Amateurity and Biotechnology

This publication could not go to press without addressing the alarming events surrounding the prosecution of activist, artist and Critical Art Ensemble (CAE) co-founder Steve Kurtz. The trials of this man, perhaps the most influential non-scientist working with biotechnology, challenges the raison d'etre of all.

This saga began shortly after he called 911 for help. Kurtz's wife, and CAE co-founder Hope Kurtz had suffered heart failure. The paramedics and firemen attending the call became suspicious when they noticed that he had BIOLOGICAL AGENTS IN HIS HOME!! They reported their concern to the FBI who promptly closed down the entire block, cordoned off the house, entered and seized a substantial amount of the artist's work and research material. The material seized posed no public safety risk, the Federal Bureau of Investigation nevertheless continued with their investigation under the US Biological Weapons Anti-Terrorism Act as expanded by the USA PATRIOT Act, specifically SEC 817 EXPANSION OF THE BIOLOICAL WEAPONS STATUTE (H.R.. 3162)

> *"Whoever knowingly possesses any biological agent, toxin, or delivery system of a type or in a quantity that, under the circumstances, is not reasonably justified by a prophylactic, protective, bona fide research, or other peaceful purpose, shall be fined under this title, imprisoned not more than 10 years, or both. In this subsection, the term "biological agent" and toxin do not encompass any biological agent that is in its naturally occurring environment, if the biological agent or toxin has not been cultivated, collected, or otherwise extracted from its natural source."*

At an opening at the museum MASSMoCA, where CAE were to have opened an exhibit, Kurtz was subpoenaed to appear before a Grand Jury. Subpoenas were also issued to his CAE colleagues (Beatriz da Costa, Steve Barnes, and Paul Vanouse), friends, other academics and even his publisher, Autonomedia. The FBI tried to obtain records of all purchases of CAE publications.

Kurtz, and colleague Dr. Robert Ferrell, Professor of Genetics at the University of Pittsburgh, who was indicted along with Kurtz, were charged not with bioterrorism but with four counts of mail and wire fraud (United States Criminal Code, Title 18, United States Code, Sections 1341 and 1343), which each carry a maximum sentence of 20 years in prison. These laws are normally used against those defrauding others of money or property, as in telemarketing schemes, but in this case were used because Ferrell transferred material he purchased. The 'defrauded' university of Pittsburg is not pressing any charges because this practice of sharing biological material is the basis of normal research activity, and absolutely ubiquitous. Is this a problem? No, it is the basis of productive research, it is as fundamental to research as citing others work. In some of the kits Biotech hobbyists undertake you may also have to find a way to acquire materials that will require you register as a lab. You will need to go about this in exactly the manner Kurtz did, by asking someone with a registered lab.You will need to discuss with them why you need the materials, what you are investigating and why, and if you can get them interested they will assist. This is peer review, and is the basic mechanism of knowledge production. Ferrell assisted Kurtz because he thought the work valuable and wanted to see it happen.

Sharing resources including bactreria, skin cultures is a fundamental part of all academic and nonacademic collaboration. The trial date for Kurtz and Ferrell is not yet set. Further details of the case, press coverage and the full text of the indictment can be found at: **http://www.caedefensefund.org/**

The prosecutors' actions were not initiated because of what the specific biological agents were – they were harmless and this was almost immediately verified. Nor were they initiated by what he was doing with them – Kurtz's 20 year art practice is documented in several books and many catalogs. The proceedings began because Kurtz had biological agents IN HIS HOME!! If the same substances had been in his lab or academic office these events would never have unfolded. Nonetheless it remains difficult to make sense of why they continue.

the home of autonomy

The *Biotech Hobbyist* publications and project invite you to take biotech material, experiments and inquiry into the unsupervised autonomy of your home. Kurtz's case suggests that this risks the suspicion of bioterrorism. Being a biotech hobbyist bears a chilling similarity to being labeled a pinko, if only in the pervasive misunderstanding that has surrounded both communism and biotechtechnolgy?

Why is technical exploration at home seen as so threatening?

Why are we encouraging and promoting DIY biotech? Or the complimentary question: how does playing with biological material become suspicious, criminalized and blurred into terrorism?

Kurtz FAQ

Let's answer these questions with more questions. Below is a list of FAQ's I have summarized from fielding press interviews on the Kurtz case. These questions are listed in approximate order of their frequency along with some of the answers I have returned.

Why did Kurtz have biological agents in his home?

Critical Art Ensemble (CAE) projects repeatedly deal with biological agents. Steve Kurtz is perhaps the most respected of an international group of artists working with biological materials. CAE's current work could be characterized as being generally concerned with public understanding of biotechnology, addressing the following questions:

- How can we provoke informed public debate on the risks, legislation and political questions surrounding biotech? For instance CAE have done a number of projects that demonstrate how the American public is systematically uninformed, making visible the concerns and risks posed from GMO substances.
- Are the risks of biotech known or ascertained?
- How and by whom are these risks publicized?
- What input do we have with respect to political decisions made regarding biotechtechnolgy, i.e. has anyone done international comparisons of legislation and its effect on biotech markets and risks?

These questions are both consistent with academic lines of enquiry and reflective of public concerns. Francis Fukuyama, a member of the current President's bioethics committee has taken a similar pro legislation, and pro participatory political stance suggesting that CAE is part of a bipartisan consensus.

What specifically was Kurtz using biological materials for?

One example of CAE's recent project's, involved Kurtz drinking beer which he had brewed using modified yeast (spliced with human Microchondrial DNA)

Cult of the new eve: **http://www.critical-art.net/biotech/cone/coneWeb/**

Are these agents dangerous?

No, the specific substances the hearings have focused on, Serratia marcescens and Bacillus globigii, can be easily obtained at the following websites: Serratia marcescens can even be ordered from a children's science kit supplies site:
http://sciencekit.com/search.asp?t=ss&ss=Serratia+marcescens&sid=OvertureB&eid=OvtB0291

Both organisms are routinely used in biological experiments because they are deemed to be harmless, and are marketed to children although a school registration number is required.

The other can be retrieved from
http://www.atcc.org/SearchCatalogs/Bacteria.cfm. atcc #31028,49760,49822.;

On reading the charges against Steve Kurtz, Ellen Alexander Conley, who has herself previously worked in a pathology lab, remarked that she would send Serratia Valentine's Day cards to her friends because Serratia marcescens has a lovely red color. Another year she used cutouts from EKG paper readings. We have asked her to revamp her kit.

Rescheduling valentine for Kurtz: spreading some love.

A spontaneous kit produced by Ellen Alexander Conley on reading that the biological agents of most concern to the prosecution in the Kurtz case were exactly the bacteria she had used to send Valentine Petri dishes.

From: Ellen Alexander Conley Elalconley@aol.com
Subject: **Re: "BIOTERRORISM" DOWNGRADED TO PETTY THEFT IN FBI EMBARRASSMENT**
Date: July 2, 2004 1:05:42 PM EDT
To: natalie.jeremijenko@yale.edu

Ellen: can you write out the instructions? I think we should reschedule Valentines, and send ìWe love you Kurtzî Serratia Petri dishes around Ö.

make or buy beef
or chicken agar plates. † Heat metal loop to
sterilize it and cool it in agar and then dip into bact.
colony and streak the plate. You could use a wire with
a very tiny loop on the end.†
Make hearts, or star, flag too complicated unless you
did serratia (red) and staphylococcus albus (white).
† Staph albus used to be nonpathogenic but I have
not looked it up recently. I will do it after I write this.
† Put streaked plate in warm spot between 95
and 98 degrees -- any hotter will kill the
bacteria.† Shade on window sill
should be good but not direct
sun. (warm but not hot).
24 to 36 hours
should show
visual
design.
†

From: Elalconley@aol.com
Subject: **(no subject)**
Date: July 2, 2004 1:11:21 PM EDT
To: natalie.jeremijenko@yale.edu

Any†bacteria that is in a supposedly sterile place can be bad but it still is pretty safe outside of the operating room.

Ellen

SHORT INFORMATION ON BACTERIA

Skin bacteria:

Staphylococcus albus (the white Staphylococcus) is spherical bacteria forming clusters. From that characteristic comes the name (Staphyle - Greek for a bunch of grapes). S albus is the most frequent skin bacteria. It has been considered an innocent partner living on the skin surface of all of us and it has been found in about 30 % of all clean orthopedic operation wounds- all of these wounds healed without complications. This friendly coexistence between the people and the white Staphylococcus changed with the advent of total hip operations.

When Staphylococcus albus colonizes the surfaces of total joints, it changes from doctor Jekyll to doctor Hyde. Once fixed to the surface of the total joint prosthesis, S. albus develops a slime cover and changes its characteristics: it develops resistance to antibiotics and causes slow, indolent infections around total joints.

If Kurtz could obtain this material, couldn't any terrorist do the same?

Kurtz obtained the material through the most secure and accountable route known to researchers; the trusted network of scientists who often transfer materials amongst colleagues. I have personally done many times what Kurtz and Ferrell are charged with, and I know that this method is more secure than entering a number in a website.

Can these agents be weaponized?

Yes. Yes, they probably could be weaponized (although bioweaponization is hard to define, and there is no blueprint for it – natural systems are generally less controllable than mechanical ones, such as a bomb) biological agents in your throat pose an equal potential to be weaponized, though probably less effectively. The real question is, what would take to weaponize them? The answer to that in short, is that it would take a large corporate and/or military lab with multi-year directed research. An academic lab is unlikely to be able to support multi year funding of such an application, simply because there are not enough research papers written about weaponizing. Such research has historically been, and continues to be, restricted to the federal military funding stream.

All biological agents to date have been developed entirely through resource rich federally funded programs. Therefore, both the history of biological weapons and common sense confer that Kurtz is the wrong person to suspect of weaponizing biological materials. Moreover, academic scientists are also structurally unsuited to weaponization, although they are more resource rich than an artist or hobbyist. In faculty positions, publishing imperatives make it difficult to dedicate resources and time to unpublishable pursuits; weaponization; peer-accountability; transparency to students in addition to the general political climate of the academy. In summation, weaponization is a line of enquiry that is only practical to pursue in corporate and military research facilities.

Take Home Message

When Heath Bunting and I first launched Biotech Hobbyist in 1998, the specific concern was not focused on bioterrorism, but lay in the unknown effects posed by the widespread release of genetically modified organisms into our shared environment, the tremendous corporate investment in biotech, the lack of public participation in the decisions that affect our biotechnological future, and other effects like the corporatization of the university lab: see Skin Kit.

But what struck me most was how different the public discourse surrounding genetic technologies was from academic conversations on the same subject. Other people noticed this phenomenon too: Conrad[1] cheerily described this mismatch as 'genetic optimism' on the part of the public, basing his diagnosis on a systematic and extensive media analysis of popular press publications.

Genetic optimism, in the area of behavioral genetics, for example is both exemplified by the appearance of page one stories proclaiming the discovery of the gene for 'x' Where 'x' is some complex syndrome, condition or characteristic such as alcoholism, homosexuality, depression, schizophrenia, violence, intelligence, thrill seeking, manic-depression, obesity or promiscuity. The 'discovery' of the gene for alcoholism has been reported on page one three times since 1980. The refutations, retractions and disconfirmations that follow these 'discoveries' in the expert literature and are rarely if ever covered and never make it to page on. This means that the number of gene based findings are skewed to the extent that the public develops a false sense of continuous genetic discovery. These stories also promote the OGOD (one gene one disease) idea, which raises cultural expectations that cures are imminent. For example, although Huntington's disease was genetically characterized years ago, it has not yet led to any useful form of therapy and most of those at high risk of developing the disease do not take the prescribed test.

1 Genetic optimism: framing genes and mental illness in the news, Conrad, P.
Department of Sociology, Brandeis University, Waltham, MA 02454-9110, USA. conrad@brandeis.edu
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?holding=npg&cmd=Retrieve&db=PubMed&list_uids=11453260&dopt=Abstract

Here is a test that that you can do at home: Lets call it the genetic optimism probe. Ask several friends if they know about any association between XYY syndrome and criminal behavior. Make it a significant sample of at least 10 people (though not at the same time, just introduce it into conversation). They may say, "sure", which would be understandable given that NYPD Blue and LA Law both have screened episodes featuring criminals with this syndrome. Or your friends may say "no", pointing out this association was disproved over 15 years ago. Go to biotechhobbyist/geneticoptimism to upload your results and see how your social network compares to mine, which is so far 29 genetic optimists (sures), 2 genetic oblivious (never heard of it); 0 genetically informed (nos).

One of the consequences of this pervasive genetic story is that we begin to see ourselves as isolated lumps of biology. That is, internal environmental interactions (what happens inside you, between your genes and the proteins they encode) are privileged over interactions occurring between the internal and external environments (what effect the environment has on your genes and proteins): nothing suggests this asymmetry is fruitful. Actually history suggests that the reverse bias is more useful, especially if you are interested in the general health and well being of a majority of the population (rather than extending life for the rich). A recent comparison of the health benefits of public sector policy in a thorough quantitative report[2] showed that just the influence of clean water was responsible for 3/4 reduction in infant mortality; 2/3rds of child mortality reduction, and 1/2 of all mortality reduction; that the social rate of return of this technology(water filtration and chlorination) was 23 to 1. By contrast genetic research, although it attracts large investments has not yet had any measurable positive effect on public health despite the 'genetic optimism' it has fuelled. In general, comparisons in the rate of return of 'silver bullet' research with public health and environmental strategies would suggest that we should invest much more heavily in the later, if measured in terms of social value (measurable public health effects) rather than the creation of private wealth.

Here is another test you can conduct to determine the extent of the bias in health research favoring internal physiological factors over the impact of external environmental ones. Breast cancer research is a complicated field that investigates both environmental and genetic factors. However, the media do not give environmental and genetic causes an equal degree of coverage. A search on any media archive for articles on the association of breast cancers with either genetic or environmental factors reveals a distinct bias in the amount of press attention given to genetic as opposed to environmental factors. Box 1 shows a search carried out on the New York Times, which lends almost double the print space to genetic causes than allowed to environmental factors. These results are extraordinary when you consider that only 4% to 5% of all reported breast cancers are associated with BRCA 1 and 2 genes.

