surgery in the buttocks or upper thigh region. A sample less then one square centimeter will be obtained through shaved biopsy procedure. (Please see attached description of this procedure.)

Qualified scientific directors of the institute will conduct all laboratory protocols in accord with level 2 biological handling safety categorization under Australian law and exclusively under direct supervision. Medical advice will be sought immediately if the procedure results in any infection or serious discomfort. Cultures will be maintained and documented but following the completion of laboratory research they will be fixed or frozen (according to existing cryogenic or plastination protocols) and archived for documentation purposes.

C. CONDITIONS OF PARTICIPATION

- I understand that I am free to withdraw my consent and discontinue my participation at anytime without negative consequences.
- I understand that my participation in this study is:

  VOLUNTARY and NON-CONFIDENTIAL (my identity will be revealed in study results)
- I understand that the data from this study will be published in a variety of artistic and academic formats.

I HAVE CAREFULLY STUDIED THE ABOVE AND UNDERSTAND THIS AGREEMENT. I FREELY CONSENT AND VOLUNTARILY AGREE TO PARTICIPATE IN THIS STUDY.

NAME (please print) _____

SIGNATURE _____

If at any time you have questions about your rights as a research participant, please contact Adela Reid, Research Ethics and Compliance Officer, Concordia University, at (514) 848-7481 or by email at areid@alcor.concordia.ca.

BIOTEKNICA | PHASE III: 3D Organic Tissue Prototypes (Soft Sculptures)
Application to Undertake Research Involving Human Subjects

BIOTEKNICA | PHASE III: ABSTRACT

BIOTEKNICA is a five-year creative project, currently in its third year, conducted between collaborators, Jennifer Willet and Shawn Bailey. BIOTEKNICA is an art/science collaboration, which explores notions of reproduction and self/other distinctions in relation to evolving biotechnologies.

BIOTEKNICA projects its viewers into the future, where within our virtual laboratory designer organisms are generated on demand. However, the organisms produced by BIOTEKNICA do not adhere to the structures and functionality normally manifest in nature. Similar to mutations depicted in *The Fly* and *Aliens* our specimens are irrational and grotesque. They are modeled on the Teratoma, an unusual cancerous growth containing multiple human tissues like hair, skin and teeth. Monstrous as this seems, scientists today are conducting research on the Teratoma with the goal of developing future therapeutic cloning technologies. BIOTEKNICA both embraces and critiques these technologies, considering the contradictions and deep underlying complexities of contemporary biotechnologies role in the future of humanity.

In the past, BIOTEKNICA has been a Multimedia production, however, we seek to bring our theoretical specimens out of their virtual environment. We have been invited to work as Research Fellows at the Symbiotica Art/Science Laboratories at The University of Western Australia in the summer of 2004, where we will grow organic prototypes that will serve as new representations of our product line. BIOTEKNICA purports to be engaged in growing specimens through cloning protocols. However, we as artists have no intention of engaging in these technologies. Instead we wish to develop soft sculptures that tip the scales between representation and reality, based on tissues cultivated under the supervision of biotechnologists and geneticists further contributing to the fascinating complexities and social discourses that arise from our project.

BIOTEKNICA | PHASE III: RESEARCHERS

Shawn Bailey is a practicing artist working with digital print media, video and installation. His current research explores notions of authority, control structures, media and international biotech and pharmaceutical policies. He completed a BFA at The University of Calgary in 1997 and a MFA at York University (Toronto) in 1999. He has lectured and exhibited internationally. He is currently an Assistant Professor at Concordia University in the Print Media programme in Studio Arts and an artist-researcher with the Hexagram Institute. He lives and works in Montréal, Canada.

Jennifer Willet is a professional artist, a part time faculty member in Studio Arts at Concordia University, and a PhD student in the interdisciplinary humanities program at the same institution. She completed a BFA at The University of Calgary in 1997 and a MFA at The University of Guelph in 1999. Her work explores notions of self and subjectivity in relation to biomedical, bioinformatics, and digital technologies with an emphasis on social and political criticism. She has traveled, exhibited, and presented her research extensively across Canada and internationally.

SymbioticA is a research facility located in The School of Anatomy & Human Biology at The University of Western Australia that is dedicated to artistic inquiry into new knowledge and biomedical technologies. Groups and individuals who are interested in exploring new possibilities neglected by mainstream science or art are conducting the research at SymbioticA. In order to facilitate the research SymbioticA has created a Research Group (SARG), which consists of the core researchers in Symbiotica and artist-researchers who are invited exclusively on project-by-project basis.

