Once again, what appears to us in the mystical guise of pure science and objective knowledge about nature turns out, underneath, to be political, economic, and social ideology.

—R. C. Lewontin

Introduction

Contestational Biology

Over the past five years Critical Art Ensemble (CAE) has traveled extensively doing participatory performances that critique the representations, products, and policies related to emerging biotechnologies. When we do projects concerning transgenics, one of the most common questions participants ask is whether CAE is for or against genetically modified organisms (GMOs). The reply from group members is always the same: We have no general position. Each product or process has to be taken on a case-by-case basis. Some appear disastrous (primarily to the environment), while others seem soundly engineered and useful. The real question of GMOs is how to create models of risk assessment that are accessible to those not trained in biology so people can tell the difference between a product that amounts to little more than pollutants for profit and those which have a practical and desirable function, while at the same time have no environmental impact. Making such decisions is further complicated by a general lack of understanding of safety testing procedures. For those without scientific training, the question of what constitutes scientific rigor seems to be a mystery, and reading a study on the safety of transgenic products appears to be a mountain that is too high to climb. The concerned public can be further bamboozled by specialized vocabularies. The result is that individuals are left with the implied obligation that they should just have faith in scientific, government, and corporate authorities that allegedly always act with only the public interest in mind.

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

However, while such perceptions have a serious degree of truth to them, they are also overexaggerated. Within a very brief period of time, anyone who is modestly literate can learn the fundamentals of scientific study and ethics. To give an example of how scientific matters are often easily understood, consider the following. Studies should be replicated numerous times not just by a single lab, but in conjunction with other labs to see if the same or very similar results are consistently obtained. If each lab shows the same findings, then the hypothesis or theory guiding the tests is said to be reliable. Reliability is a key indicator of test validity. Until reliability studies are done, a given result is suspect. Obviously, one does not need to be a scientist to understand that if a study has not been repeated by independent sources, the data are questionable. If the only replications were done by the lab (usually the lab is corporate, but academic labs are suspect too) that will financially benefit, one does not need a Ph.D. in ethics to know that this violates scientific codes of conduct due to a conflict of interest that could radically skew data interpretation (if not the data itself). Currently, biotech corporations are the primary if not sole suppliers of data to the Environmental Protection Agency and the United States Department of Agriculture for commercial licensing permits for genetically modified organisms. Amateur discourse clearly has a place in the transgenic debates since some levels of study can be reviewed by nonexperts. The stakes are too high for product safety testing to be left solely in the domain of corporate and scientific experts.

Representations of the transgenic face a deep contradiction, albeit one that emerges from imperial and/or corporate culture. The spectacle of transgenics, as usual, tends to consistently support profit initiatives, and promote the idea that the "free" market always works in the public interest by saving us from environmental, health, and population problems. Unfortunately for corporate culture, the historical representation of the rules of social purity and pollution clash with the utopian representations of transgenic products. While the former insists on maintaining natural purities and claims that it is unwise, if not catastrophic, to intervene in the engines of creation, the latter presents a world of molecular exchange that will benefit everyone. This second position is not doing very well at convincing the consuming public that genetic engineering is a good idea. After all, dislodging ideological imperatives that have settled deeply into every classist and racist separation for the past three millennia is not an enviable task. This ideological contradiction is all the more difficult to reconcile because capital does not want to disrupt effects beneficial to colonial and endocolonial initiatives that the current ideology of separation provides, thus the construction of a doublethink is required in which mixing the categories of nature is sometimes good and sometimes not. While the manner in which such imperatives are structured and selected actually depends on what is most profitable, it cannot be represented that way. Somehow this contradiction must be mythically represented and thereby normalized through the filtering code of the natural. Biotech companies have failed to solve this problem, and while they still try a variety of public relations campaigns, the fundamental strategy has been to just produce and deploy whatever transgenic products are predicted to be profitable, and not emphasize the quandary, hoping that as the consuming public builds habitual associations with the products, the problem of public "hysteria" will solve itself.

As a cultural resource for artistic material, transgenics is becoming a trendy exploitable topic for savvy career-minded cultural producers. Not that this trend is atypical: Whenever new vision technologies appear, and less endowed areas of specialization (like art production) finally gain access to them, there are those who will immediately seize the opportunity to exploit new aesthetic possibilities. It seems reasonable to assume that at this very moment, some artists are exchanging their web cams for electron microscopes. And already, the "art world" has begun to see work derived from molecular biology drifting out of the laboratories and into various cultural spaces. With two decades of the vision-tech explosion behind us, what is ahead is relatively predictable—monumental molecular landscapes emphasizing the paradox of scale and the colorful beauty of the micro-world, and the next step in living sculpture, consisting of expressions of frankensteinian desire in the form of manufactured or intentionalized life forms (glow-in-the-dark rats and proteins performing textual patterns). To be sure, these projects of technological and/or formal novelty will be more depressing this time around, because so much of the highly visible is and will be as apolitical (or hiding its politics) as possible and designed to further feed the cultural commodity's market for novelty. In terms of political economy in general, such work does help educate the public, but also functions on behalf of corporate culture to calm public skepticism by ripping bio-imaging out of the realm of political debate and fortifying it within the spectacularized and specialized bunker of aestheticization. Corporate and state culture could not ask for better public relations work, and hence the willingness of corporations to fund high-profile cultural manifestations such as Ars Electronica in Europe, or the museum extravaganzas at the Whitney Museum of American Art and San Francisco Museum of Modern Art in the US.

Finally, the problem of policy comes ready-made. Developments in transgenics will follow the path of all goods and services under capital—that is, they will rarely be in the public interest. Pancapitalist policy only fuels, strengthens, and expands the profit machine. Molecular invasion and control is rapidly being transformed into new types of colonial and endocolonial control. The focus seems to be on consolidating the food chain from molecular structure to product packaging. With the ability to better control species expression, corporations have a better chance than ever to intensify developing nations' dependency on western corporate economy. Food must either be purchased from corporate food suppliers, or the necessary organic and chemical materials must be purchased. Either way, resource management is controlled by western capital. Farmers can be leveraged either to grow cash crops like cotton or any combination that is most advantageous to the colonizer. This plan has existed since the inception of industrial farming, so food resource hegemonies have simply been given another powerful tool that fits perfectly into the current structure of domination.

In addition, any form of molecular capital can now be appropriated—it is an open frontier. As with all named and controlled objects, now, genomes, enzymes, biochemical processes, etc., will all be privatized. What was once communal and controlled by traditional authority and common understanding is now usurped by separating its molecular or chemical value from its holistic phenotypic value. For example, a plant used in traditional medicine that had general (economic, political, spiritual) value can be transformed into something of solely economic value as a chemical compound. This compound can be patented, and while the plant could still be used, the active ingredient cannot, thus functionally removing the plant from the common resources. In a moment of eco-piracy disguised as Lockean property rights, the labor of separating the various micro-properties of the plant overrides any holistic function and collective ownership.

The standard argument for eliminating any trace of the commons is to say that common property is an inefficient way to manage resources. If efficiency is increased, more goods are available, so everyone gets more for less. However, we know after two centuries of capital that the only people who get more are the owners, while the poor and disenfranchised completely lose the little resources they once had access to. The assumption that efficiency is a totalizing good is nothing more than a disgraceful example of the particular values of the powerful being represented and internalized as universal.

Efficiency stings in other territories as well. Environmental neglect, pollution, and exploitation in regard to transgenics are all occurring in the name of efficiency. Capital in the US is obsessed with speed in general, but in this case its interests are in closing the gap between the time when a product is developed and its arrival on the market. Efficiency, in this case, means profitability. Once a product is shown to function, it is ready for distribution. Transgenic products are being made available as soon as possible in order to establish a firm market niche. At present, no one knows how transgenic products will affect the environment. While the prognosis is generally optimistic for the short term, the long term is another matter. No long-term studies have been done on new types of crops and creatures, and could not be, because the technology is too new. One would hope that the producers of such products would want to err on the side of caution and wait a few decades before releasing genetically modified organisms so that proper long-term testing could be done, but for the most part it is too late now. The engine of progress (i.e., profit) moved forward, leaving the general public unaware that it had left the station. Should there be any future difficulties, those who released the GMOs will not even be held responsible for cleaning up the mess. Secondary hazards are just part of the risk of doing business.

What can be done to alter this situation? The answer is as singular as the pancapitalist machine itself—disturb the profit flows. Certainly, the use of traditional and electronic methods of contestation will be useful, but how can the new molecular/biochemical front be directly engaged as a means to disrupt profits? This is an area that is completely undertheorized, and is the subject matter of contestational biology. Two immediate hurdles that must be cleared are the connection of bioresistance to violence and the tendency of resistance to be urban-based. Given that living organisms are of concern, it is quite likely that introducing inertia into the profit system will damage genetically modified life. Industrial culture has had the environment under fire for decades (and in some areas for as long as two centuries), so CAE is only proposing returning fire.* Further, the rules of engagement are pretty well established. If one assumes that bioresistance should use violent methods only as a last resort, and only to the extent necessary to be effective, a number of possibilities that will not lead to jail time present themselves. Corporate culture has long maintained that violence through secondary consequences is not the fault of an individual agent or institution. For example, if a manufacturing process causes acid rain, the manufacturers are not responsible for any ill effects on flora, fauna, or other environmental elements, nor are they responsible for any type of clean-up. If the resistance can locate itself in the same fuzzy field, legal counter fire is possible that would be disturbing and effective.