Search on Lexis Nexis.
New York Times Past 10 years.
Headline and lead paragraphs.

breast cancer AND genes AND NOT environment: 120
breast cancer AND environment AND NOT genes: 78
breast cancer AND environment AND genes: 5

breast cancer AND genetic AND NOT environmental: 124
breast cancer AND environmental AND NOT genetic: 70
breast cancer AND environmental AND genetic: 9

breast cancer AND genes AND NOT environmental: 121
breast cancer AND environmental AND NOT genes: 75
breast cancer AND environmental AND genes: 4

It you are interested in seeing how your regional media compare with this example, try this experiment yourself using several similar terms. You can upload your results, and see the results of others at the biotechhobbyist/abreast .

2 The Role of Public Health improvements in Health Advances: The 20th Century United States, Cutler, David M, Miller, G, NBER Working Paper No w10511, issued May 4004.

'Geneticization' is a new diagnostic term which carries a similar meaning to medicalization. While 'medicalization' means to identify biological systems as the root cause of a nuanced condition such as obesity or anxiety, geneticization' takes the trend one step further, claiming that characteristics such as homosexuality are fundamentally genetic in origin. Geneticization can work both ways: while it can lift the onus of a person's condition ('It's not my fault I am overweight, I'm genetically predisposed to obesity'), it can also promote fatalism. After all, what can one do about one's genes except wait for scientists to develop genetic therapies?

Genetic Fatalism

The Biotech Hobbyist has a different approach to this fatalistic genetic optimism. Lets take something like depression and anxiety medication – which is seen as the poster child success story of the silver bullet approach of the pharmaceutical industry. Medication for depression and anxiety is usually prescribed alone or in combination with counselling; psychiatrists rarely suggest that it be augmented by self-help groups, church membership or social support. Of course it need not work this way. Look at the relative funding models for marketing drugs, and marketing AA. One approach wrought with problems is to look at the heritability of depressive and anxiety disorders. In New York, up to 2 out of 3 adults are prescribed antidepressants. Because these drugs remain biologically active when they leave the body, the water supply is inevitably contaminated with these chemicals and it therefore enters the surrounding ecosystem. So now it appears that those fish in the Hudson which have been slowly recovering from PCB contamination have now absorbed high levels of SRI's, as have the birds who eat the fish. In fact, everything and everybody in Manhattan is on antidepressants. So if you are too, you have plenty of company. Is this reassuring to know? See 'Ectotoxicity of Antidepressants: Literature Search,' page 19.

Acting Up Acting Out

Steve Epstein describes in *Impure Science* how ACT UP activists in the 1980's, knowing that some HIV patients were on placebos rather than experimental medications during drug trails, pooled all the pills together and redistributed them amongst the patients to increase the potential that were taking the actual drug and not the placebo. This increased their confidence in the effacy of the drugs – because everyone knew that they were taking the trial drugs at least part of the time, the trials were more successful and more patients showed signs of improvement. and the effectiveness of the trials. However, because doctors were unable to determine which of the patients had reacted positively as a direct result of the pharmaceuticals, and which were responding to the placebo it was to distinguish the signal from the noise. Playing on the patients ignorance, the presumption of single blind experiments, is less effective than playing on the doctors ignorance too, i.e. double blind. Both parties need to believe that it might help... But if all parties know, blindly double blind.

The point is that public health decisions that are many and various are being made in favor of the research efforts that are dominated by corporate interests.

How does bringing biological agents into your home help anything?

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

Now, more than ever, in a context where the fear of bioterrorism threatens to overwhelm any considered response and responsible political decision; now when a person – who on the death of his wife – can have his books, computers and research material seized (at best an overreaction) and then after reasonable investigation a witch hunt can ensue... Now it is critically important to demonstrate that the understanding of complex biology is not, and should not be dominated by the military, terrorists, or corporate interests.

Among the just concerns and the fearful paranoia surrounding the insidious "war on terrorism", it is crucially important to decouple biological and military concerns. There is a simple conceptual mistake that we can all make, particularly if we are non-expert. It goes like this:

> because the military funds research on biological weapons and in biology (not so much), biology is therefore a weapon, or a military threat. However, military interest in biology is a highly particular, partial and in fact very peculiar way to conceive of the unimaginably vast biological spectrum of forms, ecological relationships and complex interelationships of life.

The only weapon with which the biotech hobbyist arms his/herself is the tremendous diveristy of their interests; from propogating African violets, to growing human skin, to... well only you can imagine.

The military may have biological weapons but civil society has biotech hobbyists and their weird pursuits and diverse quixotic charm. I know which one I find more interesting.

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 thru marriage and immigration laws and our performances in our 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.

Democracies depend on transparency and public oversight. If biotechnolgy is going to inhabit the political stage and play a leading role in local and global politics then we desperately need the transparency that biotech hobbyists can offer. We need people who are comfortable with the terms and processes involved, we need more Ellen's who can tell their story about sending Valentine's Day petri dishes made with the same materials that the ongoing persecution of Kurtz is based.

*Corporate research conversely has tended to emphasize the later, which I will leave to you to speculate on why

The genetic modification of organisms is something in which we are all involved, by choosing the orchids we think are pretty, and the tomatoes we prefer at the supermarket we are naturally selecting. But it is the Biotech Hobbyists that offer a response to those involved in the biotech industry, to those who are motivated by their professional and monetary interests, those who are protecting their investments. Truth claims made by a laboratory have a truth value that draws on the stuff they describe, a material authority. In the studies of scientific knowledge production it is well known that the only way to challenge the findings and truth claims made by a lab is with another lab. You can't argue against them on the basis of just an argument, nor can you call on a higher authority, you can only point to the stuff itself.

But it is not expertise we are developing here, it is ideas about public goods and what is good for the public. These concerns do not necessarily coincide with the interests of a community of expertise. Biotech Hobbyists are opensourcing biotechnology.

Why did Kurtz have biological materials in his home?

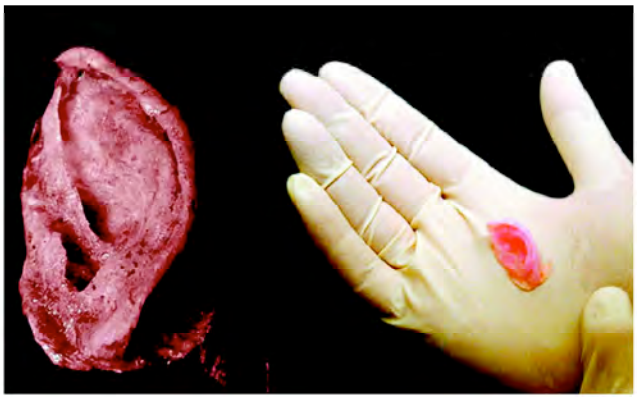
Artists, even those that work primarily in biotech, do not actually have labs, which are expensive. One reason for this we might highlight is that a large commission in the arts is $4000, where as NSF and NIH grants average $400000 and $4000000 respectfully.

But Steve Kurtz is not alone. He is perhaps the most highly respected representative of a large and rapidly growing community of biotech hobbyists. Here is an interesting indicator of the size of the biotech hobbyist field: so many people have accessed the Biotech Hobbyist website that a porn site bought the domain name when we let it lapse. This is why you are directed straight to a porn site when you try to access the URL **www.biotechhobbyist.com**

A brief overview of non-scientists working with Biotech: or, who would trust an artist with biotechnology.

Kurtz is part of a burgeoning movement of artists, activists and scientists playing around with biotechnology for non-commercial purposes. Is there room for such a field? Should bioart be controlled or regulated? In showing some of the practices and projects within bioart I hope to enable an educated assessment to be made of this ethical question; do bioartists pose a threat?

I have about 20 biotechnology art catalogs on my shelf; these represent but a fraction of the total number of bioart shows. The genre is by no means unified, 'bioart' is an umbrella term for a diverse group of practitioners largely united by the fact that they have dubious credentials and no business in biotech. This fact makes them unique in the biotech realm, which is largely directed by corporate interests. Financial independence from the biotechnology world means that these artists have no conflicts of interest. No other group in biotechnology can boast this qualification, not the investors, nor most of the academics, not the members of the boards of companies, nor lobbyists, and of course not those directly employed by huge pharmaceutical companies. Troy Duster, who sits on several committees as a social scientist, and as a person of color, quips that the conflict of interest in the proceedings that go on before a hearing take much longer than the hearings themselves. Impartiality is a precious commodity in the biotech world and one possessed primarily by a small group of artists.



Explorations in Body, Beauty and Beyond

The elder statesmen of the field include Stelarc, Joe Davis and Orlan. Stelarc is currently growing a human ear on his hand having previously mastered the ability to write with his third (robotic) arm, and hung himself by fishing hooks over the streets of Tokyo. His explorations test the limits of his body; he says they test "the Body" in his capacity to represent all humans (although some of us would quibble with this), and is profoundly committed to the popular idea that we can bravely transcend biological constraints.

Joe Davis makes often hilarious work that continues the larger themes of art in a drastically different media: he has transmitted the sounds of vaginal contractions (aka orgasms) into space. And why not? This is a form of communication probably just as interesting to extraterrestrials as encoded human language. He has also inscribed the image of a vagina into e. coli, in his project "microvenus". He also writes genetic code onto fence posts, and other unlikely contexts. And he probably reads more scientific literature than any scientist I know. He talks with scientists, challenging them to explain the strange phenomena he makes it his job to explore.

Orlan, in her inimitable way, also investigates these same ideas: that the biology we have been given is not inevitable, but plastic. Her plastic surgical performances entirely transformed the genetic deck she was dealt, using standard techniques and exposing their lovely gore. Her visceral and daily performances demonstrate the very cultural determinism that is left out of most biology classes. She shows that the extent of the categorical separation between biology and culture is constantly being reinvented.

Popularly we understand that genes encode our biology, but these artists demonstrate that culture can have tremendous biological effects as well. George Gessert examines cultural manipulations of the genome by hybridizing and selectively breeding ornamental plants. He exposes the logic behind the evolutionary process of natural selection by explaining the reasons he chooses to breed his plants in certain ways. Gessert asserts that his judgments are as natural as the orchards that he designs. The notes he scribbles on cards about the symmetry, color, and other formal characteristics look like the complex vagaries of evolution, next to the photographs of his hybridized flowers. What is beautiful for orchards? Gessert shows that there is no clear hierarchy, but rather complex, changing, and nuanced decisions.

Oron, Catts and Ionat Zurr represent a new generation of bioartists. As founding members of the Tissue Culture and Art Project they manufacture/ create semi-living objects which have become lightening rods for the discussion of the biotechnological boundary between animate and inanimate, technical and biological, natural and artificial. Pigs wings, worry dolls, frog steaks. Currently they are making a coat made of "victimless leather" grown from immortalized cell lines. They encourage audience participation in their biotechnological experiments, going so far as to bring their lab into museums and galleries. In their Disembodied Cuisine Project, they showed their audience how to harvest tissue from living frogs in order to make frog steaks without killing any frogs The feasibility of their bio-products, rather than their extreme nature, is what incites so many people to discuss the future of biotechnology with them.

Adam Zaretsy, also takes the lab into the gallery, but he uses a different strategy, than Oron and Ionat, exploiting the comedic aspects of biotechnology in his work. He has lived in a lab with other model organisms, such as arabidopsis and fruit flies. He has grown skin over his nostril and then sneezed it off. In one project, he hybridized sado-masochistic images with organic farming collectives, showing pictures of dogs having sex with pigs and enjoying with you the weird unpredictable hilarity of natural systems.

Brandon Ballengée also documents the strange diversity of nature. He collects specimens, not from exotic places, but rather from the South Street Fish Market, where he found many unidentified species trolled in the nets In his Species Reclamation project, Ballengée selectively breeds one frog species in an attempt to reclaim some traits of, an already extinct frog species. There is something mournful in his careful attentiveness to an already lost cause, as he tries to patch over a hole in the Congan ecosystem, attempting to repair the damage others have done.

Another work which examines collective loss and cultural mourning is Rachel Berwick's "May-por-e" In this project, Berwick, in collaboration with two linguists and a bird behaviorist, teaches two parrots to 'speak' an extinct South American language once spoken by a decimated tribe. She has followed and documented Lonely X, the last surviving member of his species who is waiting to die and take the collective wisdom and millennial history of his biology with him. In doing so, Berwick makes palpable the lost value of irreplaceable entities such as species, cultures, and languages, and draws attention to the inadequacy of salvage operations such as the Human Genome Diversity Project.

Artists exploring Distopia

There are two closely related categories of artists working with biotechnology: the Dystopics and the Inevitables. The Inevitables include Eduardo Kac, who is famous for his affection for a rabbit genetically transformed to express a green fluorescent protein derived from a jellyfish. His view is that transgenic animals are inevitable (and in fact are already part of our ecosystem), and that to understand the cultural implications and historical significance of transgenic organisms we must welcome a genetically engineered rabbit into our homes. He volunteered his own home for this grand social experiment, in fact. However, the French scientist who developed the technique and the rabbit in question was not willing to hand it over. Kac had little choice in the matter: he was forced to be satisfied with living with his rabbit for one week in a French art gallery. In reproduced images, Kac exaggerates the image of the bunny, photoshopping a white rabbit to appear an intense green [the color amplified to appear greener than physically possible even in the Pacific jellyfish itself]. Reproductions of the Photo of Kac's violently green rabbit have appeared in newspapers, on gallery walls, and in advertisements all around the world, and have no doubt contributed to the exaggerated public notions of transgenic animals. His media ploy has been a tremendous success; the cultural anxiety that he was illustrating in this project has been exposed in many, many articles.