BIOTEKNICA | PHASE III: ORGANIC TISSUE PROTOTYPES | OBJECTIVES

We see four sets of objectives related to Phase III of BIOTEKNICA:

(1) Theoretically, our goal is to provide a site of critical and artistic contemplation where the ramifications of biologically enhanced forms of reproduction can be addressed and redefined collaboratively by individuals both within and outside of the scientific community.

(2) In terms of cross-disciplinary experimentation, BIOTEKNICA would like to produce a series of six organic prototypes in conjunction with The Symbiotica Laboratory at The University of Western Australia.

(3) In terms of new media production, BIOTECKNICA Phase III will result in the development of a series of digital images, web based production, and an interactive installation documenting the organic prototypes.

(4) Professionally, and in terms of dissemination, we aim to present BIOTEKNICA both within Canada and internationally with a series of exhibitions, lectures, conference presentations, and print and web based publications.

BIOTEKNICA | PHASE III: ORGANIC TISSUE PROTOTYPES | SPECIFICATIONS

We are proposing a series of six three-dimensional prototypes that possesses some likeness and qualities with our virtual specimens modeled on the teratoma. We see these prototypes as organic sculptures that could be exhibited in Perth, and possibly in Montreal at a McGill University or Concordia University laboratory venues. In addition to the exhibition of the prototypes, we intend to present photographic and video representation of the laboratory procedures and resulting prototypes in the gallery context, as well as web and CDROM dissemination. All forms of dissemination will overtly acknowledge the collaborative contribution of Symbiotica and The University of Western Australia and other supporting institutions.

Prototype Attributes:

1) Our prototypes will exist in three dimensions

2) They will possess a permanent (non-degradable) internal three-dimensional structure. This structure will be based on scans of Willet and Bailey's bodies, then digitally altered, manipulated and mutated, and output as a three dimensional rapid prototypes. We

project these structures could be made of Poly HEMA hydrogel - the same material Symbiotica used in "The Stone Age of Biology" artwork.

4) We are proposing the growth of human skin tissue. We propose to use tissues donated by Shawn Bailey with the intention of growing both within the framework of the scaffold structure.

BIOTEKNICA | ORGANIC TISSUE PROTOTYPES | PROCESS

With BIOTEKNICA Organic Tissue Prototypes we are proposing a dynamic and alternative use of advanced imaging technologies, 3D rapid prototyping, and tissue engineering technologies. To complete this phase we will first compile three-dimensional scans of both Willet's and Bailey's bodies. These scans will be manipulated in AutoCAD to create the structural dimensions of each of the six organic prototypes. These structures will then be outsourced as three-dimensional prototypes in a non-biodegradable material called Poly HEMA hydrogel. This will serve as the dense inner structure for our prototypes.

At this point Shawn Bailey will undergo a shaved skin biopsy with a certified plastic surgeon. The biopsy will be processed in the laboratory where we will isolate a number of uncontaminated cells, and proliferate them in the laboratory setting through the passaging process. These cells will then be placed in the three-dimensional scaffolds and chemically treated to induce prolonged cellular division. This entire process will be executed under the supervision of scientists and technicians at the SymbioticA Laboratories.

The tissue engineering processes involved in our project are very safe, and extremely commonplace in contemporary bioscience circles. The cultivation of human tissue cells has been an ongoing scientific and medical activity for over thirty years. Related processes are taught as cellular biology curriculum in institutions worldwide. What makes BIOTEKNICA's prototypes significant is the use of such technologies in the production of art, and the critical demystification of specialized scientific practices in the public sphere. In the last eight years, several international artists have worked with SymbioticA in this capacity.

At all stages of production we will be documenting the laboratory processes with digital microscopic photography, and digital video with the intention of producing a series of oversized digital prints, a documentary video and an intensive website programmed in multimedia authoring software.

BIOTEKNICA | PHASE III: ORGANIC TISSUE PROTOTYPES | SIGNIFIGANCE

We see the proposed BIOTEKNICA Organic Prototypes as engaging in several critical social and theoretical terrains. These include: redefining notions of self/other, reproduction, representation, gender and genetic identity, self-experimentation, reality and the virtual, ethics and the biosciences, and interdisciplinary – or cross specialization in contemporary research. Upon completion, the BIOTEKNICA Organic Prototypes will

be presented in conjunction with a series of papers and presentations providing a complex analytic context for interpretation.