The second problem is deciding how to redeploy resistant forces. Currently, the majority tends to focus its activities in urban areas. Only the green movement has developed methods for rural and wild areas. The means by which rural capital can be used for resistant purposes is only modestly theorized. Bioresistance is still waiting for the day when a demonstration of 20,000 people will be launched at a Monsanto test site in Alabama, or when farms dedicated to the development of resistant species will appear. This logistical problem and need for redeployment gives nomadic capital quite an edge in terms of maintaining its

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*This method provides an escape from the current renaissance of propaganda by deed—a very gratifying experience, but one that leads to little in the way of profit disturbance or policy shift, and that justifies escalation of violence by the authorities against all resistant manifestations. Propaganda by deed was a late 19th century, early 20th century tactic in which a revolutionary makes a bold, violent gesture to get media attention and fan the flames of the fire burning in the hearts of revolutionaries worldwide. A good example of this type of heroism was Alexander Berkman's attempt on the life of the Carnegie Corporation's Chairman of the Board Henry Frick in reaction to the Homestead lockout. The attempt failed, although it still had international implications for the morale of revolutionary parties, but did not affect steel manufacture or labor management policy. This idea had some merit at the time, but seems less significant in an era when commercial media is monopolized by capital.

activities in territories where social and political friction is minimal.

In the following chapters, CAE examines how to use rogue representational capital for purposes of consciousness raising, and attempts to model the possibility of contestational biology. Hopefully, this book will be a helpful contribution to the development of increasingly complex ways and means of slowing, diverting, subverting, and disturbing the molecular invasion through radical appropriation of knowledge systems and appropriation of the products and processes developed by imperial powers.

He turned his thinking
Toward unknown arts, changing the laws of nature.

—Ovid

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Fear and Profit in the Fourth Domain

One symbolic, dual directional, vertical flow that continuously proves fruitful in the examination of cultural structures and dynamics is the continuum between purity and pollution. The social organization of normative conditions tends to place purity at the top of the cultural value hierarchy, while pollution tends to lie at the bottom. There is no cross-cultural consistency in expressions of this separation in terms of belief, behavior, and representation, and within each culture, there are always contradictions and exceptions to the rules. To be sure, the endless negotiation of how to navigate through and organize the perceived manifestations of purity and pollution is a primary part of cultural becoming, and in many ways is key to describing and understanding cultural difference.

In western cultures, centuries of intense cultural exchange among the nations of Europe and North America have given rise to fundamental metanarratives that channel the expression of the categories of purity and pollution. Two fundamental and often linked metanarratives are God and Nature, which are charged with symbolically managing thoughts, behaviors, representations, and all other forms of expression by associating with them various degrees of value, legitimacy, and acceptability. Purity is a positive subcategory of these primary codes, and hence purity is associated with signs of goodness, legitimacy, and the authoritative. However, human agents are not only discouraged from fully realizing the category of purity on an earthly plane, they are forbidden from doing so. This quality is transcendent and beyond the capacity of humans. Anyone who claims purity (to be without sin or sickness, for example) will be punished by being classified and treated as a hypocrite, a criminal, a heretic, a schizophrenic, etc. Individuals instead are supposed to attempt to approximate the ideological phantasm of purity as best they can. However, even this expectation cannot exist in an unblemished form without endangering a given social constellation and the individuals within it. At times, pollution may or must be embraced. For example, if we accept the Freudian thesis that cleanliness (freedom from pollution) is a necessary part of civilization and associated with purity, it could be said that the accepted presentation of an individual covered in sand while at the beach is a retro-norm. Or, when a cancer patient must endure chemotherapy, thus allowing impurities to enter the body, this form of pollution is socially accepted and even encouraged, when it is medically authorized.

Even though the purity/pollution polarity is one of imperfection and approximation, there are elements of the profane, the unclean, and the polluted that are strictly taboo. One of these general elements is the mixing of "natural" separations. Not only is such mixing not tolerated (unless it is due to the intervention of entities and/or forces outside of and in some way superior to humans), it has traditionally not even been believed possible. For example, in a crude system of classification, such as animal, vegetable, and fungi, normative standards deny that these fundamental elements may be mixed. Historically speaking, these are categories of purity of form that are transcendent. To mix them would be a crime against God and/or Nature. The problem now is that what was once thought to be impossible in terms of hybridity (the mixing of animal and plant for example) is now an actuality. Transgenic practices have thrown understanding of the natural order into an unresolved, contradictory rift, thus giving rise to a whole series of new questions about which authority may designate exceptions to the codes of organic purity. At present, there is no stable authority in regard to this matter, and hence a profound sense of ideological dissonance now haunts the western world.

The Fourth Domain

If popular, yet significant biological classification systems, such as animal and vegetable, are forgotten for the moment, and one instead examines the classifications used by specialists in biology, we find a general system of three domains.[1] This scheme is relatively new and is based in molecular studies that reveal the existence of a small group of organisms now known as archaebacteria. Formerly, these organisms were placed in the kingdom *Monera* (a classification reserved solely for bacteria), because they appeared to be just another form of bacteria. However, since it has been recently discovered that these organisms have significant differences from bacteria in the composition of their 16s rRNA sequences, cell walls, plasma membranes, and other key molecular features, many scientists now believe that they should have their own unique classification. Furthermore, in terms of evolutionary distance from bacteria and eukaryotes, archaebacteria seem to require a domain of their own.[2] Some biologists believe that the traditional general classification system of the five kingdoms (which is primarily based on morphology) is no longer suitable, given recent developments in molecular biology, and they now favor the domain classification system. Following this trend, and for the purposes of this essay, CAE will also use the domain system: bacteria are in the domain *Bacteria*; archaebacteria are in the domain *Archaea*; and eukaryotes are in the domain *Eukarya*.

However, since DNA from these domains is now transversal, given new breakthroughs in transgenic practices, it seems that the time is right to suggest the creation of a fourth domain (*Transgeneae*). This domain would be reserved for organisms that were manufactured by mixing genomes (or parts thereof) from the three domains, in a manner different from species emergence through evolutionary process. Whether mixing genomic elements from the various domains (along with mixing genomic elements from different species of the same domain) will have the effect of creating creatures with significant enough differences to warrant such a radical classification is open to speculation.[3] However, if molecular difference and evolutionary distance can give rise to such considerations, it would seem that radical intervention into the evolutionary process (both in terms of selection and velocity) and into genomic construction could make such a reclassification necessary. It should also be noted that classification systems are in a constant state of flux because of the rapid leaps in knowledge that various biological specializations are making on a regular and immediate basis. What at first might seem premature can quickly become necessary.

In the end, however, CAE is more than willing to leave biological classification systems to the specialists. At the same time, however, scientists must realize that no semiotic system is pure. Even scientific systems are affected by the recombinant nature of language. Social, political, and economic meanings all inform any textual configuration. While the fourth domain, from the point of view of the specialized position of molecular biology, may currently fall somewhere between the nonsensical and the speculative at best, it still represents a significant series of social, political, and economic separations. The appearance of organisms conceived within an ideological matrix of categorical mixing, and removed from the evolutionary chain via the process of manufacture, will have profound effects on biological sign and exchange value, will alter the construction of western cosmologies, and will dramatically affect the development of industries of applied biology and the general technological apparatus of all fields of communication and research. Perhaps the fourth domain will only function as a socio-political interpretive model, but even if this turns out to be the case, it will be compelling nonetheless.

The Mythology of the Fourth Domain

While the material appearance of the fourth domain has coincided with giddy euphoria among many biological specialists, industry leaders, and those willing to swiftly embrace new scientific and technological developments, its traditional mythic place has not been one of such positive associations. This domain was among the unnameable, either in its purity as the domain of the power of God(s), or in its profanity as unthinkable taboo in the realm of humans. This latter possibility is what defined its tendency for people in the west, thus establishing it as one key site associated with the ideology of fear. The fourth domain was the category of the monstrous: A location where mixing categories by humans conjured the sinful, the perverse, and the horrific, and thus offended God and/or Nature. For those who were willing to do what ought not be done, punishment was swift and harsh, coming from both secular and metaphysical forces. Entering the fourth domain was the ultimate challenge to the authority of order and all its institutional manifestations.

One need only look back to foundational mythic texts (in the broadest sense of the term) of the western world to see that hybridity was a concept stratified in accordance with social relations. A central text for issues of transformation, synthesis, and recombination is Ovid's *Metamorphoses*. This work is a full compendium of becomings that reveal the rules of who has the power and ability to rearrange the natural order, and explains the consequences of such arrangements. Ovid offers two key rules about interventions in the natural order. The first is that creation, invention, and movement beyond the flow of the logos is limited to the will of the gods. The second is that such activity among humans (when not guided by the hands of the gods) will end in disaster. Punishment for such transgressions is contained within the process of recombination. Appropriating the power of the gods (whether manifesting as either a spiritual entity or as a natural force) will only speed a mortal's confrontation with death—the harshest penalty is always issued for such excessive appropriations and is quickly delivered without remorse or pity.