The Berkeley ecologist Ignacio Chapela pointed out this stunt, stating that the rabbit photograph was photoshopped and explaining that creatures cannot have green corneas. Chapela did not make this point to rain on Kac's parade, but rather to argue that green fluorescing rabbit pets are not inevitable. By pointing this out Chapela shows that: a) the press doesn't care about the veracity of an image, a simulated one is better if it is more sensational; and b) the French scientist's refusal to give Kac the rabbit in question is an example of this very phenomenon. GloFishTM, a genetically modified fish which appears red in regular light and fluoresces under ultraviolet lights; it created by injecting genes from sea coral into zebra-fish eggs, and has been on sale for a couple of years [Yorktown Technologies LP in Texas]. Similar fish, but with different genes for bioluminescence have been sold in Taiwan as well: a look at the website reveals the tremendous effort that the companies have taken to reassure potential purchasers that these fish do not pose environmental hazards. The concern that these genetically modified fish will enter the environment seems unfounded when one considers that other zebra fish have been sold as ornamental fish for years without ever establishing themselves in the wild. Despite the fact that these fish were genetically engineered for their dramatic coloring, the fish in question are rather less brilliant than those produced by traditional selective breeding.

The New York-based artist Alexis Rockman is an example of the Dystopic school of bioartists. He paints gruesome images of genetic dystopias. One painting that appeared on billboards around Manhattan includes square cows, three-winged chickens, and pigs with spare livers, all depicted in his illustrated children's encyclopedia style. While these may be warnings to the public, they also radically overestimate the control we have over biological systems. He paints organisms that cannot feasibly be produced or physically created, producing a delusion of comprehensive genetic knowledge and control. It is what we do not know that is truly risky. These images have the opposite effect of their intended shock-and-awe tactic; by contrast actual images of genetically engineered organisms look banal (for instance the genetic contamination of maize by a genetically modified corn crop in Oaxaca, México). Potentially such images of lurid dystopias have the capacity to alert people to actual issues raised by biotechnology, such as the lack of control we have over GMOs, while at the same time promulgating a false sense that the associated ethical issues are being carefully considered.

The dystopia of biotechnology is not only tremendously mediagenic but also potentially mutagenic.

Figure 1: This is the adapted poster for the Paradise Now exhibition, an exhibition of 39 artists working with genetic representation, Exit Art, NY 2000. The poster image is by Alexis Rockman, and was originally entitled Paradise Now, however I re-issued this poster after investigations with Jacqueline Stevens that found that the celebratory tenor of the curatorial position, and the uncited claims throughout the exhibition touting the success and benefits of biotechnology, may have reflected the interests of the exhibit's hidden funder: the Joy of Giving Something Foundation, aka Howard Stein, a wealthy individual who is heavily invested in biotechnology. Jacqueline Stevens found evidence that the PR firm handling this exhibition, had an explicit strategy to use museums to "avoid the hysteria surrounding GMOs seen in Europe", to manipulate the media coverage via the art world. The names of the artists are replaced with the names of the Biotech corporations represented by the PR firm, Noonan Russo.

But finally, it is harder for the dystopics and the Inevitables to be stranger than the scientists themselves. Think for instance of Chris Somerville's idea to engineer plants to manufacture plastic. Somerville's research is even more interesting and disturbing because it cannot be trivialized like the work of the bioartists can. He has a good argument with respect to positive aspects proposed by a plant that produces plastic: it would be both environmentally biodegradeable and highly efficient. However, does the need to reduce manufacturing pollutants outweigh the potential risks of reengineering this system? These are powerful ideas that have potential industrial applications. Ultimately, the strange fictions and fabrications of artists and scientists can become hopelessly confused in the complexities of producing the future.

Honorary BhDs

In addition to artists there are scientists who have entered the public eye and received a level of attention typically eschewed by scientists and envied by artists. While science journalists usually endeavor to respectfully and clearly translate scientific findings into lay terms, there are times when journalists are used to arbitrate scientific controversies, which are normally settled by the peer review process.

These scientists are often demoted, and their credibility as experts is challenged in a manner all too familiar to artists dealing with science. I have nominated the following scientists to receive honorary amateur degrees (Biotechhobbyist Demotions).

Arpad Pusztai was a consultant for the Norwegian Food Sciences Institute and had been the Principal Scientific Officer at the Rowett Institute, Aberdeen, Scotland. He found cytological and histological damage to rodents fed with transgenically-modified potatoes. Shortly after Dr. Pusztai reported his findings he was fired from the position he had held for 30 years at the Rowett Institute. His home was broken into, his research files were seized and a major discreditation campaign ensued.

Further references:
http://plab.ku.dk/tcbh/Pusztaitcbh.htm; http://www.psrast.org/pusztai.htm

John Losey is an Associate Professor of Entomology at Cornell University. He discovered consistent damage and premature death in Monarch butterfly caterpillars fed pollen from genetically-modified corn. Although his academic institution supported him, subsequent research targeted at discrediting his discoveries was systematically promoted and an associated media campaign against Losey was unleashed.

Further references:
http://www.sciencenews.org/sn_arc99/5_22_99/fob1.htm
http://www.news.cornell.edu/releases/May99/Butterflies.bpf.html

Tyrone Hayes is an Associate Professor in the Department of Integrative Biology at UC Berkeley. He discovered damage to the tissues, organs and ecology of amphibian reproduction due to low levels of Atrazine, the most widely used chemical in U.S. agriculture. Attempts at suppressing, delaying and derailing his research followed as did targeted research to discredit his findings.

Further references:
Blumestyk, G. The Price of Research. The Chronicle of Higher Education, October 31, 2003: A26.
http://www.mindfully.org/Pesticide/2003/Syngenta-Tyrone-Hayes31oct03.htm

Ignacio Chapela, Assistant Professor of Microbial Biology in the Department of Environmental Science, Policy, and Management at UC Berkeley discovered that maize in Oaxaca, Mexico, was genetically contaminated by a neighboring genetically modified corn crop. His findings were alternately suppressed and ignored, his career and his life were threatened, and he was denied tenure by UC Berkeley.

Further references:
http://www.theatlantic.com/issues/2000/03/press.html
http://www.mindfully.org/GE/2003/Ignacio-Chapela30jun03.htm
http://www.thenation.com/doc.mhtml?i=20021028&s=schapiro
http://news.bbc.co.uk/2/hi/programmes/crossing_continents/1871216.stm

So, should there be more regulation of these artists?

1 Athletes are systematically incentivesed to try use performance enhancing drugs. By contrast, artists and amateurs cannot be characterized in this way.

2 Artists systematically have to produce 'statements and rationales for their work.' They exhibit to and for the public. Science does not have a public forum built into the professional raison d'etre and knowledge production process.

3 Artist are by definition transparent, even as they elude didactic theme songs. They are diverse and undisciplined. Amateur.

These questions principally and ethically relate to Claire Pentecost's description of her position: the deliberate and unashamed unapologetic status of a non-expert. To legislate artist's is similar to legislating nurses, garbage truck drivers, or other people that are professionally handling biohazardous material.

Throughout the history of bioterrorism, without exception every single bioterrorist strategy has been developed by sustained bioweaponry research. Yes, artists might create a bioweapon; anyone can, but artists never have developed a bioweapon before, and have no structural, personal, or ideological reasons for doing so. It is unintelligent and uninformed intelligence that results in the arrest and indictment of artists like Kurtz under suspicion of bioterrorism. It is the corporate and military labs that have the resources, the specific professional directives, and the salaries to sustain weapons development programs.

As I finalize my notes more significant events are occurring in the world of biotechnology: Francis Crick, co-discoverer of the structure of DNA, has died; the National Academy of Sciences just released a report on the health effects of GMO's, Savings and Clones has published images of the second and third cloned cat, claiming these to be public proof of feline cloning and taking advantage of the situation to advertise for a business which promises to clone your pet. Biotech is fast-moving, like the river of investment poured into it, the market forces still control the field.

Such is the state of biotech in the US, and the fear of biotech. The FBI is intimidated by the fact that Kurtz kept biological agents in his home because Kurtz's unabashedly civilian approach to biotechnological research flies in the face of the established academic-industrial order which drives and directs biotechnological research. In keeping biological agents in his home for artistic purposes. Kurtz derailed biotech from its context of economic and military productivity, and that fact is what has consistently disturbed the federal agents, the grand jury, and the federal district court which has been asked to decide Kurtz's case.

Biotech hobbyists vanquish the ignorance that is threatened by biological exploration. They celebrate the "right to tinker": to contextualize, to rethink, and to participate in the decision-making on biotechnological issues that have consequences for us all. The risk of suppressing public participation in biotechnology is far more real and pervasive than any perceived terrorist threat.

As Crick and Watson smugly ended their paper on the structure of DNA, on behalf of the biotech hobbyists and amateurs, we similarly believe – this publication may have implications for the field.

Critical Art Ensemble: **http://www.critical-art.net/**
Stelarc: **http://www.stelarc.va.com.au/**
Joe Davis: **http://www.viewingspace.com/genetics_culture/pages_genetics_culture/gc_w03/davis_joe.htm**
Orlan: **http://www.orlan.net/**
George Gessert: **http://www.viewingspace.com/genetics_culture/pages_genetics_culture/gc_w02/gc_w02_gessert.htm**
Tissue Culture and Art Project: **http://www.tca.uwa.edu.au/**
Adam Zaretsky: **http://www.emutagen.com/**
Brandon Ballengée: **http://greenmuseum.org/content/artist_index/artist_id-19.html**
Rachel Berwick: **http://www.brentsikkema.com/rachelberwick.html**
Eduardo Kac: **http://www.ekac.org**
Alexis Rockman: **http://www.viewingspace.com/genetics_culture/pages_genetics_culture/gc_w02/gc_w02_rockman.htm**
Glofish (tm): **http://www.glofish.com/**

Ecotoxicity of Antidepressants: Literature Search

Pharmaceuticals and personal care products (PPCPs) in surface and treated waters of Louisiana, USA and Ontario, Canada. Boyd, Glen R.; Reemtsma, Helge; Grimm, Deborah A.; Mitra, Siddhartha. Science of the Total Environment, Jul2003, Vol. 311 Issue 1-3, p135

A newly developed analytical method was used to measure concentrations of nine pharmaceuticals and personal care products (PPCPs) in samples from two surface water bodies, a sewage treatment plant effluent and various stages of a drinking water treatment plant in Louisiana, USA, and from one surface water body, a drinking water treatment plant and a pilot plant in Ontario, Canada. The analytical method provides for simultaneous extraction and quantification of the following broad range of PPCPs and endocrine-disrupting chemicals: naproxen; ibuprofen; estrone; 17ß-estradiol; bisphenol A; clorophene; triclosan; fluoxetine; and clofibric acid. Naproxen was detected in Louisiana sewage treatment plant effluent at 81–106 ng/l and Louisiana and Ontario surface waters at 22–107 ng/l. Triclosan was detected in Louisiana sewage treatment plant effluent at 10–21 ng/l. Of the three surface waters sampled, clofibric acid was detected in Detroit River water at 103 ng/l, but not in Mississippi River or Lake Pontchartrain waters. None of the other target analytes were detected above their method detection limits.

Aquatic ecotoxicology of fluoxetine. Brooks, Bryan W.; Foran, Christy M.; Richards, Sean M.; Weston, James; Turner, Philip K.; Stanley, Jacob K.; Solomon, Keith R.; Slattery, Marc; La Point, Thomas W.. Toxicology Letters, May2003, Vol. 142 Issue 3, p169

Here, we summarize information on fluoxetine detection in surface waters and review research on single-species toxicity test, Japanese medaka (Oryzias latipes) reproduction and endocrine function, and freshwater mesocosm community responses to fluoxetine exposure. Based on results from our studies and calculations of expected introduction concentrations, we also provide a preliminary aquatic risk characterization for fluoxetine. If standard toxicity test responses and a hazard quotient risk characterization approach are solely considered, little risk of fluoxetine exposure may be expected to aquatic life. However, our findings indicate that: (1) the magnitude, duration and frequency of fluoxetine exposure in aquatic systems requires further investigation; (2) mechanistic toxicity of fluoxetine in non-target biota, including behavioral responses, are clearly not understood; and (3) an assessment of environmentally relevant fluoxetine concentrations is needed to characterize ecological community responses.

Waterborne and sediment toxicity of fluoxetine to select organisms. Brooks, Bryan W.; Turner, Philip K.; Stanley, Jacob K.; Weston, James J.; Glidewell, Elizabeth A.; Foran, Christy M.; Slattery, Marc; La Point, Thomas W.; Huggett, Duane B.. Chemosphere, Jul2003, Vol. 52 Issue 1, p135 [PDF]

To evaluate the potential aquatic toxicity of fluoxetine, single species laboratory toxicity tests were performed to assess hazard to aquatic biota. Average LC₅₀ values for Ceriodaphnia dubia, Daphnia magna, and Pimephales promelas were 0.756 (234 µg/l), 2.65 (820 µg/l), and 2.28 µM (705 µg/l), respectively. Pseudokirchneriella subcapitata growth and C. dubia fecundity were decreased by 0.044 (14 µg/l) and 0.72 µM (223 µg/l) fluoxetine treatments, respectively. Oryias latipes survival was not affected by fluoxteine exposure up to a concentration of 28.9 µM (8.9 mg/l). An LC₅₀ of 15.2 mg/kg was estimated for Chironomus tentans. Hyalella azteca survival was not affected up to 43 mg/kg fluoxetine sediment exposure. Growth lowest observed effect concentrations for C. tentans and H. azteca were 1.3 and 5.6 mg/kg, respectively. Our findings indicate that lowest measured fluoxetine effect levels are an order of magnitude higher than highest reported municipal effluent concentrations.

Cradle-to-cradle stewardship of drugs for minimizing their environmental disposition while promoting human health. I. Rationale for and avenues toward a green pharmacy. Daughton, Christian G. Environmental Health Perspectives, 2003 May;111(5):757-74.