Symbiotica is of particular interest to us as a venue where non-scientists can enter the laboratory and contribute intellectually to the application of contemporary tissue engineering technologies. BIOTEKNICA is directly concerned with creating a site for non-specialists to participate in (virtual) scientific investigations. To bring BIOTEKNICA researchers – and thus BIOTEKNICA content – into a functional laboratory will only heighten our original intentions with this project.

BIOTEKNICA | ORGANIC TISSUE PROTOTYPES | ETHICAL ISSUES

Contemporary Art offers a multitude of subjective narratives, often representing disenfranchised viewpoints or uncomfortable truths that are given public voice. In art, compelling social issues become public and contribute to a shared community, political discourse, and cultural dialogue where they did not exist before. Artwork that is compelling, provocative and controversial is a necessary condition for the play of individual subjectivity in a postmodern society whose laws and mores are increasingly focused on capital exchange to the exclusion of non-privileged members of society. BIOTEKNICA explores notions of reproduction, transformation and self/other distinctions in conjunction with recent biotechnological developments. Our project is founded in an exploration of the relationships between aesthetics and ethics. BIOTEKNICA research is a timely meditation on the ultimate fragility of the natural body.

BIOTEKNICA is a unique artistic endeavor in that it requires ethical approval from both Universities on the grounds that it utilizes human biological products in its creation. We will be integrating the ethical exploration inherent in our project, as well as our publishing and dissemination programme in order to raise and address critical issues surrounding contemporary biotechnologies in the realm of non-specialists. All relevant Ethical approval by Concordia University will be sought and confirmed prior to the use of any human tissues. The University of Western Australia has already approved similar projects within the SymbioticA Research Group, and has offered to approve our project under a larger umbrella application. It is absolutely essential that our proposed programme is scrutinized and found to be consistent with standardized scientific approaches, and contributes to the emerging definition and debate concerning art-science research in Canada and abroad.

BIOTEKNICA conforms to all scientific protocols and international laws related to our project. Licensed specialists in the field will train us in established laboratory protocol and supervise the research. The organic structures that we create will lack a functional nervous and immune system. They are not cognitive or aware on any level, whatsoever. The structures that we grow in the laboratory are less complex on a structural level than simple plant or fungal life forms. They are self-contained, and removal from the very specialized environment they are grown in, results in immediate destruction of the fragile artwork. They can only be exhibited in laboratory environments. Ironically, it is the gallery-goers who actually present the real risk of contamination and destruction to the extremely delicate artwork.

Shawn Bailey has volunteered to donate a sample of his own tissue to the BIOTEKNICA Project, and will be submitted to the SymbioticA Organic Tissue Database for future

art/science research purposes. The donation on our part is entirely voluntary and involves very minor surgical procedure (skin tissue samples). In no way would we be denied access to the SymbioticA facilities, if we chose not to make a contribution. This procedure is minimally invasive and carried out by medical professionals. All protocols will be conducted in accord with level 2 safety and under supervision, and medical advice will be sought if necessary after the biopsy. Cultures will be maintained and documented but following the research they will be fixed or frozen (according to existing cryogenic protocols) and archived for documentation purposes.

Additionally, all other biological materials (i.e. Fetal Bovine Syrum) used in our project are recycled from external approved scientific experiments occurring at the department of Anatomy and Medicine at the University of Western Australia.

BIOTEKNICA | ORGANIC TISSUE PROTOTYPES | INNOVATION

BioArt and GeneArt is an emerging field of contemporary art production where the artistic media is organic cell structures, and where the boundaries between art and science are permanently blurred. In April 2003, we presented BIOTEKNICA at *The European Media Art Festival* congress (which was entirely dedicated to BioArt practices) where we met some of the most successful and provocative contemporary BioArtists including: Eduardo Kac (Chicago Art Institute), Joe Davis (MIT Media Lab), and the SymbioticA Research Group (University of Western Australia). There is a very pressing need for artists to engage innovative new technologies. Contemporary technological evolution is often dependant upon the potential for commercial development, particularly with expensive new technologies whose ethical and cultural application is uncertain. Artists are increasingly the leaders in exploring new technologies, and creating social and cultural discourses around their application. BIOTEKNICA mobilizes an array of specialized technologies (both biological and computational) for purposes, which they were not originally intended. It creates a site for cross-disciplinary communication between artists, new media specialists, and scientists – spanning international borders and making connections between several reputable universities and research centers.