Let us examine a myth that illustrates each of the two principles. One less well-known myth is the story of Achelous and Peremele. Achelous (a river deity) tells this story to Theseus and some other honorable warriors while they wait for a river flood to subside. Achelous explains how he fell in love with and seduced the daughter (Peremele) of a local king. When the king discovered his daughter's indiscretion, he concluded that the proper punishment was death, and tossed her off a cliff into the ocean. Achelous prayed to Neptune for aid; his prayer was heard, and Peremele was transformed into an island as a means to raise her above the sea. The separations regarding certain types of commingling are readily apparent. Peremele, from the human perspective, is perceived as radically transgressive for mixing her mortality with immortality. As usual, the punishment for engaging in this process is death. However, this is not what this myth emphasizes. That lesson, while consistent with the general text, is of secondary value. The primary lesson is that the gods have the power and the right to make any alteration in the natural order that they think is necessary, and it is only when *they* do it that there can be a positive outcome. This is not to say that there will always be a positive outcome. Conflicts among the gods (most notably between Jove and Juno) can lead to monstrous outcomes. Even in a sacred sphere, recombination can take less than desirable turns. Polyphemus the cyclops or Io the heifer are such examples of the many monsters or unfortunate victims that populate this mythic landscape.

The myth becomes even more compelling when Pirithous, one of the honorable warriors, challenges the story saying:

These are fairy tales;
The gods have no such powers, Achelous,
To give and take away the shapes of things.

The soldiers hearing this challenge are horrified, and the wise elder Lelex replies:

The power of Heaven has no bound or limit.
Whatever the gods will is done, believe it.

Lelex represents a consensus among heroes concerning the natural order. While there are spheres, even incredible spheres, open to heroic humans, there is still another one beyond human control that must be left to transcendental forces. This is the realm of creation and recombination.

A better known myth in Ovid's volume is the story of Daedalus and Icarus. Held prisoner on Crete, Daedalus bemoans his fate and his inability to escape by sea routes that are well controlled by Cretan forces. However, he notices that the heavens are an open field that is not under the control of any king. He then devises a scheme to create wings that would allow him and his son to fly off the island

and back to their homeland. He successfully transforms himself into a recombinant creature by appropriating some of the forms of a bird. Daedalus and his son fly from the island; however, Icarus, being young and impetuous, does not follow his father's advice of staying the middle course (a quick lesson in Aristotelian ethics), and pushes the limits of his recombinatory nature by flying too high. The wax that holds the feathers in his wings melts due to the heat of the sun, releasing the feathers into the air, and Icarus falls from the sky, landing in the ocean where he drowns.

This myth focuses on what occurs when humans attempt to appropriate the space and skills of the gods. Rearranging the natural order is a "fatal art" that ends in accursed consequences. (Eventually such practices will be renamed the black arts, but they remain just as fatal.) Daedalus' crime is clear:

He turned his thinking
Toward unknown arts, changing the laws of nature.

He transgresses the limits of human agency and ability, and pays an exceptional price in the death of his son. Much of the story also describes commoners (fishermen, farmers, and shepherds) who see the two flying overhead. They are content with their sphere of influence, and perceive those who challenge the sky as necessarily being gods. Separation and law are intimately linked, and neither must be transgressed for any reason. As shall be shown, this story resonates through time well into the industrial period ("if man were meant to fly, he would have wings"), and onward into the postindustrial period, with our current fears and concerns over transgenics.

Mythologies like the above do not fade away after the Greco-Roman period, but instead continue to harden in their expression. The little flexibility afforded humankind in Greco-Roman myth is tightened all the more in the Christian paradigm. The chain of being was a fearsome catalogue of separations that put a clear limitation on when and how what could mingle with what. Only now, the intensity of horror was increased. The monstrous became cruel, grotesque, and ever-present. Constant temptations to transgress the natural order became a part of the human burden, and monsters and demons born of human failure, folly, and lack walked the earth. Further, the polarities between good and evil with regard to categorical mixing became less ambiguous. The kingdom of God was perfect. Unlike in the world of pagan gods, no monsters of the earth were spawned by conflicts in heaven. The recombinant beings of heaven were always delightful. For example, angels could have wings, for unlike Daedalus and Icarus, they were designed by God to be a part of the heavens. Flight was a natural part of their domain. On the other hand, demonic creatures were recombinant as part of their fight against the natural and spiritual order. They were manifestations of perversity and evil, where the most repulsive and dangerous physical characteristics of the earthly domain were mingled together in a manner that reflected an inner being of defiance and disobedience.

The paintings of Hieronymous Bosch are excellent visual texts revealing the continuance of the association of fear, monstrosity, and death in the fourth domain. Bosch illustrates the shifting and differing elements between pagan and Christian ideas about the nature of the fourth domain. His paintings are filled with recombinant creatures that mingle with humanity, and he also represents the transformation of humans themselves into recombinant creatures because of their unrepentant transgressions. The variety of creatures representing various depravities in the form of recombination are too numerous to catalogue in this essay. Throughout his work, and most notably in *The Garden of Earthly Delights* (GED), *The Haywain* (TH), *The Last Judgment* (LJ), and *The Temptation of St. Anthony* (TSA), viewers get a smorgasbord of possible recombinations. The human form is combined with birds (TSA and LJ), with fish (TW), with rats (GED), and with plants (TSA)—all of which are grotesque and frightening to behold.

Bosch also populates his landscapes with human transformations. For example, the berry-head (middle panel, bottom-center-right) in GED represents voracious carnality as a metamorphic catalyst. The phrase "to pluck fruit," a common vulgarity at the time for a sexual escapade, becomes the metaphor for the fate of a sinful mingler—the loss of humanity, and a reduction of status in the chain of being to that of a plant.

In addition, Bosch catalogues numerous "unnatural acts" in the form of deviant intimacy between animals and humans. This may be read literally, as it seems quite probable that bestiality was on his list of perversions, but there are additional layers. The bird sodomizing a man with its beak in GED (middle panel, top-center-left) indicates a concern for sodomy itself and the sinfulness of homosexuality in general. The pig in a sexual embrace with a nun in GED (third panel, bottom-left) is a reminder of similar sins, but is also a charge against the decadence of the Church, and its fall from the natural order.

Bosch's images, much like so many representations of earthly recombinancy that sprang from the medieval imagination, are visions of horror and the monstrous that have considerable currency in the present. The model has not changed—not in Gothic horror of the 19th century, nor in the present flights of horrific fantasy that Hollywood presents. Perhaps Hollywood has increased the intensity of the image by increasingly presenting explicit depictions of the codes of the monstrous, but the codes themselves are quite stable.

Beginning with Gothic tales of Frankenstein, the change that occurs is that the recombinant becomes secularized. The natural order is not part of the intention of God; the delightful and the monstrous are just an emergent part of nature itself. Science as the daedalean intervention can help improve the human relationship with the natural order; however, it must stay within the fairly traditional sphere of human intervention. This means that encroachment upon the fourth domain, the domain of hybridity through recombination, should be off limits. When this boundary is crossed, the monstrous appears, and it is usually to the mortal detriment of the one who conjured it. Traces of both pagan and Christian wisdom continue to appear in the notion that transcendent forces, which will bring doom if disturbed, should be left alone.

David Cronenberg's remake of *The Fly*[4] demonstrates the power and longevity of the representation of the monstrous as recombinant, its new grounding in the secular, and the persistence of the belief that certain creative boundaries should not be crossed. Here, a scientist hoping to make the greatest breakthrough in transportation history begins to fiddle with ideas of teleportation. An investigation into increasing transport velocity is acceptable, and this is not his transgression. The problem begins when he wants to teleport flesh, rather than limiting himself to inanimate objects. However, his computer is unable to reintegrate living tissue. This is the point where he crosses the boundaries of creation—he programs his computer to be imaginative in the manner in which it reassembles the molecules of the flesh. When a fly is caught in the teleportation chamber with him, rather than reintegrating the two as separate entities, the computer combines them, so they might mingle and improve at the molecular level. At first this synthesis has positive effects, but as time goes on and the less desirable traits of the fly begin to assert themselves, the character Seth Brundle becomes increasingly monstrous, until he can no longer be part of the natural *or* the social order. The moral, in this case, is that messing with time/space for the purpose of transporting objects is fine, since that is within the confines of human agency, but insinuating oneself into the integration of the flesh is unacceptable, and carries with it its own harsh punishment. No character in the film is afraid of teleportation (in fact, most are thrilled by it); rather, the molecular reconstruction of the flesh is what causes fear and skepticism among them. This concern is later amplified by the fact that Brundle's transgression affects his reproductive system, ending in the passing of his monstrous becoming (a genomic time bomb that removes the stability of species boundaries) on to another generation. The curse of the fly has a germline effect, and that element provides the narrative for *The Fly II*.