I focus initially on the background behind the imperative for an ecologically oriented stewardship program for PPCPs [pharmaceuticals and personal care products]. I then present a broad spectrum of possible source control/reduction actions, controlled largely by the health care industry, that could minimize the disposition of PPCPs to the environment. This two-part mini-monograph attempts to capture cohesively for the first time the wide spectrum of actions available for minimizing the release of PPCPs to the environment.

Pharmaceuticals and personal care products in the environment: Agents of subtle change? Daughton, Christian G.; Ternes, Thomas A. Environmental Health Perspectives Supplements, Dec99, Vol. 107 Issue Suppl. 6, p907, 32p [PDF]

Focuses on pharmaceuticals and active ingredients in personal care products as pollutants. Pharmaceuticals in the environment; Names of compounds; Environmental occurrence; Aspects of ecotoxicology; Studies on pharmaceuticals' impact on the environment; Antibiotics; Blood lipid regulators; Antidepressants; Antiepileptics; Antineoplastics; Impotence drugs.

Solid-phase microextraction–gas chromatography–mass spectrometry for the analysis of selective serotonin reuptake inhibitors in environmental water. Pablo Lamas, J.; Salgado-Petinal, Carmen; García-Jares, Carmen; Llompart, María; Cela, Rafael; Gómez, Mariano. Journal of Chromatography A, Aug2004, Vol. 1046 Issue 1/2, p241

Solid-phase microextraction (SPME) coupled to gas chromatography–mass spectrometry has been applied to the extraction of five SSRIs—venlafaxine, fluvoxamine, fluoxetine, citalopram and sertraline—from water samples... Two of the target compounds, venlafaxine and citalopram, were detected and quantified in a sewage water sample.

Fish on Prozac. Parks, Noreen. Science Now, 11/4/2003, p1, 2p

Fish in Texas are absorbing antidepressant drugs from waste water, according to a new study. The chemicals can apparently alter brain activity in the fish, but a general sense of well-being isn't the likely payoff, the researchers say. To find out whether fish in the Trinity River Basin north of Dallas are affected by the widely prescribed antidepressants Prozac and Zoloft, ecologist Bryan Brooks of Baylor University in Waco, Texas, and his colleagues tested samples of three common fish in Pecan Creek. In the brains and livers of the fish, the researchers found concentrations as high as 30 parts per billion of the active ingredients and breakdown products of the drugs.

Fluoxetine treatment decreases territorial aggression in a coral reef fish. Perreault, Heidi A.N.; Semsar, Katharine; Godwin, John. Physiology & Behavior, Sep2003, Vol. 79 Issue 4/5, p719, 6p

We used fluoxetine, a selective serotonin reuptake inhibitor, to experimentally enhance serotonergic neurotransmission in a territorial coral reef fish and test the role of this neurotransmitter in mediating aggressive behavior and dominance interactions. The bluehead wrasse, Thalassoma bifasciatum, has a complex social system in which large males aggressively defend spawning territories from intruders. In separate experiments, we tested the effects of chronic and acute fluoxetine treatments on aggressive behavior using a resident–intruder design. In a laboratory experiment, males treated daily with intraperitoneal fluoxetine injections for 2 weeks (6 μg/g bw) displayed fewer intruder chases than saline-treated controls. Chronically fluoxetine-treated males also showed lower levels of activity than saline controls prior to intruder trials. However, activity was not correlated with chases on an individual level, indicating the lower aggression displayed by fluoxetine-treated males was not due solely to general reductions in behavioral display. A field study exposed males to a confined territorial intruder following single intraperitoneal injections of fluoxetine (10 μg/g bw) or saline given to the same individual on different days. The frequency of aggressive chases following acute fluoxetine treatment was significantly lower than that following saline injections.

Determination of selected pharmaceuticals and caffeine in sewage and seawater from Tromsø/Norway with emphasis on ibuprofen and its metabolites. Weigel, Stefan; Berger, Urs; Jensen, Einar; Kallenborn, Roland; Thoresen, Hilde; Hühnerfuss, Heinrich. Chemosphere, Aug2004, Vol. 56 Issue 6, p583, 10p [PDF]

Selected pharmaceuticals, among them analgesics, ß-blockers and anti-depressants as well as caffeine, the anti-bacterial triclosan and the insect repellent N,N-diethyl-3-toluamide (DEET) were determined in different sewage samples (sewage treatment plants, hospital effluents) from Tromsø/Norway and in seawater from Tromsø-Sound, into which the sewage is discharged. While caffeine, triclosan, ibuprofen and its major metabolites hydroxy- and carboxy-ibuprofen were present in all sewage samples, additional pharmaceuticals were observed in sewage containing hospital effluents. Concentrations were in the range of 20–293 μg/l (caffeine), 0.2–2.4 μg/l (triclosan) and 0.1–20 μg/l (<f>?</f>ibuprofen + metabolites). In seawater, only caffeine (7–87 ng/l), DEET (0.4–13 ng/l) and ibuprofen + metabolites (sum concentration < LOQ–7.7 ng/l) were detected.

Frogs, fish and pharmaceuticals a troubling brew. Walton, Marsha. CNN.com, November 14, 2003.

In 2002, 80 percent of streams sampled by the U.S. Geological Survey showed evidence of drugs, hormones, steroids and personal care products such as soaps and perfumes. The U.S.G.S. tested 139 rivers in 30 states.

Medicated ecosystems: human drugs alter key aquatic organism. Carson, Emily. Innovations Report, July 8, 2002.

Reviews short- and long-term studies on the effects of clofibric acid, fluoxetine, and five antibiotics on the freshwater zooplankton Daphnia.

PPCPs as Environmental Pollutants: Summary of Media Coverage Regarding PPCPs in the Environment and Involvement of EPA-Las Vegas

Website provides links to articles from the past four years evaluating the ecotoxicity of PPCPs.

Skin kit

not a tamagochi but one of its contemporary progeny

This article is updated from the original one published in 1998, prompted by two seemingly unrelated neological events: a virtual pet propagated in people's pockets that infected the public imagination: the Tamagotchi epidemic, and the launch of the 1st FDA approved commercial human skin product: Apligraf. The original human skin kit in all of its charming brevity is available at **www.biotech.org**

Tamagotchi was the first virtual pet and a strange hallucination that shifted the popular imagination towards hand held electronics that convincingly represented something alive. The Tamagotchi project was to make "you carry around your pet and care for it". According to the website: "Your Tamagotchi pet will interact and play with you as it learns and grows," (their emphasis). This was a technology of dependence, not one of convenience, and it was hailed for its capacity to teach children responsibility. What is it about pressing a button to meet the demands of a 4-frame animation – something that you could reset or kill at anytime without any consequences – that looks like responsible behavior?

Nonetheless as a widespread artificial life device the virtual pet begged the question: what is alive?

Artificial life assumes that life is a formal phenomenon, that is, if you carefully abstract something living then you can reproduce it, and it doesn't matter if the system you describe is in silicon or flesh – it can still be alive. Others maintain that life is a material property, and a complex one at that, and that what it is made of matters. Do you?

The FDA approval of Organogenesis' skin substitute Apligraf – a mostly human tissue (some cow), bi-layered skin product – signaled that it does. For the first time you could buy something human off the shelf. Although how human? Was it human? It had all the identifying langerhorn cells removed so it is from no-one in particular. Does that work? Can there be human without human? In Apligraf the stuff of life – living stuff, our tender armor of skin – becomes a representation. Human skin not exactly representing humans, but representing something of them, and leaving out all the messy agency stuff of humanity. While mice, monkeys, rats and rabbits are used to model human biology, it doesn't make them human. What is so special about tissue cultured skin?

Like Tamagotchi, or simulated life, the skin kit requires 'caring for' or feeding by replenishing the growth media rather than pressing a button. Maybe you can learn responsibility, you might just enjoy carrying it in your pocket, or you might like to explore a wet and juicy representation on the definitional front of humanity.

A growing interest in skin

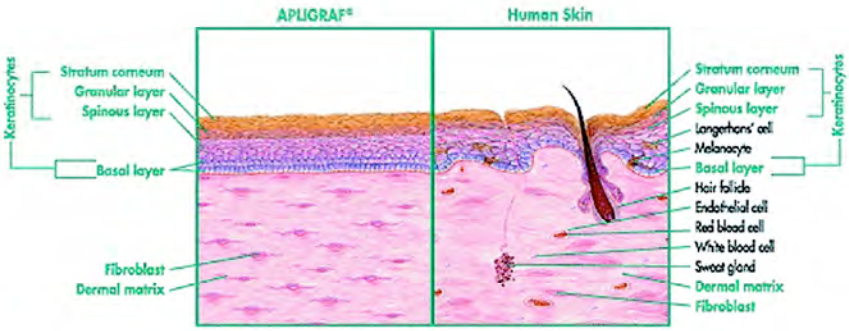
Growing skin off your body, aka tissue culture, is a little more challenging than growing it on there, but it is more fun than a virtual pet. Think of it as a virtual flesh pet... how alive does a pet have to be anyhow? (Tamogotchis would suggest: not very)

Living skin—perhaps the most familiar material of all – becomes peculiar when it is not on a body: human and living, yet not human and alive as we normally mean. It remains intimate but wavers between inanimate and animate. We don't really have words for this in-between state; not not alive, is the best I can do. Yet there are many, well... things, which we could put in this unnamed category, take for example the contentious career of an embryo outside the body. Tissue culture is more ubiquitous than loose fetuses, yet receives less attention from the paparazzi. It has become a fully commercialized product line and a standard tool (how un-alive does a tool have to be anyhow?). This makes it easy for biotech hobbyists to get hold of the materials needed to grow and nurture the stuff, yet it remains fascinatingly undefined. Just try to make sense of it. Is it alive? Is it life? Whose life then? Or, who owns it?

Recent history has answered these questions in some counterintuitive ways. For instance, your skin is not yours once it is not on you, but nor does it belong to those who invested in its development. Below is the brief history covering some highlights of skin's out of body experiences – and what is remarkable is how it plays out the racial, gendered and institutional transformations of academia and the market in its short life. Otherwise you can skip straight to the recipe. Does recipe suggest eating? Lets call it a kit, albeit a wet kit.

Showing some skin

But what does it feel like? People will want to know and the biotech hobbyists need to be prepared to deal with this pornographic impulse. I want to give you a preview of this in my own experience. I exhibited an epithelial skin layer growing atop a commercially available human epidermal layer – this was to give it some flesh because the epithelial layer is so gossamer-thin – and a fake tattoo. I thought it would be clever to play on the contrast of artificial and not: Real skin, fake tattoo. It was growing in a positive pressure container with HEPA filtered air keeping the nasties from settling on it, and I had sterile surgical gloves right there beside it presuming that some game hands-on types might be interested in reaching out a carefully extended finger from on high. I named it TOUCH to encourage this, which may have sounded like an imperative in the do-not-touch context of museums and lab, and people did. Many, much, constant jabbing the little 2-inch thing over and over. But they did not use the gloves!! Almost without exception the viewers wanted unprotected touch. Although human and living, therefore infectious and infectable – with no active immune system behind it – apparently it seemed neither vulnerable nor dangerous. Maybe it was not human enough?

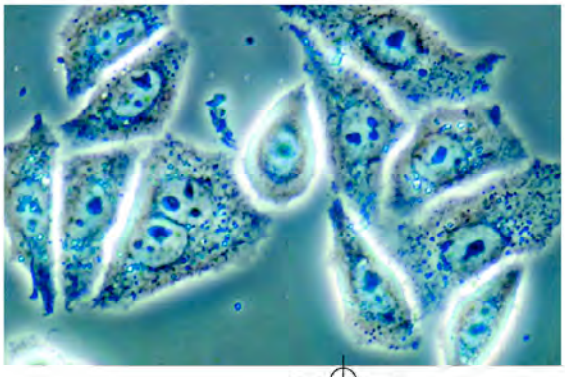


A brief history of tissue cult(ure)

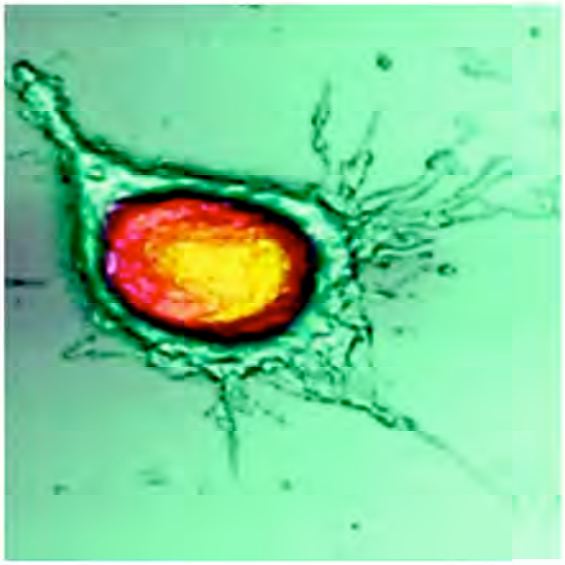
Ross Harrison is generally accepted as the founder of the technique of tissue culture. In 1907, he adapted the 'hanging-drop' method previously used by bacteriologists to culture bacteria, using it to grow a nerve cell from embryonic frog tissue. Alexis Carrel and Montrose Burrows soon modified Harrison's technique and used it to grow adult mammalian tissue and malignant tissue in vitro. The discovery of tissue culture did not lead inevitably to its widespread adoption by research scientists – tissue culture did not begin to proliferate as a research tool until after World War II.

When Julian Huxley, an eminent biologist and vocal proponent of biological engineering, published 'The Tissue-Culture King: A Parable of Modern Science' in the Yale Review in 1926, tissue culture still seemed fantastic, having not yet been assimilated into the mundanity of bench science. In Huxley's cautionary tale of biotech falling into the 'wrong' hands, an African tribe employs a British scientist to produce cell cultures in the service of the tribal king, with monstrous repercussions. Huxley describes tissue culture as 'a technique of great power' and lends the tissue an aura of religious significance. Sven Gard also invokes the sanctity of tissue culture in his presentation speech for the Nobel Prize in Physiology or Medicine in 1954: 'Tissue culture developed almost into a tissue cult, a mystery the secret rites of which were revealed only to a narrow circle of inaugurates with [Alexis] Carrel as their high priest.'

The American Tissue Culture Association was founded at a conference in Hershey, Pennsylvania in 1947. Two years later, Dr. G.W. Hyatt created the US Navy Tissue Bank to store bone tissue collected during orthopedic surgery. Over the course of the next decade, the tissue bank expanded to become a full-scale human tissue facility, the first of its kind. By the 1950s, tissue culture had been transformed into a tool for biological investigation and was a functional unit of analysis for diverse research experiments. In 1951, the first human tumor cell line, 'HeLa' was established from the cancerous cervical cells of Henrietta Lacks. The HeLa cell line continues to flourish today, and is one of the most commonly used cell lines in biological research. Leonard Hayflick, a microbiologist at Stanford University, created the first normal human diploid cell line in 1962. When he began to market his cell line to other scientists, the NIH claimed that the cells were the property of the federal government, since Hayflick had been conducting his research under a federal grant when he developed the cell line. Hayflick brought suit against the U.S. government, and reached an out-of-court settlement with the NIH in 1981 whereby Hayflick was recognized as the owner of both the cell line and all proceeds from sale of the cell line. The Hayflick settlement effectively established biotechnology as a federally funded, privatized industry.



By mid-century, mass production techniques and standardized nutrient media began to emerge, and the use of penicillin helped tissue to survive longer in vitro. A series of legal cases in the 1980s and 90s privatized and commercialized human tissue. While at General Electric, Ananda Chakrabarty genetically engineered a strain of bacteria that could digest crude oil. When the patent application for his invention was rejected, Chakrabarty brought his case before the Supreme Court. In 1980, the Supreme Court sided with Chakrabarty, creating a precedent for the proprietary protection of genetically engineered biological materials, including whole organisms. In 1990, the California Supreme Court ruled that John Moore, a leukemia patient, did not have ownership rights to a cell line that his physician had created (without Moore's knowledge or consent) using tissue from Moore's spleen. In 1993, the US Secretary of Commerce filed a patent application for the immortal cell line of a young Panamanian Guaymi woman whose cells were believed to have antiviral properties. When the Guaymi tribe and several activist organizations voiced their opposition, the US government quickly dropped the application. Nonetheless, the US government has filed several new patent applications for the biological materials of indigenous peoples within the last decade.



Just as the current technique for tissue culture bears little resemblance to Harrison's initial experiments with frog neurons, the status of tissue culture outside of the lab evolved dramatically over the course of the twentieth century. Cellular material is transformed in several fundamental ways by growing and reproducing outside of the body. Scientists who culture cells de-contextualize tissue both materially and rhetorically: in order to visualize dynamic processes which naturally occur within the body, these very processes must be removed from the body. Because tissue culture was developed as a technique for overcoming the obstacles which the body poses to scientific experimentation, it is often described in terms which are diametrically opposed to any classical definition of the body: where the body is whole, tissue culture is fragmented; where the body is opaque, tissue culture is transparent; while the lifespan of any body is finite, cell lines can be 'immortalized.' Since tissue culture was invented in 1907, tissue has been progressively redefined as an exchange good, an intellectual property and as a commercial product.

The bulk of tissue culture experimentation undoubtedly takes place in the service of the biotechnological industry. While there are a few tissue culturing kits that biological supply companies sell to high schools and universities for use in advanced biology curricula, the biotechnological experiments performed at the high school and undergraduate level are carefully scripted and allow for a minimum of creativity. There is nothing particularly exciting about amplifying fruit fly DNA using PCR, isolating the DNA of an onion, or DNA fingerprinting. Rather than allowing students to cultivate a creative experimental approach to the manipulation of living materials, educational biotech kits teach students the skills they will need to become docile lab technicians. This, of course, is no surprise. At a very early age, our mothers admonished us not to play with our food. If we are conditioned to believe that we should not play with the food on our plate, what chance is there of trying to play with the tissue on our Petri dish?

Biotech Hobbyist Starter Skin Kit

It is time to wrest tissue culture from the experts and relocate it to your kitchen. The recipe for cultivating tissue culture is simple, but just like a Tamagotchi it takes a bit of tending. The game is to see how long you can keep your culture alive.

In order to grow skin you need three essential ingredients:

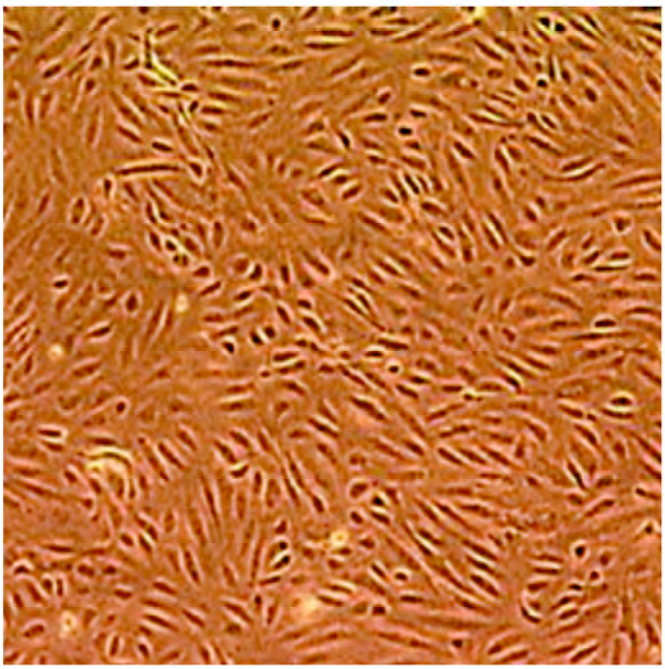
1 A Cell Line (preferably immortal)
- Cambrex – Human endothelial cells
- American Type Culture Collection-cell line catalog

2 Growth Medium
- Cambrex – Endothelial cell medium
- Clonetics – Endothelial cell medium

3 A Body Temperature Growth Environment
- Economy Incubator – $325.85
- KwikCulture Incubator – $80.00
- Brinsea Avian Incubator – $93.50
- Hova-Bator Incubator – $59.50
- Incubators Value Line
- **www.scientific-surplus.com** often has cheap used incubators for sale

You can order everything you need for your SK-A1 Starter Skin kit from the websites provided including a cell line and growth medium. You get to choose where on the body your want your skin – aorta, coronary artery, iliac artery, bladder, cardiac, dermal and lung microvascular, pulmonary artery, umbilical veins and arteries, uterus, mammary glands, small intestine, colon, cecum, cornea, skin, and prostate. Foreskin tissue is usually the source of the commercial skin substitutes but it seems harder to get as a cell line.

The hardest, or most expensive part is the incubation. You have a few options: you can keep the culture on you – your body is (not so) coincidentally the perfect temperature for growing human tissue. There are also a few home incubator kits that you can use. One kit adapts the waste heat from the back of your refrigerator, another repurposes an oven. You might find something inexpensive at your pet supply stores, who usually carry a whole range of inexpensive precision control incubators, brooders, hatcheries and other heating elements designed to keep whole dislocated organisms warm. They work, as well, for the more demanding job of tissue culture and are sufficient without the expense of lab equipments. But if you do go the high budget alternative make sure to look for CO2 regulation. This makes the growing much easier.



What to do with your living skin

What to do? There are endless things to do with skin. Do you want to make it Glow in the Dark? Of course you do.

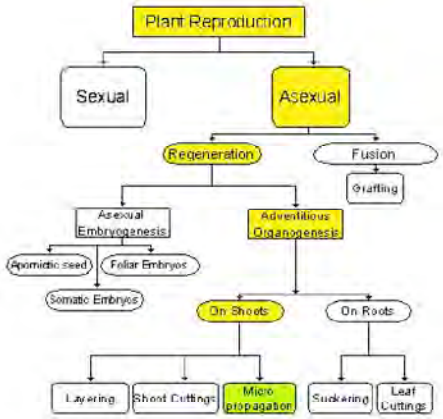
The next project installments will explain how to splice in an amplified Great Star coral gene that will make your tissue glow cyan under UV light.

Some people are pursuing making their tissue talk directly to your computer by interfacing aka growing it on top of a silicon chip. Because many believe that human tissue is a great representation of humans, they are trying to make sensors in this way. If you want to know if a place is toxic to humans, sprinkle some of these skin sensor products around and see how they react. Of course this measure is only skin deep.

Others are interested in body modification applications, extending the tattooing and piercing insertions, with biological ones. Talk to the inimitable Adam Zaretsky about this if it is up your ally.

One of his co-conspirators has developed a brilliant, interesting troublesome life changing application: Google "Julia Reodica and her vivolabs" to investigate further...

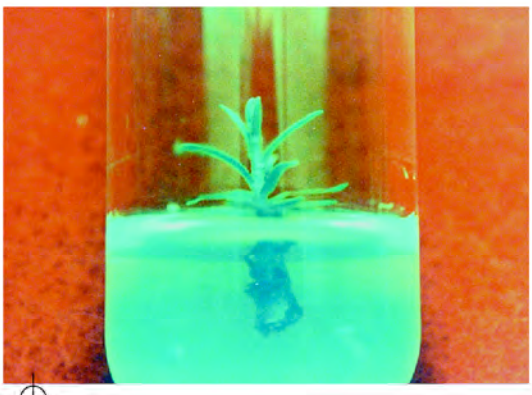
Tree Cloning



In 1902, German botanist Gottlieb Haberlandt proposed that it was feasible to create artificial embryos from cultured vegetative cells. Although Haberlandt did not successfully develop a technique to do so, his landmark paper sparked decades of research into plant cloning. In 1938-39, three biologists independently reported successful plant tissue cultures. All three researchers had developed a totipotent mass of undifferentiated plant cells, now known as a callus, and sustained it for several months. The culture is still maintained. However, plant tissue culture did not become a viable commercial industry until 1957-8, when researchers discovered the growth regulators of plants and used them to direct the growth of different plant morphologies and to regulate the growth rate in vitro. In 1983, Belgian scientists created the first transgenic plant, a tobacco plant resistant to the antibiotic kanamycin. In 1994, Calgene became the first company to market a transgenic plant: the Flavr Savr tomato was genetically modified to increase its shelf life. However, the tomato exhibited increased disease sensitivity and decreased productivity, and was soon removed from the market. Despite this setback, genetically modified foods are now prevalent in the food industry.

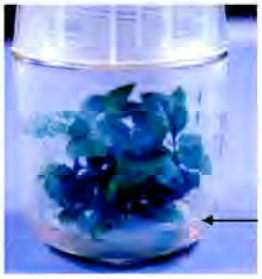
Plant tissue culture makes it possible to quickly grow large amounts of uniform, disease-free plant tissue. G.M. Morel rapidly propagated orchids in 1960, creating a multi-million dollar market for micropropagated ornamental plants. Tissue culture also makes possible the commercial production of plant-derived pharmaceuticals, flavorings, and colorants. The most widely recognized benefit of tissue culture is the perceived uniformity of the resultant clones. Thus, tissue culture is recommended as a method for increasing the stock of elite clones – a clone can be micropropagated to produce over a million genetically identical plants.

As of 1991, laboratories around the world were culturing over 1,000 different plant species. However, plant tissue culture is still not a perfect science. Microbial contamination is a common problem in commercial laboratories today. Furthermore, while many plant biotechnologists tout the myriad commercial applications of plant tissue culture, it is still significantly more expensive to micropropagate clones than to grow seedlings.



Furthermore, the capacity for a cloned plant line to successfully produce new clonal embryos decreases with each successive generation.

One of the clearest commercial advantages of plant tissue culture is the production of uniform plants in a species that has not been bred to uniformity. While the main industrial application of tissue culture is the elimination of variation, any home tissue culturist possessing a keen eye will notice how different each plant is from its fellow clones. Scientists have noted that despite the fact that micropropagated plants should produce clones, 'genetic instability' often leads to new morphological variations in resultant plants (Litz et al, 1993).



Heterotropic Nutrition
sugar, minerals, hormones, vitamins

Biotech Hobbyist Micropropagation Kit

1. A sterile still air cabinet (fish tank on its side works well)
2. A pressure cooker, for sterilizing tools and materials
3. Glass jars with lids (such as baby food jars)
4. Scalpel and forceps
5. Paper towels
6. Disinfectant, preferably 70% alcohol solution in a spray bottle
7. Bleach, diluted to 25%
8. Skin disinfectant (such as hibitane)
9. pH indicator strips
10. Basic media
    - 2 c. rain water
    - 1/4 c. sugar
    - 1 c. fertilizer stock (1/2 T 10:10:10 (NPK) water soluble fertilizer in 1 L water)
    - 1/2 inositol tablet (500 mg)
    - 1/2 multivitamin tablet (must contain thiamine)
    - 4 T agar flakes

(Recipe adapted from *"Plant Tissue Culture for Home Gardeners"*, by Dr. Acram Taji)

The media can be easily modified for different purposes. To make multiplication and rooting media, add 1/2 tsp. malt and 1/2 c. of either coconut milk, orange juice, or green tomato puree. Media should always be between pH 5 and 6.

The Biotech Hobbyist Micropropagation Kit will contain everything needed (including further instructions!) except the still air cabinet, pressure cooker, and glass jars. The cabinet may be purchased at a pet store. Pressure cookers are available commercially through cooking supply stores, as are glass jars. The biotech hobbyist can also buy baby food at their supermarket and save the jars, or ask their reproductively-minded friends for leftover jars.