While this data may only be impressionistic, the countless examples of the interconnection between recombinancy, the monstrous, and the ideology of fear are too numerous to ignore. These inescapable, traditional ideological structures are internalized by individuals within western cultures, and send waves of panic whenever they are made manifest. Hence, capital must contend with the nonrational fears that often accompany biotechnological initiatives that explore recombination in the form of the transgenic.

Fear, Imperialism, and Ideological Dissonance in the Fourth Domain

The idea that contamination through the blending of natural separations leads to the monstrous easily slides out of the biological and into the social. In general terms, this mythic structure is among the primary roots that feed the fear of the other. For the west, the semiotic regulatory system of the monstrous (that which has been contaminated by deviant mixing) blends with rational, pseudo-scientific systems, such as Social Darwinism, to create an ideology of separation. The establishment of this ideology has long served colonial and endocolonial initiatives. From the first western imperialist expeditions onward, civilization has been represented as a purifying category—one that liberates the cultural other from the profane and unclean positions of savagery or barbarism. The process begins with a reinscription of the territory of the other with the signs of civilization—manufacturing, commodities, resource management, and the full host of social relations that accompany these materials and processes, all tied together under the sign of providence or progress. Progress assures that the appearance of this symbolic order is presented as enormously positive and indisputable in its generosity, while the signs of the indigenous regimes are parodied, ridiculed, assimilated, or destroyed. Those who refuse assimilation and/or resist their placement in the newly introduced system of separations tend to be categorized as dysfunctional excess ready for disposal. Whether the traditional model of military intervention, or the newer model of commodity desire linked with global market pressures (the replacement for muskets and battering rams) is used, the result is the same: First and third world separation is maintained, and cultural mingling is structured for the material and social benefit of the "civilized."

As functional and successful as this form of cultural/economic imperialism may be, the system is still imperfect due to its limitations. First, earthly frontier space is finite, and is about to run out. At present, there is no space that is not under capitalist invasion. All that is really left are zones of contestation (such as in Islamic or Maoist cultures). Second, while the body can be made to reflect the signs of civilization, the flesh itself is not fully rationalized to best approximate the ideal demands of capital in terms of market adaptability and efficiency. Consequently, and in relation to this latter difficulty, capital has since the late 19th century placed a great emphasis on constructing an apparatus that would manufacture flesh in accordance with its needs and values. For the first one hundred years capital made clear what needed to be done, but had no idea how to accomplish the task. The various eugenics movements in the west between 1900 and 1945 were failures due to both theoretical and technical impoverishment. However, this situation has recently changed with the appearance of molecular biology and the increased sophistication of genetics. In addition, the former problem of finite territory has also been temporarily solved. The molecular invasion of the body is the new frontier where untold resources and profits may be appropriated.

Transgenic processes are a key part of this development, but they have also left capital with a major ideological problem to solve, because stable, naturalized categories are in theory and practice becoming fluid. The traditional social pressures regarding what constitutes deviant mixing hold back experimental transgenic research and applications. What makes this problem so complicated is that it cannot be neutralized solely through rational argument, nor through the appearance of seductive technologies (as occurred with information, communications, and transportation technologies). The fear factor, which has been refined over the past two millennia, will not disappear in light of any promissory rhetoric or new technology. In fact, the new technology only seems to intensify the level of fear. The unnatural reproduction of the flesh still tends to be seen as taboo within the human/cultural sphere. Further, when the flesh becomes unnaturally mixed, the fear heightens all the more (for example, consider the fear and legislation generated by the prospect of human cloning). Throughout history, ideology has always exclaimed that such mingling is perverse and will bring about punishment and catastrophe, and this is also the common perception of transgenic practices.

For example, the first everyday-life, public interaction with transgenic forms has arrived in the form of genetically modified (GM) food. Certainly there are many rational arguments about why tampering with the food supply at the molecular level should proceed with tremendous caution, if at all. But this is not the sole source of public caution. People are simply afraid of GM food. All varieties of ungrounded speculations exist, particularly fears about the consequences of pollution. Perhaps these foods may cause illness, or could affect one's own genes. Anxiety about personal catastrophe following eating (mingling with) these perverse foods permeates public perception. The monstrous will reproduce the monstrous, and every bit of folk wisdom and cultural mythology concurs with this conclusion.

In addition, capital must not only find a way to disrupt this deeply internalized, nonrational belief system, but must also maintain it for other purposes. It must continue to be used to support functional social separations and the imperial apparatus. Developing this kind of doublethink is a common occurrence in capital, and generally it is relatively prepared for constructing complementary contradictions. The construction of the metanarrative of nature provides an excellent example. On the one hand, the romantic model of nature associates it with goodness and morality. People should do what is natural, and avoid the unnatural. On the other hand, the Hobbesian model defines nature as a blind, barbarous force that runs on an engine of conflict. The role of civilization is to tame these powerful, random, and violent forces, so they might submit to human need. Obviously there are many more narratives of nature that stand in conflict with one another, but this multiple structure allows the code to be deployed in a tactical manner. The narrative that best fits a situation is the one used, and at times, various combinations can be used simultaneously. For example, the colonial subject represents the conflicted status of nature. On the one hand, this subject/animal must be tamed by civilization through the repression of instinctual activity. On the other hand, the rituals and behaviors of the colonial subject are savage (such as scarification or cannibalism) and are perversions and distortions of nature's perfection. In spite of this ideological flexibility, capital will have a difficult time managing this current ideological dissonance; it is close to causing a serious legitimation crisis on the level of the scientific apparatus and in terms of the relationship of corporate structure (at least that of biotech companies) with public welfare.

For movements that challenge capital's hegemony, this moment of cultural confusion offers an exploitable glitch in dominant representation. There is a chance to amplify these legitimation crises and undermine areas of traditional authority. However, activists will have as hard a time as capital at intelligently organizing within a spectacle of fear.

The Activist Paradox, or Whose Work Are We Doing?

For capital, the first step in resolving these active ideological contradictions is to restructure the rhetoric that accompanies biotechnology in general. Instead of using the enlightenment promissory rhetoric of creating a new body through technological extensions (a McLuhanesque model that worked very well in structuring the cyborg body), one that can all too often conjure associations with eugenics and other related bio-atrocities, there has been a switch to the promissory rhetoric of Christianity—the public is promised miracle cures, edenesque abundance, immortality, and a new universalism. Hence the abundant use of biblical metaphors when describing biological advancements (for example, the trope that the human genome is "God's blueprint"). Of these promises, the most significant in regard to the fourth domain is a new universalism. DNA is the common element in all life. The lateral transfer of it, even through artificial means, is only a way for the natural constellations to share the bounty of life. On the other hand, this universal characteristic (the new soul) is also one that produces complexity and difference. Transgenics is only going to expand the field of possibilities for life and culture. This method of naturalizing transgenic manufacture should have the effect of reducing the levels of anxiety in the minds of those who have internalized the spectacle of fear associated with the fourth domain. In other words, the fear factor can be regulated and directed in a more precise manner, and remain particular to colonial and endocolonial separations.

To some degree, resistant coalitions and cells concerned with the current applications of biological research and with the corporate attitude of "profits first, risk assessment later" must calm public fears as well. Biotechnological research is a very broad field, much of which could be useful or does not seem to be very dangerous. The most problematic areas in the field (and these are usually social and economic policies about managing biotechnical application, rather than the technology itself) must be identified, and resistant efforts focused upon them. Unfortunately, fear does not allow individuals to pick and choose particular objects of concern. It causes a blanket dismissal of entire categories. Resistant organization in such emotionally charged situations is difficult at best. This leaves cultural and political activists with a two-point mission: First, to neutralize the fear factor, and second, to produce an informed public discourse extracted from a specialized area of knowledge. To accomplish this task, the mythic past and the sci-fi future have to be separated from the reality of current research initiatives; utopian rhetoric must be exposed for the propaganda that it is; and people must be taught to be informed amateurs and armed with basic skills in risk assessment. However, the process of meeting these goals is begging for recuperation by dominant culture. The risk of doing its work is what makes the development of this type of pedagogy and subversive representation a roll of the dice. Unfortunately, there is not really any choice. Without fear of the consequences, the US is moving at top velocity to corner this new colonial market/territory. Since biotechnology in general and transgenics in particular is central to profit expansion on a global level, even the most cautious of capital-saturated cultures must move quickly into this territory if they do not want to be locked out of this new economic opportunity.

During this period of molecular invasion, the fourth domain will be transformed more than it has been throughout all the previous periods of history combined. Transformative times are the most productive moments for subversive political and social change (which is a double-edged sword). The construction and manipulations of representation can have a profound impact on discourse generated by nonspecialists, and in turn, affect policy construction in both its process and product, but only if resistant representation is produced from a critical position with the interests of the general public in mind.

Notes

1. CAE would like to acknowledge the important contribution of Dr. Mustafa Ünlü of the Mellon Institute to the development of this section.

2. This system was suggested in 1977 by C. R. Woese and G. E. Fox after their recognition of archaebacteria as a distinct form of life. For an excellent summation of new trends in classification systems, see Protein Phylogenies and Signature Sequences: A Reappraisal of Evolutionary Relationships among Archaebacteria, Eubacteria, and Eukaryotes. *Microbiology and Molecular Biology Reviews*. Dec. 1998, 1435-1491.