The Great Ladybug Animation

The word "database" is a fairly recent addition to the English language, its roots extending only so far as the birth of computer science. However, as an ontological category, the database is an old concept referring to any collection of information which has been organized to facilitate quick retrieval or comparison. Victoria Vesna, a media artist and professor at UCLA, recognizes the Library of Alexandria (circa 100 B.C.) as an early incarnation of the modern digital database. In the same essay, Vesna writes that digital databases collapse the space that traditionally separates word from image, encompassing both under the inclusive rubric of "data." The photographic database, then, is neither a collection of images nor of data, but a set of images meant to impart information about all of the images as a unique set. The way in which visual databases are organized reveals much about the way we classify knowledge, how we define entities, and how we interpret difference between them.

Because an integral aspect of the database as a medium is the comparison and analysis of its components, the database necessarily assumes an intelligent viewer who can navigate its infrastructure and synthesize its data to draw meaningful conclusions. Vesna's "aesthetic of navigation" is both a structural and temporal aspect of photographic databases such as the Great LadyBug Animation and the Visible Human Project; both projects animate their collection of images to create the appearance of travel between and through bodies, respectively. This sense of movement draws the viewer's attention to the fact that they are actively engaged in experiencing the database, and that it is the viewer's consciousness which animates the database, transforming it from a jumble of data into a structurally coherent tool for information-gathering. In order to gain a better sense of how these visual databases alternately draw attention to and obscure diversity, even how they contribute to the very definition of what "diversity" is, it is necessary to look more closely at the databases and their history.

The Great LadyBug Animation is a database of photographs of ladybugs that have been ordered in quick succession to create a short animation that reveals the intra-populational variation in the patterns of spots on the insects' wing covers. Natalie Jeremijenko, a design engineer and technoartist at Yale, photographed 200 ladybugs out of a total population of 4,000 insects. She then scaled and color-corrected the images before ordering them by similarity using computational algorithms normally used in face recognition software.

The result is a fluid animation of the ladybugs' spots; while the bodies of the ladybugs remain uniform, the spots on the wing covers alternately grow larger and smaller, increase and decrease in number, and migrate across the ladybugs' thoraces. There is no definite beginning or end to the animation. Each image constitutes one short moment in the overall representation of population diversity, which can be viewed as a continuous loop. Having compiled the foundation of her LadyBug database, Jeremijenko is now creating a flipbook using the animated photographic database. The flipbook will demonstrate the diversity exhibited within the ladybug population as a function of time, which can be manipulated by the individual operating the flipbook.

The LadyBug Animation does not present its viewer with an archetypal image representative of the "ideal" wing cover pattern. Rather, the animation is a technology for seeing that which is normally invisible - that each population exhibits a profusion of diversity. This fact is often obscured by technologies which use visual archetypes as a tool for identifying whole populations. An example of such a technology is the Audubon Guide, which shows photographs of archetypal entities to aid in the easy identification of birds, trees, insects, or minerals in the field.

The photographic database originated at the end of the 19th century as a disciplinary technology designed to assist criminologists and eugenicists in positively identifying individuals predisposed to a life of crime. Francis Galton, a British gentleman and science enthusiast best known for coining the term "eugenics" in 1883 and founding the forensic study of fingerprints, published "Composite Portraits, Made by Combining Those of Many Different Persons Into a Single Resultant Figure" in 1879. He details the process of creating composite portraits and suggests that composite portraiture is capable of "extracting the typical characteristics" of a group of individuals to create a realistic "portrait of a type" (Galton 132-3). To create his composites, Galton exposed between two and one hundred photographs on a single photographic frame, giving "each successive image...a fractional exposure based on the inverse of the total number of images in the sample" (Sekula 368). Galton claimed that these portraits were "generic images" which exposed the physical characteristics of the criminal, the Jew, and the consumptive. The resulting images were blurred photographs, which revealed, upon careful investigation, that the photographic subject has two distinct hairlines, shirt collars, etc.

Galton's composite portraiture was a surveillance technology meant to eclipse individual difference in favor of visualizing broad, archetypal characteristics. Galton assumed that the categories he was investigating were natural ones, and not determined by socio-economic status, racist thinking, or other culturally mediated constructions. Furthermore, he argued that individuals exhibited physical marks that betrayed their inner attributes. Whereas Galtonian composites collapse difference so as to emphasize a set of general signifiers, Jeremijenko's Great LadyBug Animation is a method for visually expanding difference within a population.

In adopting the flipbook as the medium of the Great LadyBug animation, Jeremijenko combines the scientific, evidentiary purpose of the visual database with the mode of the flipbook, which is often associated with children's entertainment. Historically, the boundary between scientific experimentation and entertainment has often been blurred, most famously in the history of the air pump, which was used variously in the experiments of Robert Boyle and in the parlors of the Enlightenment elite. The same tension between experiment and play is present in Galton's composite portraiture. While Galton claimed his composite portraits were statistically legitimate and objective indices of population characteristics with potential scientific applications, Robert des Ruffieres points out in a response to Galton's article in The Journal of the Anthropological Institute of Great Britain and Ireland that:

Mr. Galton's discovery has been spoken of elsewhere as a toy, but the same was said at the time of the Kaleidoscope, which has done such good service in the Arts, and very recently of the Radiometer, which it has been shown can be successfully applied in Climatology for testing gas-light, and other purposes (Galton 144).

Both experiment and play are methods of knowledge-production carried out outside of "real-world" conditions, whether from the variable-controlled laboratory or the safe haven of childhood dissimulation. I point out these similarities between experiment and play in order to draw attention to the fact that visual databases tend to occupy the productive area in which the two overlap -the medium of animation exists comfortably in both realms.

Alphonse Bertillon, a Parisian criminologist, founded the first modern criminal identification database a year after Galton's Composite Portraits. Bertillon's database combined "photographic portraiture, anthropometric description and highly standardized and abbreviated written notes on a single fiche or card" (Sekula 18). Like Galton, Bertillon's goal was to create a statistically quantifiable method for identifying those Parisians predisposed to criminal behavior. By collecting exhaustive data on the physical characteristics of Parisian criminals, Bertillon hoped to filter out idiosyncratic characteristics and determine which physical characteristics disclosed criminality.

While the examples of Galton and Bertillon emphasize the eugenic history of composite photography, the same theoretical assumptions of archetypal classificatory schemata are still embedded in recent databases which index human bodies. The founding supposition of the Human Genome Project was that the sequencing of one "generic" human genome created by combining sequences derived from numerous samples would lead to a profound understanding of and mastery over the genetic sequence found in every human (note that the project sequenced the archetypal "Human Genome", singular). Similarly, the Visible Human Project compiled "complete, anatomically detailed, three-dimensional representations of the normal male and female human bodies" by combining cryosection images to create a fluid animation of the human body's interior (emphasis added). This quote from the National Library of Medicine website betrays the normative assumptions of the Visible Human Project, which Lisa Cartwright characterizes as the exhibition of a "digital Adam and Eve" (Cartwright 33). The Human Genome and Visible Human Projects, the prime examples of modern bioinformatic mastery, are predicated on an archetypal classification of the human body, which both projects suggest is not only accurate, but also medically salient.

Watching the quick procession of cryosection images of the Visible Human Project, one gets the uncanny feeling of traveling through the interior of the human body, speeding through tissue and bone in a disembodied realization of the science fiction film "Fantastic Voyage" (1966). By animating the photographic database of cryosection images, the Visible Human Project makes the invisible visible and the internal external. Revealing what the inside of our bodies looks like, the Visible Human Project draws attention to the invisible terrains that exist in us all, and engages the viewer in a pornographic aesthetic of alternate concealment and revelation, calling attention to the viewer's voyeuristic role in this bioinformatic surgical theater.

So too, Galton's composite portraits engage their audience in an act of voyeurism, albeit more demurely. Because Galton posits that an individual's external features are signifiers of immutable internal characteristics, his portraits are not depictions of physical characteristics, but of external reflections of internal conditions. The tension in Galton's portraits exists not only between the individual and the type, but also between that which is seen and that which remains invisible,

Furthermore, Galton's composites are not images of real individuals, but of "ideal types," unrealized fantasies of the prototype standing in for an entire class of people.

The Great LadyBug Animation is singular in its representation of polymorphic diversity within populations. The theoretical difference between the Great LadyBug Animation and other photographic databases is best illuminated by John Taylor's definition of Aristotelian vs. prototype classifications (Bowker and Star 61-64). Whereas Aristotelian classifications are organized according to a "set of binary characteristics that the object being classified either presents or does not present," prototype classification operates by presenting us with a "broad picture…and we extend this picture by metaphor and analogy when trying to decide if any given thing…counts" (ibid 62). Databases ranging from Galton to the Visible Human Project are aligned with a prototypical classificatory schema which metaphorically expands upon the ideal to create an exclusive notion of the category "human". In contrast, the Great LadyBug Animation is a technology for visualizing an Aristotelian, polythetic (i.e. having several classificatory criteria) classification of the category "population" by standardizing characteristics such as color and size to reveal those variations which span a single population.

It is not accidental that all of the visual databases examined here have living things as their subjects. The dialectics of individual and population, specific and general, visible and invisible are intrinsic to the very notion of "life" as a category of surveillance, investigation, and control. Foucault differentiates between the anatomo-politics of the individual body and the bio-politics whose site of application is the population in The History of Sexuality: An Introduction: "the great bipolar technology-anatomic and biological, individualizing and specifying, directed toward the performances of the body, with attention to the processes of life-characterized a power whose highest form was perhaps no longer to kill, but to invest life through and through" (139). The digital database, then, can be understood as a technology which "invest[s] life through and through" by allowing for translation between surveillance at the level of the individual body and at the level of whole populations.

Current technologies for visualizing and classifying populations render differences invisible while highlighting the archetypal features that characterize the population. Such technologies abound, and are so embedded in the way we classify objects and organisms, that they are not readily apparent. A cursory glance at a biology textbook, an Audubon field guide, or a trip to a natural history museum reveals the prototype classification schema used to catalog plants and animals into family, genus, and species according to their visual archetypes. More importantly, humans continue to be slotted into racial categories despite the fact that "race" as a biological category has long been invalidated. Indeed, genetic research has shown that the fundamental site of human genetic variation is within populations, accounting for 90% of all human genetic variation. The amount of genetic variation between human populations, in contrast, represents a negligible amount of total human variation (Chakravarti).

However, because such information is in direct opposition to the classificatory infrastructures which undergird our society, it does not "count" as knowledge worthy of being known and disseminated. Thus, technologies for visualizing diversity are scarce. It is for this reason that the Great LadyBug Animation is both a novel and essential site with which to begin troubling the traditional definitions of difference, variation, and diversity. As a tangible representation of difference within the ladybug population, the Great LadyBug Animation forces its audience to recognize the incredible amount of physical variation that exists within a population and refutes the notion of prototypical population classification.

Milgram's Mice: bioinformatics in the wild

The kits in this section are for whole organisms.

Specifically the kits pictured below are for testing feral mice:

Will they self administer psychoactive drugs, muscle relaxants, alcohol (of several flavors)? Will they learn to use a mouse-operatable light, mix a little sound up? Will they eat black jelly beans (does anyone?).

These and many more tests for preference, addictive, adaptive and political behaviors are yours to explore. You can settle old disputes and ask the mice: which is better, white chocolate or dark chocolate? The possibilities are extensive.

Other Whole Organism (WO) kits and instructions are at: biotechhobbyist/Organismic.

biotechhobbyist/milgramsmice has test equipment for your own feral mouse. This is also the site to upload video and view footage generated by your kits and others peoples. Please remember to upload your results.

Recommendations for getting a webcam to trigger on light sound or movement:

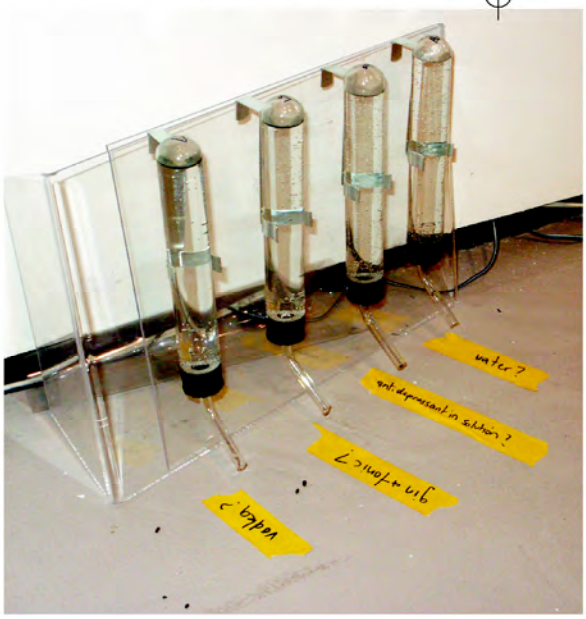
Figure 1: Milgram's mice

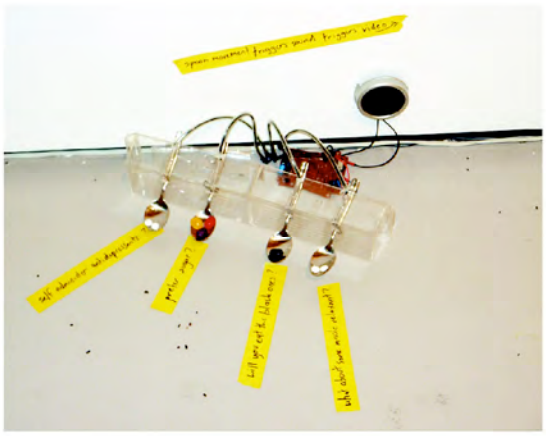
The first device(on the left) is a light switch that can be controlled by a mouse. The mice can accidentally trigger the light switch, that is, discovering it, as they are running along the walls, aka mouse freeways. If they find the lighting useful, fun or interesting they can then learn how to trigger the switch deliberately [in other words: operant conditioning]. The webcam on far right high on the wall is triggered by light.