3. In biological terms, the idea of a fourth domain would be suspect because only small portions of genomes are being moved across domain lines or even between species, and only under tightly controlled, limited conditions. It is unlikely that profound molecular differences would occur at this developmental stage of genetic engineering. Further, some scientists suggest that eukaryotes are naturally transgenic, because molecular study has revealed laterally transferred bacterial traits. "Hundreds of human genes appear likely to have resulted from horizontal transfer from bacteria at some point in the vertebrate lineage." For additional information, see Lander, et al. Initial Sequencing and Analysis of the Human Genome. *Nature*. Feb. 2001, 15; 409(6822): 860-921.

4. *The Fly* is a remarkable film in terms of its continuous cultural resonance with the cinema-going public in a time so consumed by developments in biology. It was first made in 1958, and spawned two sequels. It was remade in 1986. The remake was followed by another sequel, making five *Fly* films in all.

All Edenic projections of plenitude have proven dangerous.

—Avital Ronell

2

The Promissory Rhetoric of Biotechnology in the Public Sphere

> *Just as the Christian soul has provided an archetypal concept through which to understand the person and the continuity of self, so DNA appears in popular culture as a soul-like entity, a holy and immortal relic, a forbidden territory. The similarity between the powers of DNA and those of the Christian soul, we suggest, is more than linguistic or metaphorical. DNA has taken on the social and cultural functions of the soul. It is the essential entity—the location of the true self—in the narratives of biological determinism.*
>
> —Dorothy Nelkin and Susan Lindee

Popular wisdom in western culture has long told us that science is our new religion. This trope has been repeated regularly since Turgenev's creation of the nihilistic Bazarof and Nietzsche's pronouncement of the death of God. Like most propositions derived from popular perception, there is an element of truth in it. Science is the institution of authority regarding the production of knowledge, and tends to replace this particular social function of conventional Christianity in the west. In keeping with this position, science has slowly but surely become a key myth maker within society, thus defining for the general population the structure and dynamics of the cosmos and the origins and makings of life, or, in other words, defining nature itself. Much as religion once defined the human role in the cosmos, science does the same in such a way that the political economy of the day seems to be a part of nature and attuned to its laws and imperatives. Certainly the theory of evolution is an example of science fulfilling the ideological needs of capital.

Science has never been very comfortable with its designation as the new religion, and rightly so. After all, the analogy is very loose, since science and religion share very few master narratives. The rhetoric of science has also generally strayed far from the rhetoric of theology. Science has developed its own language to represent itself to the public (i.e., those outside any scientific specialization), and the roots of its language are in the secularized speech of the Enlightenment. However, in the relationship between science and the public, we find a second suggestion of why science is often perceived as the new religion. Science is a key mediator of the public's relationship with nature, much as the Roman Catholic Church in medieval times mediated its public's relationship with God. Perhaps the greens, with their simple, personal relationship with nature, could be our modern-day Protestants. Again, the analogy can start to get pretty silly when pushed too far, but in light of the new biotech revolution, this exercise may be a necessity.

As the key knowledge producer for capital, science finds itself in a subservient middle-management position. Popular wisdom fails us when one notes that science as an institution is not the Church of Innocent III. It is by no means a general seat of power; its power lies only in the particulars of knowledge production. Indeed, this position is one of privilege, but it has definite limits. It must account for itself, and do so in the way that capital demands by showing that its knowledge production is profitable (particularly in the form of application, hence the marriage of science and technology). Should it fail in this endeavor, it will not be the great mediator of nature for long; however, science has been very successful at impressing its boss for the past century, and shows no signs of retiring. It is willing and able to exclusively serve the needs of capital, not just by generating knowledge that can be applied for profit, but also by *not* generating any knowledge or applications that could be detrimental to the maintenance and/or expansion of the system (for example, science has avoided creating a car that does not use fossil fuel).

In order to justify the selective nature of this variety of service, to impress and excite the various classes that monitor and distribute the investment capital marked for research and development, and to uphold its spectacle as a benevolent institution providing great marvels to the general public, science has constructed a rhetoric of promise derived from Enlightenment political principles to deploy either as a spectacle of seduction or deflection. This rhetorical system is most evident when the knowledge meets the public in the applied form of new technology. From the building of railways to the construction of the Internet, utopian promises regarding the latest technological phenomenon have deluged us. And like those in every generation since that of the mid-19th century, critics of technology have tried to puncture these inflated claims (although usually with only modest success). While much of this rhetoric does come from scientists for the reasons given above, they alone are not to blame. These promises only continue to inflate when redeployed by the marketing and media agents of capital and by a broad variety of capital's ideologues. In this generation considerable time has been spent on critiquing the value of the Internet by leftist thinkers such as Pit Schultz, Geert Lovink, Richard Barbrook, Konrad Becker, Lev Manovich, Inke Arns, Oliver Marchart, Matt Fuller, Mark Dery, Critical Art Ensemble, and many others. They have endeavored to deflate the promises of marketers in their many guises, to reveal the ideological infrastructure of the technology and its representation, and to demonstrate that even the smallest utopian possibility contained in the rhetoric would probably not be generally realized by most of the world's population.

While the promises made about technology are many and appear in various permutations, they tend to fall into four main categories—democracy, liberty, efficiency, and progress. Democracy appears as the notion that everyone will be empowered by the new technology, and thereby have increased agency within the social realm. For example, one promise is that new transportation technology (the elder of the techno-revolutions birthed with capital's commitment to trains) will create a cosmopolitan state in which no one is restricted by spatial limits. Of course there is no real gain, only relative gain. Class structure replicates itself in the technology. Class strata reveal themselves in who can go farther, faster, more often, and in what degree of comfort. While a less privileged person can travel farther than ever before if so inclined, the relative distance between what members of different classes can and are likely to do remains about the same (or increases).

Liberty is usually presented in terms of freedom from restrictive social elements. This promise can take many forms. Liberation from drudgery in the form of work is an example of a typical form; however, decades of technoculture have taught us only that the greater the intensity of technology, the greater the workload. Much the same is true of efficiency. Improved efficiency only means more profit and speed for capital, while the implied promise of individual benefit never seems to materialize. Taken together, a working definition of progress emerges that means nothing more than the expansion of capital, but presents itself as advancement of the common good.

This collection of rhetorical truisms has worked well for over a hundred years, ushering in numerous innovations both mechanical and electrical, both analogic and digital, with strong public support. As the biotech revolution is being set into motion, the standard practice of parading the utopian principles of bourgeois society should be happening again, but strangely enough, it isn't. The problem is that history is disrupting the deployment of another round of the same old promises. Biology tried to have its social revolution once before (before it was technically ready to carry it out), when it was believed that Darwinism could explain the nature of biological process and its relationship to social "progress." The usual promises were made: real democracy would emerge through biological engineering, because all citizens would be fit agents for political action. A truly self-aware, self-generating equality would emerge. People would be liberated from biological destiny by controlling it themselves, and would be able to apply the values and morals of society to the production of the flesh. In this manner, biological progress would parallel technological progress.

What appeared instead was the horror show of eugenics that spawned unspeakable atrocities. The utopian mask fell from capital's face, and the sight was repulsive: selective breeding, forced abortions and sterilizations, and in the worst cases, genocide. All excess populations (i.e., those of no use to capital) were viciously attacked or done away with. At the other end of the spectrum (positive eugenics), capital worked on a biological means to replicate the populations it required by socially rewarding those who bred for health, intelligence, and moral character.

The eugenic initiative sliced a wound so deep into the social body that it has yet to fully heal. To this day it remains a painful memory that is almost impossible to acknowledge. In the US, eugenics is considered something dead and best forgotten. Few American authorities acknowledge that the US was a leader in eugenic philosophy and practice. The feeling is that it happened somewhere else (probably in Germany, where there were Nazis). Unfortunately for the new generation of geneticists and molecular biologists, the utopian rhetoric that once served other science and technology producers so well is now tainted. Using such language could raise up ghosts from the past that are better left to rest. Since the public has already seen the true face of capital and its plans for the flesh (invasion and instrumentalization), it would not be wise to use representation that could encourage remembrance of this vision, because it could lead to a popular condemnation of the new trajectory of flesh sciences.

The question now is, what rhetoric can be used to represent the new biological initiative so that it can keep its distance from eugenics? If the secular rhetoric of the Enlightenment is off limits, then what is left? One good place to turn is the utopian rhetoric of Christianity (and the Roman Catholic Church in particular).* The Church survived the eugenics movement reasonably unscathed—at least to the extent that it was not seen as a primary initiator of the movement, and in some cases was an open critic of it. Why the Church acted this way is open to question. Clearly, the idea that creation could be appropriated by humans would not sit well with the Church, and hence its position was to defend its belief system from a secular hubris that was out of control. However, one could also argue that Church denunciation of eugenics was self-serving. For example, between 1900 and 1920, many of the marginalized groups in the US that would be negatively affected by the eugenics movement, such as the Poles, the Italians, and the Irish, were largely Catholic. The Church could lose its constituency in America, and hence its public outcry. This notion of self service is reinforced by the fact that such protectionism wore off later in the century when the Jews became the primary target group affected by eugenics. Be that as it may, the rhetoric of origination and creation used by the Church remained disassociated from eugenics, so its rhetoric is still open to appropriation for those with the authority to use it.

Returning to the popular wisdom that science is our new religion, in the case of the biotech revolution there may well be an additional element of truth. The spiritual promises of a dying institution are now being reborn as a material reality that is not dependent on faith. In the process, perhaps we are witnessing another attempt to solve the conundrum of the skeptic who wants to believe. This problem was eloquently presented by Dostoyevsky through the character Ivan in *The Brothers Karamazov*. Ivan has a desire to believe in God, but His envelopment in mystery and otherworldliness leaves Him unaccountable for the evils in the world. If indeed there is a God, the empirical proof of His incompetence is overwhelming. For instance, Ivan saves newspaper clippings of atrocities committed against children. How can a good and righteous God allow such things to happen? In deciding between God and justice (the secular), Ivan feels compelled to choose justice, but suffers greatly for this choice. Here at the beginning of the next millenium, this paradox of psychological suffering is no longer so perplexing. All that was once shrouded in mystery is now open to accountability and measurement. The choice is neither to push through the absurd and leap into transcendental worlds through uncompromising faith, nor side with justice at the expense of an empty soul; rather, the best option is to understand that redemption is grounded in the material. Whether speaking of questions about a new genesis, healing, universal connectedness, or even immortality, the answers are to be found in molecular strata beyond operational reality; however, this other realm can be measured, modeled, catalogued, and manipulated. Controlled access to creation, life, and the cosmos should be considered the solution to Ivan's dilemma.

The Quest for the New Eve

Biblical signs and symbols are entrenched in western culture. From childhood, we are taught to recognize and interpret them. For this reason biblical metaphor has always been an excellent resource for specialized culture to use in speaking to popular culture. Eve is one of those symbols that is immediately recognizable, for even the undereducated and/or the staunchly secular have had this sign of origination embedded in their cultural vocabulary. Since the legitimation of the theory of evolution, science has had a begrudgingly antagonistic relationship with creationist theory, which clings to the literal interpretation of the sign of Eve and the narrative of Genesis. It would be best if the creationists just went away and left science to its work, but like pesky gadflies they keep on challenging evolutionary theory with arguments solely supported by unfounded propositions contained in a sacred book. As the popular wisdom of the American bumper sticker flatly states: "The Bible says it, I believe it, that's the end of it." In order to speak back to the nonspecialized public regarding the matter of the origin of life, science has managed to more than swat at the creationists with its partly empirically buttressed arguments—it has appropriated its symbol. We now have a Simian Eve—a lovely australopithecus found in Africa, and believed to be the oldest of our human ancestors. (One must note that while she is the Simian Eve, she is also known as Lucy, named for the Beatles song playing at the moment of her discovery.) Science corrected the Biblical misconception a second time by empirically proving that the first Homo sapiens woman was of African origin and appeared somewhere between 100,000 and 400,000 years ago. She is known as Mitochondrial Eve after the genetic trait used to trace her origin and clock her age. The broad approximation of her age is due to uncertainty among scientists as to how the mitochondrial clock works. One thing they do agree on is that the first Homo sapiens is older than the 6,000 plus years that Christian fundamentalist scholars claim for Eve.

The Human Genome Project has one last Eve for science to offer us. She is the one who will help the public understand the beginning of a second genesis—one that is not beholden to any reproductive boundaries that once separated the species—and to understand it as a good thing. She is Eve without the fall—an Eve of perpetual grace, but most amusingly, she is a random Eve.

The mythology of this Eve goes as follows, although the narrative tended to vary slightly with each scientist CAE interviewed: When the Human Genome Project (HGP) began its mission of mapping and sequencing the entire human genome, it needed DNA in order to start. Since HGP was an academic/government initiative, ethics committees were established to make sure that this genetic investigation did not go into territories best left unexplored. One of the concerns among all the participants was to insure that those who donated blood to the project would do so anonymously, so their identities would be protected from the media and various objecters to the project who might harass willing participants. A review board with strict procedures was set up to insure the privacy of blood donors. However, after the first donor was approved, no other donors were needed. The DNA of the first approved volunteer was mass produced (copied) as needed. Why go to the trouble and expense of having any more? After all, one donor is sufficient for the project's needs. What is known about this donor is that she is a woman from Buffalo, New York. She is the Eve of the second genesis. It will be a curious sight to see if she, too, is labeled by science with the sign of origination.

New Nature

The ability to copy and recombine presents a cosmological paradox. On the one hand, the creatures of earth, plant and animal, great and small, no longer have any essential traits. Postmodern theory made this proposition years ago, claiming that all qualities are a matter of performativity grounded in the social, and are always already becoming other. To prove their proposition, theorists scoured the planet for evidence that contradicted biological universals. For example, Judith Butler followed this formula when studying human sex and gender. In order to show that gender was a category of becoming rather than being, she struck directly at medical and social essentialism by citing examples of persons who had male genitalia but double X chromosomes, and hermaphrodites who had both male and female genitalia. This demonstrated that the choice of gender is an arbitrary medical determination reinforced by the dramaturgy of everyday life. While these biological manifestations are relatively rare, they occur regularly enough to call into question any universalist claim about gender. Now that DNA can be replicated and spliced at will, the concept of the individual (or any living thing) as a temporary set of organic relations could become an operational norm. Even Butler would have to admit that, just ten years ago, gendering was bounded by the limits of sexual reproduction. In the new version of nature, there are no limits. The species is completely boundless (in fact, the idea of a species may now be a biological anachronism). DNA is DNA is DNA, and so the DNA from one species can be recombined with the DNA of another. The DNA could come from hundreds of donors, all from different species. To use Guattari's terms, we are now literally becoming plant and becoming animal. These abilities to copy and recombine can be used to remake the world, and design life in a manner that creates heaven on earth, a process that molecular biologist Lee Silver calls "remaking Eden."

On the other hand, if all DNA is compatible, is this not the essential link between all living creatures? Here is a new universalism—the proverbial "we are all one" at the molecular level. Or, as Mellon Professor of the Sciences Edward O. Wilson puts it:

> *We are literally kin to other organisms.... About 99 percent of our genes are identical to the corresponding set in chimpanzees, so that the remaining 1 percent accounts for all the differences between us.... Aren't these small steps gradually enlarging the self by degrees until the self is identified with more and more others?*

To once again use the language of Deleuze and Guattari, we will be able to escape the tyranny of the arboreal that emphasizes the perception of interspecies relationships as fragmented and separate, and thus becoming ever more remote from one another in their complexity, and hence, forever more specialized. Instead the living world will become viewed as more rhizomatic, with each point immediately connected to any other point. In this case, our own survival and development is intimately connected to that of all other living things.

This new universalism will have a dramatic impact on how we perceive the world, and how we act in it. For example, the new universalism will revolutionize medicine (such as in pharmacology and gene therapy as answers to surgery and other forms of mechanical invasion), but will also revolutionize the very worldview of medicine itself. Many now complain that modern medicine has become fragmented and wish to return to older holistic models. Prior to the development of western modern medicine, western medical practice was dominated by a form of holistic healing based on the Galenic system of the four humors that determined the character of the person. In this model the doctor was interested in the patient as a whole—activities (both material and spiritual), environment, diet, and so on. With the emergence of modern medicine in the 19th century, this type of practice was abandoned and medical practice became much more specialized in its interests. It focused on the micro-level, concentrating on cellular pathologies and micro-body invaders (i.e., germs), and de-emphasized the person as a whole or the influence of he/r daily life on he/r health. In light of the new universalism, medicine could return to a new consideration of the patient; anything (environmental conditions for example) that affects the molecular level (rather than focusing on the cell/germ face-off and surgical intervention) could become significant, and therapy could be skewed toward molecular prevention rather than toward cure and symptom arrest.

To be sure, this new paradox, in which the temporary and the permanent exist in the same moment, is going to be presented as a win-win situation. Whether we are redesigning ourselves, or learning to understand our natural interconnectedness in a tangible (as opposed to mystical) way, good things are going to happen. These promises go to the extreme of offering the material reality of immortality (and not as an angel or condemned soul). In regard to immortality, there are cautious promises such as this one by Professor of Biochemistry S. Michal Jazwinski:

We are generating transgenic worms and mice to test the hypothesis that at least some of the longevity genes isolated in yeast are important in aging in mammals. If we can validate this notion, we will have contributed a foundation for drug discovery efforts aimed at ameliorating some of the deficits of old age. This in turn would help to further our goal for everyone to "die young at an old age."

And wild promises such as this one from Michael Rose, Professor of Evolutionary Biology at the University of California at Irvine:

Death rates go up sharply with increasing age, but once you go off the edge of that ramp, you reach a plateau where you are dependent on the quality of your cell repair capability.... I believe there are already immortal people and immortal fruit flies. We just need to get the benefits of these genes conferring immortality at a younger age, before we suffer too much damage.