The second device incorporates spoons containing a selection of test products. When the mice touch the spoon to sniff or nibble the medications – Aleive muscle relaxants, Prozac and Lexapro in this case – and jelly beans, they trigger sounds – samples of my favorite percussive tracks. This means that if they like the food I can know about it. I can hear their repeated use of it (which also triggers the webcam) and can figure out if it is the same mice or different ones. The sound may deter them, or maybe the mice will learn that the sounds aren't directly related/ connected to a danger, or perhaps scratch up some music, playing the spoons. I can hear which sound they trigger, which of the antidepressants is popular, and are they favored over the jelly beans. They may learn to use the sounds as a way to signal other mice, and/ or relay to them not to eat the medication or food. (the reverse is not true – i.e. it is impossible for them to eat without triggering sound. The webcam is triggered only by the sound.

The third device enables the mouse-administration of fluids. Each of the 4 containers has a different transparent fluid: vodka, water, anti anxiety medication in solution, and gin. These fluids are filled to the same level. The difference in the mouse's preference can be compared by the relative fluid height. The webcam is triggered by any change within the fluid levels.

The forth device is the webcam, triggered by sound, motion or light. The AXIS 2120, with audio module, allows you to listen and communicate with the mice. This means that you can address the mice you see in the webcam and they might possibly begin to recognize you and try and learn to respond to your particular voice. They might also become aware of the fact that the noise does not belong to a body.





Animal Models, Political Experiments

Will mice deliver food to a trapped mouse?

Cynical? Unrelated birds have been observed doing just this across species boundaries. There was a touching scene observed of a Robin regurgitating food into a flailing song sparrow in late fall, who promptly perked up. Just because you haven't seen it doesn't mean they don't.

Will mice in Paris deliver (or take) food from a trapped mouse?

Will mice in Manhattan deliver (or take) take food from a trapped mouse? That is to say, how different are mice geographically? As different as the humans are, or more different? After all they have had many more generations than humans have, and presumably less interbreeding, global travel, and immigration. Is it cultural or genetic variance?

Will mice work to deliver food to other mice? How do they cooperate and collaborate to deliver food?

To test mice governance models you need to start with a question like the above about the relations between mice, simple devices to test these will follow. Think of these as political experiments. After all, resource distribution (resource in this case food) is the fundamental problem of governance. Who gets the food, in what order, how is it shared? Humans have lots of problems with this and it is possible that mice are better at managing this than us.

An easy cheap way to get answers to these questions and more, is by trapping your mice in so-called humane traps. Most of us don't have compunctions about trapping mice this way, temporarily. If you do there are plenty of other experiments to do. The traps pictured below are the ones I recommend and cost about $1.75. They are easy to adapt by drilling through the back wall to make a small food exchange opening, about 2 cm (1/2inch) diameter. These little traps allow some visual access without being clear which makes it a little more comfortable for the mouse inside.

Figure 2:
Recommended mouse trap.
With rather large mouse trapped!

Figure 3:
One way door has perforations so a mouse can last in there for a couple of days.

Figure 4:
trap in place for POV of motion triggered webcam. If you don't know mice use walls as their guides. Set up your experiment on the mice freeways.

Drill the hole a couple of cm's from the bottom so the food does not accidentally fall in and out, and place the food in a small neat pile a few cm's/an inch from the back of the trap. This way only very deliberate exchanges happen. I tried more elaborate food delivery mechanisms, and spent a lot of time working on a water wheels made of fake fingernails but the hole worked just as well for sharing and taking. If you use soft thick Chinese noodles you will see just how dexterous these creatures are.

Warning: Mysterious Communications

Be warned that your mice may quite quickly learn to avoid these traps. In my case they worked for abut 2 weeks before the whole population wised up to one way doors. Perhaps you can solve this mystery: how do they communicate that the trap is dangerous and not to go in there?

I am confounded by this! I was very quick at emptying caught mice, so they were unable or had little time to communicate with each other about the trap. I also washed the trap before reuse to prevent chemical communication. Still they learnt. Now my mice will march into another trap (the tin cat trap) set up right beside one of these.

I have been testing this further.

Art for Mice and Mice for Art

These were not included in the picture above, because this was exhibited in the Yale art school gallery. Like many galleries they have nonnegotiable rules that will not allow actual mice to be (intentionally) exhibited, even though the students who work in the building testified to the presence of mice that keep them company in the wee hours. Nonetheless mouse traps (or temporary entrapment) are permissible everywhere else without animal subject clearances, unless you try to do this in a laboratory.

The resulting video clips of all of these experiments are viewable at the website
http://xdesign.eng.yale.edu/MilgramsMice

Your Mice, Your Environment, Your Information

These devices are particularly useful for those interested in how 'your' mice (i.e. those that share the same local environmental stressors) respond to 'your' medications or other substances you like to ingest. You can then compare your results with lab-based studies, and get a sense of the difference.

The fable of the lab mouse and the feral mice: an update of the city mouse and the country mice.

Difference? Well for one thing how much do you believe the studies based on mice and rats in cages in labs – how do you think you would behave or feel in a cage in the fluorescent comfort of a lab. Think Goth – rats and mice really do not like bright light as you might have noticed, nor cages, nor isolation. Furthermore, they are highly communicative, urban animals with territorial ranges and complex social structures. What does solitary confinement do to you? And yes, it is not only OK to empathize with mice , it is basic premise of contemporary biomedicine.

This "shoebox" cage contains a new product called EnviroDri ® (Shepherd Specialty Papers, Inc Kalamazoo, MI) as an nesting material for the laboratory mice. This recommendation is part of the new report: Environmental Enrichment for Laboratory Animals published in April 2004. **http://www.ivis.org/advances/Reuter/stewart/chapter_frm.asp?LA=1**

Over 95% of all medical research on animal models is done on rats and mice before jumping straight to humans. This is a figure that is widely promoted at universities and other research labs to deflect the animal sympathizers. Apparently the idea of submitting rats and mice to inhumane conditions is less offensive than applying the same treatments to rabbits, dogs, monkeys et all...

Anyway, reciprocity would suggest that because mice are used as animal models for everything human, from human cancers, diabetes, motivational, aggressive and addictive behaviors, sexuality, maternal behavior and for testing anti-anxiety and antidepressant medication, that is, higher cognitive and emotional modeling, then the approximation must works both ways. If they can model us, we can model mice, or put in another way, mice stand in for humans as well as humans stand in for mice. So go right ahead and empathize, from your highly communicative urban animal point of view.

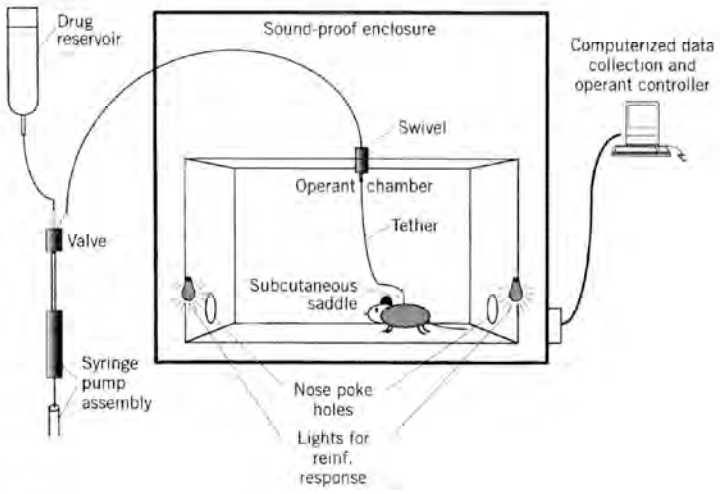
Theory of Mind

There is an oft-quoted study of wiring up a rat with a mechanical method to stimulate the 'pleasure center' in the brain (it would be nice to think there were more than one). The story goes, that the rat will keep pressing that pleasure pedal in lieu of food, drink or other necessities until it dies of starvation, presumably happy. This is often used as evidence in an argument that we are slaves to pleasure, that values are a mirage, that biological imperatives override all rational political decisions or agency (I know this is extrapolation is more than a stretch... but that doesn't stop it being used). But the experiment prompts many questions: Would the rat still do this if s/he were among friends, family and there were many other forms of pleasure to choose among? With foreknowledge of the pleasure derived, would the rat choose the discomfort of the electrode insertion and accompanying social isolation?

This result would be much more persuasive if the poor rat didn't have its brain exposed with an electrode sticking in it, was not confined to a cage and was not inside a lab. Suicide rates are higher in both incarcerated humans and animals, whether slow self-destructive behaviors of starvation, self-mutilation, aggressiveness, and killing offspring; or through faster more dramatic methods favored by inmates (suicide is the leading cause of death in prisons). Aberrant behavior is the term used in the behavioral neuroscience literature, but the aberrant is normal in labs, it is normal in prisons.

What do we learn from the suicidal pedal-pushing pleasure rat? What is the information value of a rats behavior in profoundly abnormal social circumstances? Some might say: less than the influence of that study would suggest.

Our guy Milgram, who used his life to study social constraints, social determinants of behavior and institutional critiques/ experiments said the (self-described) major lesson of his research: "... often it is not so much the kind of person a man is as the kind of situation in which he finds himself that determines how he will act" (1974).



Nick Grahame and Chris Cunningham did this drawing of the operant system for intravenous self-administration of drugs in mice at Oregon Health Sciences University. Essentially when the mouse pokes it's nose through the hole it can trigger increasing doses of cocaine (or drug of choice) directly to the brain or other area of interest. Mice perform about 90 nose pokes per hour for cocaine and 20 nose pokes per hour for nicotine, 5 nose pokes per hour for saline, but this varies tremendously between strains. Note the isolation of the mouse most likely introduces aberrant behavior through the stress of social isolation.

Presumably this is similar for rats? Maybe we are more or less socially constrained than another social animals... But this would be interesting to know.

Testing 'biological' mechanisms without understanding how they are constrained, changed and modulated by social and external structures, or the effects introduced by the (lab) research itself, is based on the presumption that rats and mice make adequate biological models but not adequate social, political or ethical models; this division is a little forced, right? It is as if social phenomena are not biological, and vice versa. Whereas the biotech hobbyist understands that they are intimately interconnected – the triple helix as Lewontin calls it – the traditional organization, of traditional research, separates these. There is also a reaction against work that has come to be called Sociobiology and Social Darwinism: The attempts to explain complex social behavior – like (and especially) social stratification, sexual behavior, rape, aggression, parental instincts, depressive disorders, anxiety, even political preference – as biological mechanisms alone have made many good careful thinkers wary of the use of the animal models for developing social understanding of human societies.

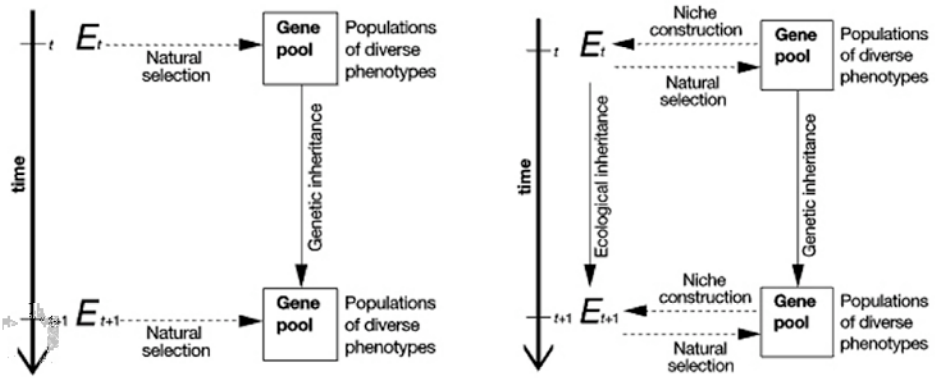
But from the view point of the biotech hobbyist, I would like to suggest that the radical differences in biology (did you know that mice can jump 10 times their body height? straight up!! can u imagine being able to do that?) are no more radical than the radical differences in social structuring and constraints. And that the similarities can be made explicit but only if you understand what you can see inside a lab and what you can see outside one.

Theory of Lab

A few things to understand about lab studies so that you can understand the value of your extra-lab biotech hobbyist studies... with your mice (by which I mean to convince you that the value is potentially high).

Labs are designed to control experiments so that the researcher can control the variables involved. Labs are designed to exclude the world and to let one thing in at a time to test, so you know what you are seeing. However, this excludes many of the things that are interesting and important about organisms: like their environment, like the organisms' actions on the environment, like the organisms' adaptations to the environment, and the organisms' adaptive capacities. Darwin's idea was that the later was the most important thing in the evolutionary process of natural selection. The way he put it: "it is not the strongest of the species that survives, nor the most intelligent, it is the one most adaptable to change". Put in another way by my favorite evolutionary biologist: "...Natural selection over the long run does not seem to improve a species' chance of survival, but simply enables it to 'track', or keep up with the constantly changing environment."

So while this is a fine way to go about asking some interesting questions, it doesn't work so well if we acknowledge that the environment plays a significant role – and it does. In social animals this includes the social environment. Moreover, if you recognize that organisms are defined not simply by an internal code, but by their environment and the interactions between that code and the environment (aka the organism), lab studies leave out 1/2 the story at least.



We can begin again from the idea that the environment defines organisms genetically, behaviorally and socially with room to adapt to different contexts, and act on these. Then the environment becomes much more important, although still difficult to see in it pervasiveness. It is not the painting on the back of the diorama in the Natural History Museum; it's the driving force without which biology and the evolutionary process make no sense and can't happen. The idea that you could preserve an organism by preserving its DNA is lacking. It is like the idea of preservation through photography, or through detailed drawings; or collecting dead stuffed specimens who seem less sad than the live specimens in the Zoo. The animals in the Zoo are kept in the same categorical boxes that are just a little bigger than in the Natural History Museum – they are not able to manage their own territory, feeding, governance, mating or cross species interactions and are therefore unable to act as animals.

Nonetheless, collecting organisms is the prevalent form of knowledge production that now has its genetic era. Now we have to bear press coverage with heroic images of Venter, heroically 'hunting' genes to be able to collect and bank his heroic codes. No matter how many he collects he obscures each organisms dynamic relationship to the environment, their raison d'etre.