Some biologists are convinced that they are coming to understand the mechanisms of aging and cell repair. For example, one hypothesis is that every time a chromosome directs a cell to divide, a small piece is shaved off the chromosome's tip. When the tip becomes too short it stops directing the cell to divide, and cell repair stops. As the nonreproductive cell ages it can begin to malfunction, and here the problems of aging really begin. Biologists believe that if they can find a way to maintain the tip, it will never give the cell the message to stop dividing, and in this manner we can combat age, fight certain illnesses, and perhaps live forever. This discovery is doubly exciting because it has long been known that some animals, turtles for example, do not age (decay). Perhaps a lifelong process of cell repair can be initiated in humans through molecular therapy.

As always, capital makes techno-revolutions sound good, and to the extent that the interests of individuals and of capital overlap, the revolution will be good. Unfortunately, we do not know how big this overlap will be, and if we are to judge from past experience, we can expect much more to be worse than better. Further, while the utopian promises have yet to really manifest themselves, the numerous problems (too numerous and too great to list here) are already manifesting themselves.

The most gruesome of these problems is the rebirth of eugenics. This time, it is primarily a positive eugenics that has returned in a form designed to solve the problem of workforce replication during a time of rapid economic change and expansion.** Now that humans have become a temporary set of biological relationships, an opportunity has arisen to redesign their biological matrix to better fit the needs of capital. To those who submit their offspring for redesign, capital promises in return to give that child a predisposition for a competitive edge in the open market (higher intelligence, better health, better dexterity, more desirable appearance, etc). This form of positive eugenics is market-driven, and pays for itself, thereby killing two birds with one stone by achieving both profits and a better worker/citizen. The values/needs of capital are now being inscribed on the body at a molecular level. Just how far this redesign process will go remains to be seen. Currently, very simple forms of choices are offered, such as sperm or egg donors with particular traits, embryonic testing (at four or eight cells) followed by embryonic self-termination if the quality is not up to standard, selective reduction of multiple fetuses, and so on. Recombinant traits have not been introduced yet, but given capital's values of profit, speed, and expansion above all else, there is no reason to believe the experiments in redesigning will not continue (most likely they will be presented as medical research).

The second major problem revolves around privatization. Under the hegemony of capital it is a miracle that we are not paying for air, or that there isn't a tax on it at the very least. However, we will soon have to pay for our genes, because no biological resource from the molecular level on up will remain in the public domain. All useful/profitable genes and biochemicals from various genomes are being privatized and patented. Emblematic of this tendency is the patenting of azadirachtin, derived from the neem tree of India. This tree has been known for centuries for its general cure-all traits (but it is particularly helpful in relieving infection) and as a natural pesticide. W. R. Grace isolated the plant's most useful chemical (azadirachtin) and patented it. While the isolation process was known to Indian companies, they did not patent it; the neem, along with its helpful properties and the knowledge of how to use them, was considered to reside in the public domain. After all, understanding of how to use the medicinal and other useful properties of the tree had developed over centuries. In a direct act of colonial aggression—eco-piracy by any other term—W.R. Grace appropriated and now has relative control of a traditional public resource.

The final problem is the ecological need for diversity. Biological diversity among species and within species that share the same operational realm as humans is beginning to dwindle. The truth of the matter is that monoculturing is very profitable in the short term, even though it may spell disaster in the long term, particularly in regard to food production. Industrial farming is always looking for ways to maximize land use and to grow as robust a product as possible. Consequently, those plant varieties that are less robust or for whatever reason require too many resources to produce are being lost. For example, at the turn of the century there were over 7,000 varieties of apples grown in the US; now there are less than 1,000. This interspecies diversity is a natural defense against parasites and diseases. Should an apple tree disease similar to the Dutch Elm disease sweep through this population with its diminished variety, the chance is small that one of the varieties will have a natural defense against it. Imagine this problem affecting already monocultured staples like soy or wheat. Industrial farming techniques, pushed to the limits by the need to remain competitive in price, are forcing farmers to use recombinant seeds developed by corporations. The profit machine is on, and not even the threat of ecological disaster will turn it off.

Conclusion: On Miracles

To the philosopher of skepticism, David Hume, a miracle is "a violation of the laws of nature." In Hume's day one of these laws was that only members of the same species could breed via gendered pairing. This is no longer true. Is the new biology a miracle in this sense, or is it that there is no nature left whose laws can be violated? Is all that is left a collection of resources to be managed for the generation of profits? Many of the new miracles spoken of in this essay are truly wonderful unto themselves, but as they are assimilated into the system, they evolve into creatures less reminiscent of those in the peaceable kingdom of Eden, and become more akin to the predators of the Hobbesian war of all against all. There is no rhetoric glorious enough, not even the rhetoric of the miraculous, that can hide humanity's tragic trajectory under the rule of pancapitalism.

Scientific expertise among specialists must be accompanied by public understanding or problems will surely arise.

—C. Thomas Caskey

3

Transgenic Production and Cultural Resistance: A Seven-Point Plan

1. Demystify transgenic production and products
2. Neutralize public fear
3. Promote critical thinking
4. Undermine and attack Edenic utopian rhetoric
5. Open the halls of science
6. Dissolve cultural boundaries of specialization
7. Build respect for amateurism

Part 1: Objectives

Given the complex situation of fear and anxiety about transgenics that is being carefully prodded with utopian theological rhetoric, we come to the question, what can resistant cultural workers do in such an environment? What are the objectives? For those ready to engage this struggle in the biopolitical realm of representation, the work appears to be overwhelming. There is no doubt that resistant cultural practices and the representation that emerges from these processes is minimal. The hopeful side is that representation originating in the biotech industry is not doing that much better at calming the public (although, as will be described in Chapter 4, material initiatives on the molecular level are moving along in an almost uncontested manner in the US, and only with modest friction elsewhere). Deep suspicion and mistrust still reside in the public sphere. This flow of affective social current is the point of intervention; however, one must at the same time be careful not to fan the flames of emotion that lead to knee-jerk or absolutist activities. The aim should not be to intensify transgenic fear in the hopes of solidifying rejection on a nonrational foundation, but to counteract it with information that makes informed opposition not only possible, but probable. The first goal should be to neutralize the fear that comes from the centuries-old ideology that the monstrous emerges out of recombinant impurity. Contestational representation needs to contain complex yet accessible information about the nature of biotechnological initiatives, as opposed to the often reactionary green politics that categorically denies any use for biotechnology, or the happy-faced, empty rhetoric of the biotech industry. The standard job of demystification is in front of us, and through this process we hope to achieve the neutralization of fear.

Some may object that resistant culture is doing the work of industry for them. After all, it is to the benefit of capital that the public does not fear its production techniques and products. Certainly any corporation would prefer a public that is open-minded and willing to give the benefit of the doubt to any given production process or product line, and to not have to spend public relations funds on hiding or misrepresenting their true nature. The classic example of the hiding strategy is clear when we think of all the Americans shopping at major grocery chains who are nearly oblivious to the fact that nearly 100% of the packaged foods that they are purchasing is genetically modified. This is the extent to which industry has managed to keep the intensity of the GM transition under wraps. In the end, capital has no desire for public education on such matters (perhaps some indoctrination would be useful). All it seeks is for the public to feel a sense of security that will neutralize any doubts along with fear. Consciousness raising, on the other hand, removes fear through the realization of individual agency and collective power—the ability of people to understand and thereby affect situations allows individual participation in shaping the policies, laws, products, etc., concerning the biotechnological. In the pedagogical process, only the fear dissipates, the doubt remains.

But the real question is not one of education versus spectacle. The real question comes as the neutralization occurs. Once a vacuum in biopolitical space is left by the reduction of fear, what will fill it? Will it be critical discourse or will it be the absolute of the commodity? To be sure, the corporate revenues are available that are necessary to launch whatever type of campaign may be needed to sway the public. However, if enough doubt remains, and people have the ability to formulate their own questions, then some of them who will productively and intentionally resist by whatever means they believe appropriate will maintain a contestational discourse. Its intensity will vary considerably, and for the most part it will be weak and underrepresented at this point in time, but it will be a beginning.

However, to ask good questions, one needs the language to do so. The means to direct public resentment, mistrust, suspicion and even hostility in a productive way requires that each individual know precisely why s/he resists. Hence, the construction or recuperation of language(s) that adequately describes the contested situation from a minor position(s) becomes a necessity. The first step, in the case of transgenic production, is a nihilistic one. Utopian Edenic rhetoric must be revealed as the fraudulent clap-trap that it is. To appropriate public ignorance and fill this absence with a simulation of mystery to enhance one's authority and to inspire awe over the mundane is worthy only of the lowest carnival, spirit-knocker hucksters. What makes matters worse is that this rhetoric is not used only by industry promoters, but by scientists and artists as well. Anything that can be done should be done to expose the social separation and solidification of authority reinforced by their claims of being new creators and bringers of plenitude to the masses. Plenitude for the world is not just around the corner. The corporate claim that it is producing the means "to feed a hungry world" (a motto that has sunk deep into food economy and is used by corporations, farmers' associations, food distributors, even charitable organizations) is a falsehood. The world could be fed before biotechnological means were available. For more than half a century, starvation has been little more than a military tactic to bring rogue nations into line or eliminate excess populations, and will probably remain so long after new, more efficient means of food production are in global use.