So remember, labs are designed to hold the 'environment' outside, and exclude any complicating parameters with which the research(er) is not immediately concerned. But this introduces more. Remember the isolated-lumps-of-biology image that is favored in the popular coverage of biotech context. There is lots of press about isolated lumps of biology because that is what the institutions of laboratory science are about: put a lump of biology in the lab and poke it and see what it does. They try to put together a puzzle while throwing out most of the pieces.

The biotech hobbyist knows that genes do not define organisms, and precisely because you are not in a lab you can see things that laboratory science cannot, and can see the limitations of laboratory investigations of whole organisms.

Labs don't just remove things of interest, they introduce many special conditions of observation. Take the mice used in labs. You cannot just catch any old mouse and keep it in your lab. I have tried this, and the full wrath of the Institution came down on me. You have to buy rodents at some expense from accredited suppliers [supplier listed below] who know the pedigree of the mice, will guarantee that they don't carry the bubonic plague (not sure what else), and keep track of what modifications and characteristics they have been bred for. Have a look at the product catalogs listed in the laboratory animals publication [website and (free) subscription details below] and look at the lists of transgenic and knockout mice, custom ones available too. It is a lot like Pokemon.

http://guide.labanimal.com/guide/index.html

So, where do the companies get their mice? This is where it gets interesting because almost all the mouse products originate from a handful of mice donated to Harvard by a Boston based fancy mouse breeder at the turn of the (last) century. Sound familiar? Just like the human genome project is actually mainly Venter's very own genome, a self-portrait really, and the mice are all selected by a fancy mouse breeder. What is good breeding in the mouse breeding world? Although it is likely the breeder donated her duds—wouldn't you?—the ones that were no good for showing. Now combine this already strange isolated poodle mouse population, to the idea that this population remains isolated for a significant time period in the evolutionary timescale (over a hundred years at twelve generations/yr is approximately 1200 generations) where the environment that is being selected for is actually the rather peculiar environment of the laboratory (and the commercial laboratory supplies industry that has grown around this). This suggests more fantastical implications than the Galapagos Islands. And it is this organism that all modern human medications, genetic therapies, behavioral studies etc are developed on.

What is the relationship between the lab mice and the mice that live in your neighborhood?

This is an important question for the biotech hobbyist. My own opinion is that Manhattan mice have a certain manic sophistication that I didn't see in the New Haven mice, they actually live more densely than the text books suggest , and they are tremendously clever at detecting food stuffs through all sorts of toxic packaging,

A word on the WILD mice of your neighborhood

So unlike the lab mice, your non pet mice have been happily tracking the changing urban environment which manages to support you both. Yes, they are exposed to the same cocktail of environmental stressors, i.e. air pollutants, lead paint, asbestos levels, volatile organic compounds and every other common urban pollutant that your biology is dealing with too. Moreover they are probably eating essentially the same foods scavenging for refined sugars, stale white bread etc that are plentiful in urban contexts. Yet all the reasons that make them popular in labs hold in the wild too—where the wild means inside the walls of your house. Mice breed fast, so you can observe developmental issues that are too slow in humans, you can see the effect on lifespan, and heritability of traits. Mice also have a much smaller body mass than you, so although they are dealing with the same environment that you are, they are testing it at much higher doses—like in labs where they are administered higher per gram doses than would be humane for humans.

These mice have a tremendously high information value – to you. How are they coping? What cancers are they getting? Do they get diabetes too, and how do they deal with excesses and obesity?

If you can figure out how to ask them these questions, or if you can learn how to read their behavior this could be a very useful representation of your environment. That is what the kits do.

Think of your mice as your friends and biosensors, your smart distributed environmental monitors.

My mice are smarter than your mice

The comparative value of your mice and my mice are tremendous. What are their different political organizations, how do they distribute resources. What forms of governance do they use? Do mice societies exist without punishment? How does this vary across environments? How do they deal with aberrant behavior we have seen them capable of in labs?

One thing remains to be addressed before calling a truce on the rodent war and bringing them into the information age. They have a very bad reputation for their standards of hygiene, and are conflated with the very idea of icky dirtiness. Like many people I believed that they were not only dirty creatures, which they are not, but as a population I believed that they were a "reservoir of disease". It is a phrase reserved for, and synonymous with mice and rats. So, what are the health risks of having mice around? This was a question I put to the NY Dept of Health, when I first noticed the mice around my place, and in my kids' favorite park. I was expecting an official report stating associations with respiratory disorders and lists of studies. But they had none, and combing through all the State Health Dept. public warnings only revealed one case which I already knew about – the Deer mouse – which prefers rural plain country.

Subsequently, I went hunting and have not found any population studies that can demonstrate that mice have more diseases than other creatures, horses, cats, dogs, cows, etc. Like all creatures they share some diseases with humans – they died from the bubonic plague too – which is precisely why they have information value, and why animal models have any associated value to humans. But they are also different enough so that most of their ailments and ours do not cross. A person is more likely to catch diseases from other humans than from a mouse. It follows that eradicating mice in the name of eradicating disease, even if we could, would have little or no effect on the amount of disease affecting humans. It would be much more effective – to extend this logic – to avoid any contact with other humans. But humans have more value to us than their associated risk. The same could be said of mice. So next time they are about to check you into the infectious disease ward ask to be taken to the Zoo, for your own safety.

Some anecdotal evidence you might draw upon to address that deep squealing reaction to mice that some of us carry, is that mice seem to thrive in art museums/galleries. These clean white boxes that are themselves the icons of gleaming clean poised human culture are favored by mice. Think about the implications of this. Highly controlled areas with limited substances entering these spaces, no popcorn, no other food or drink (except at the openings), no pets, no plants and nothing else alive. Find a more sterile urban environment than an art gallery, yet they seem to be as often as not inhabited by mice. Ask your local gallerist and then think about this peculiar environmental niche. Why do mice like it? What do they select this environment for? Nonetheless, they are nice company late at night when quietly installing; a secret audience that appreciates the spare lighting.

Initial results:

In the Yale art School gallery where these kits were set up – a brand new building – there were at least 6 individual mice spotted, though the gallery did not want to leave the lights on at night for better images. The mice immediately noticed their art – the first night and seemed to have returned each night.

But the main thing about mice is that they survive. They are better at sharing resources with us and we can learn a thing or two from them. We may as well.

Surviving

Now whatever you think of mice – and I am likely to squeal if I come across one in my home, I remember the deep disgust when I first saw rats in the Manhattan subway – you have to hand it to them: they have a collective genius at adapting, surviving and thriving is tremendously diverse urban environments, despite (and sometime I think because of) our collective best efforts. In fact we could draw an analogy between the thousand year rodent war in urban environments to the so-called war on terror. Both are insidious, fought largely on the homeland, although ever shifting fronts. Both are never really won and both are animated more by fear than risk. It is worth considering that in 'the war against rats', the US has been failing to prevail for much longer, despite its use of the full repertoire of stealth tactics, Special Forces, bombs, biological and chemical agents.

What has been successful in the Rodent wars in New York? The non-violent methods of population control, i.e. sparrow and urban birds – it is natural competition and not predatory tactics that have been the most effective. Then perhaps the war on terror could learn that population pressure is the answer. We will come back to this... but the point is they are not controlled nor barely managed by humans. It should be known that the most powerful country in the world can't manage its own rodents. Come visit Manhattan and see.

So why Milgram?

The title 'Milgram's Mice' was developed after a scare of 'wild' mice in the Yale research buildings, including Dunham lab. While mice are ubiquitous in New Haven like the rest of the East coast of America (and beyond) their presence at Yale created institutional panic because of the perceived threat to the hundreds and thousands of dollars worth of laboratory mice and rats. The idea is that wild mice might infect, inseminate or contaminate the controlled laboratory conditions... mice-ogeny!! My dear Dean Fleury sent a lovely note admonishing the entire faculty to be neat and clean and not to leave any food in our offices and labs. It was very motherly.

My building and office and lab were a few doors away from where Milgram performed obedience experiment asking participants to administer lethal shocks to performers, and ushering in a new era of human-subjects committees. Scientists were no longer trusted to self govern, and administers pointed to the post-experiment trauma of the subjects involved. Although many of these subjects also claim to be pleased to have been involved in such important experiments, nonetheless it struck an institutional nerve. In addition to doing the experiments at Yale, he also performed the same experiment in Bridgeport, a neighboring town that does not have an Ivy League institution, nor really any institution of much influence. This was an experiment within experiments to see the effect of the differing institutional contexts. These are exactly the experiments left out of medical research. You might be relieved to know that the level of obedience in the subjects was not drawn from the institution of Yale, but the person to person interaction and the perceived authority of the experimenter. There was as much obedience in a nondescript office in Bridgeport as observed in the nondescript office at Yale.

The legacy of Milgram's experiments that haunted the hallways like the mice, emphasized the effects of "the kind of situation a man or mouse may find himself in", the environment or the context. This was much cited in the recent Guantanamo Bay snap shots of torture, and Milgram's own interest was in explaining the German citizens role in the extermination of his family. We can't now downplay the import of this. The compliance rates that Milgram's experiments, repeat and sequel experiments show – hover around 80% – and have much much more explanatory power than any wild genetic associations. It blows them away. While the press gives lots of attention to genetic behaviorism, at it's most successful, it never begins to approach this level. Earlier I spoke of BRCA I and II gene markers which are associated with only 4% of all breast cancers and which are the most successful of genetic markers. Most genetic associations, like all schizophrenia and aggression markers register only a few % points (100th and 1000th), and disappear with more stringent statistical methods.

The good news is that by placing emphasis on our social and biological environment, rather than the internal genetic codes, we have far more agency and effectiveness. If we find effects, we can act on these and effectively change the prognosis. If you find a genetic association, what can you do? Probably nothing. It is like gambling.

Milgram's institutional critique and the (self-described) major lesson of his research: "...often it is not so much the kind of person a man is as the kind of situation in which he finds himself that determines how he will act". (1974)

Genetic Horoscope

What do your genes have in store for your future?

Ashkenazi Woman

Dear reader, your genetic odds are stacked against you. In addition to having a 4% chance of carrying Tay-Sachs Disease, a 10% chance of carrying Gaucher Disease, and a 21% chance of carrying Familial Mediterranean Fever, there is a 2.5% chance that you carry a mutation of the BRCA gene, which confers a 60% lifetime risk of breast cancer. BRCA mutations account for approximately 20% of Jewish breast cancer cases. But there is also good news: there is a 20% chance that you carry the ADH2*2 allele, a variation of the gene that codes for an enzyme that metabolizes alcohol. Under the sway of this mutation, you can expect to drink less and have more adverse reactions to alcohol, which will make you less likely to succumb to alcoholism (Hasin et al 2002).

African American

The genetic dice have not fallen in your favor. Your risk for developing Alzheimer's is 14-100% higher than that of the general American population. While several genes for Alzheimer's have been identified, the illness is significantly more common among individuals who never received a high school diploma. Beware: you also have a 33.5% chance of developing hypertension (35.8% among women) (Hajjar and Kotchen). Suicides (which are now believed to be genetically influenced) among African American youth increased 233% between 1980 and 1995, compared to 120% among non-Hispanic whites (Surgeon General). Chances are good that you will become a heavy smoker, especially if you carry a gene prevalent in the African American population which predisposes you to nicotine addiction.

Native American

A piece of advice: now is the time to pay attention to your health and to start thinking positively. Your suicide rate is currently 50% higher than the national average. Furthermore, you have a 60% lifetime risk of alcohol dependence, and are twice as likely to be alcohol dependent under the influence of the ADH2*1 allele (Wall et al. 2003). You are almost three times as likely as the general US population to contract Type 2 Diabetes, even higher if you are an Arizona American Indian (65% prevalence in men, 72% in women) (Gohdes 1995; Lee et al. 1995).

Homosexual

Stop beating yourself up! You are not at fault for your sexual orientation-it was preordained by your genes. Studies of identical twins show that if one twin is gay, there is a 48% chance that the other twin is, too (Bailey 1993). Scientists have also shown that lesbianism is a genetic trait with 50% heritability (Hershberger). And if that isn't enough to convince you, consider this: experts who have measured the physical characteristics of gay men say that homosexual men weigh less, have lower spatial ability, and larger genitals than their heterosexual counterparts. Also, you are more likely to be left-handed than the general population (Hershberger 1999).

School Children

News flash: there has been a 900% increase in diagnoses of autism since 1992 (U.S. Department of Education). If your parents don't have you diagnosed as autistic, perhaps you could still be "autism-lite": in a group of 10,000 school children, between 23 and 36 students have Asperger's Syndrome. If you are a boy, the prevalence jumps to 60 in 10,000. You are much more likely to be diagnosed with Asperger's if you are the child of Caucasian, upper-middle-class professionals. But even more certain in your near future is a diagnosis of ADHD, a disorder that might be associated with mutations of dopamine receptor and transporter genes. You have a 7.5% chance of being diagnosed ADHD, and if you are an American child, you are 20 times more likely to be diagnosed with ADHD than a Western European schoolchild (Barbaresi et al. 2002; Osborne 2002).

Intelligence

Do you think you're brainy? Here are a few ways to find out for sure: If you wear glasses, you are genetically more likely to be an intelligent person. While only approximately 15% of the general student population is myopic, at least 44% of students with an IQ higher than 135 are near-sighted. However, myopia also increases with academic status: while only 4% of Taiwanese 6-year olds are myopic, 70% of Taiwanese 15-year olds and 95.5% of Taiwanese medical students are near-sighted. It now appears that intelligence is 80% heritable, and has a 40% correlation with brain volume, which is 85% heritable (Posthuma et al. 2002). A recent study shows that Caucasian brains are 4% larger than Black ones (Rushton 1995). Also, if you are intelligent, you are more likely to give birth to an autistic child than a parent of average intelligence (Eldridge 1971).