Edenic rhetoric brings its own inversion—the complaint that the class of people who use it "are playing God." This rhetoric of spiritual trespass is as dangerous and as authoritarian as the claim of the Secular Creators. Not only do both of these rhetorics reinforce one another, but they deflect the conversation from the critique of production, commodification, and value onto the trivialities of ethics and morals—a circular sign exchange that continuously flows nowhere. Meanwhile, the piratical exchanges of capitalist political-economy continue relatively uncontested. A key example of this deflectionist strategy is *still* cloning. Cloning is presented as the ethical issue of the day and the cause of considerable public discussion due in part to the media coverage (the exchange between the media and its consumers is now looping in terms of causality). Cloning is a completely underdeployed biotechnology. The knowledge base for it and its applications are modest. On the other hand, consolidation of the food chain by corporations affects at present 40% of people on this planet, in addition to having a direct linkage to eco-piracy and molecular and environmental pollution. No need for ethical discussion here. Exploitation, domination, and what to do in the face of it are the topics needing discussion and action, but at present the ethical black hole of cloning has the spotlight.

When Edenic rhetoric can be understood in general as the oppressive language that it is, resistant culture can move to the second part of the initiative, and that is to replace this rhetoric with a critique of power that reveals the relationships of individuals to biopolitical authority and the consequences of these relationships. Providing simple, practical tools of risk assessment that are grounded in science and placed within historical and cultural context is the easiest way for doubt to be transformed into insightful critical questions. As always, the constructive task is far more difficult than the destructive one.

The maintenance of mystification takes more than just a rhetorical formation. The question of access to scientific institutions is another significant element. To take an extreme example, Australia has eliminated nonspecialist intervention in transgenics by sealing off the institutions involved in such investigations. (Perhaps this was done in good faith, but CAE will not be questioning that in this essay.) Given Australia's history of ecological problems due to release of alien species into the environment, there was a public outcry for caution and care with transgenic initiatives. This idea is all well and good; transgenic investigation should proceed with caution. The problem is that the rules for handling GMOs became so strict and regulated that for all practical purposes the public can have no contact with them or the physical apparatus that produces them. The positive side is that the likelihood of accidental release is very low; however, the downside is that what is going on in the labs will forever be a mystery. Creatures cannot come out of the lab, and people cannot go in without going to considerable difficulty. The consequence is that the public remains ignorant and is only comforted by a feeling of security. Reasonable consensus exists among scientists that these precautions regarding physical containment and importation are excessive; however, they are necessary to keep the public from panicking. Education (liberation) about transgenics could have the same effect, but security (repression) was seen to be the better (most efficient) option. The political result is that the power of transgenics and its knowledge base remains in the hands of bureaucrats (the regulating agencies) and the scientists, and therefore is outside democratic process. Just as bad, the bunkers allow for rumors and conspiracy theories to spread because no one has experiential evidence to contradict popular fantasy. Only those within the bunker can dispute it, and they are dismissable because they are representatives of the conspiracy itself.

While Australia may be the strictest nation in this regard, the repressive model is fairly representative of institutional positions worldwide. (The economic reasons for this situation will be described in Chapter 4). The goal for cultural resistance is to create temporary public space where education and intersubcultural labor exchange can occur. Opening the knowledge bases and dissolving boundaries of specialization is a primary goal. Creating a space away from Edenic rhetoric becomes a necessity. Under such conditions, dialogue can occur that is grounded in the present rather than in utopian or apocalyptic projections for the future. Understanding and consensus arises out of interaction, but for it to actually happen, respect for the knowledge bases of all participants is necessary. For this reason the space must be one where the authority of the scientific personality is not so powerful. The hierarchy of expert over amateur has to be suspended in this context. If experts have no respect for the position of amateurs, why would they come to a place where dialogue is possible? But more significantly, why would amateurs come to a space of monologue where the experts dominate? This separation has to be dissolved through interdisciplinary facilitation: This is a service that cultural workers can provide and have a history of providing.

The final question is where should these spaces be created? The easiest locations to use are spaces designed for cultural activity (art museums, natural history museums, ethnographic museums, etc.). These spaces are useful and provide a legitimacy that is sometimes necessary; however, they cannot be used exclusively nor can they be overdeployed. Other venues have to be appropriated. Spaces that lend themselves to overlaps in interest in the organic are tremendously fruitful. Grocery stores, farmers' markets, zoos, parks, fairs, and so on are locations that have a participatory dynamic built in, and where, out of everyday life association, people are predisposed and sympathetic to discussions of biological issues. They are often spaces where people feel they have a voice (unlike so many cultural institutions). These spaces should be exploited for their dialogic potential. If they can be created with the seven objectives in mind, there is a chance that a complex, tactical countersymbolic order could be established, and if fortune is with us, even thrive.

Part 2: Representational Pitfalls

Monumentality

Anyone who has attended digital media arts festivals over the past decade should be shocked by the replication of the monumental as a primary criterion in deciding the value of a given project. A work has to be big; it has to be overwhelming; it has to be global; and if one isn't doing a BIG project, it is somehow an insult to computer capability, hypertextuality, interactivity, and nonlinearity. If the project does not possess monumental scale or volume, it's considered just the work of a common user. This attitude is supported by the structure of festivals, which all want the biggest attractions; by the prize system, in which big is a necessity just for entry; and by the granting system, which seems to function in accordance with monumentality regardless of whether the judges are specialists or nonspecialists. This prejudice in favor of scale is evidently a trace of the traditional art world replicating itself in a new territory. In order to intervene in art history, monumentalism has always been a good tactic, but in the case of electronic media it has become the only tactic. What makes this situation very odd is that electronic media research has not progressed to the point where monuments are really appropriate. This year's monument, after all, is next year's dinosaur. The technology changes too fast, and monumentalism requires technological stability if it is to stand the "test of time." Perhaps this is putting the cart before the horse: We are attempting to write multivolume encyclopedias before writing an article that can be adequately understood.

As the field of the digital expands into wetware, the replication of monumentality as the equivalent of quality is continuing (albeit at a slower pace), and with this expansion come the same disappointments—primarily product (in every sense of the word) before process, and scale over concept. The emptiness and lack of experimental spirit in new biotech work is depressing, but not surprising. The means to try to cover the emptiness of content by the use of scale are all the more amusing. Given that much of the work is in the molecular and cellular world, how does one make that big? Video projectors attached to microscopes become necessary, and any other type of technological superstructure that can fill a room with an image. The other option is to construct symbolic monumentalism by making monstrous, heroic claims such as that one is "creating life." The saddest part is that these claims are often believed by less informed members of the public. In the end, what an audience gets is a big product demo (much the same as with ICT), in which standard lab techniques are dressed up with a slick design job and parade themselves as new breakthroughs in cultural practice.

The difficulties do not stop there. The monumental also compromises the work of the content-minded. The two are almost mutually exclusive, not because an electronic monument cannot have content, but because the wowie-zowie effect of the scale overwhelms any content it may have. (When the project becomes a dinosaur, the content reappears, and can potentially save the project from extinction.) Spectacle can overwhelm even the most critically minded, and in light of the mystery of technology for the nonspecialist, and the heroic hype given techno-explorers, audiences are primed to focus on spectacular entertainment even when conceptual value is available.

Finally, one must ask, is this structural replication of monumentality desirable (at least in its current form)? Politically, for anti-authoritarians, monumentalism is generally undesirable because it tends to transform the specific into the general (if not the universal). With electronic media under the domination of white males (with perhaps the exception of video, the financial runt of the litter), it's hard to support this new wave of monumentalism. At the same time, there is a technical research component to monumental works that offers a shred of redemption. If no one experiments with monumentalism, the possibility of alternative technical options will be diminished.

Formalism

Formalism presents a second possible pitfall. Recently invented imaging technologies designed for biological investigation and the images derived through their use have inspired a host of new art objects that replicate or abstract the forms of the micro and molecular landscape. In addition to traditional formalism, another type has appeared that is based in the re-presentation of the processes that form organic matter, ranging from tissue cells to GMOs, and then products that are derived from these processes are often displayed. In both cases, functionality is stripped from the process/object and the ideology is hidden in order to skew experience toward an enveloping aestheticized perception. The decontextualization turns processes that are fascinating in and of themselves into a banal series of statements. How much more art is needed about the beautiful or sublime qualities of nature? The only reason that it can even be stated yet again without people breaking into laughter is because the novelty factor is so high. Artists forming life itself to make a statement about life—what a concept! And what a great sleight of hand—mundane cookbook recipes of science that have a profound effect on knowledge, methodology, and material culture are transformed into transcendental voodoo. Such activity is mystification on an intolerable scale that directs viewers away from an understanding of their world in general and away from an understanding of the flesh machine in particular; rather, it redirects discourse into the disempowering realm of the abstract. The bio-commodity is beatifically naturalized, becoming an enchanted/haunted process/object that accepts the projection of sublimated desire and is ready for consumption. The end-game of this style of production is, of course, recuperation by the corporate state.

CAE hopes that we are not misunderstood on this issue. We are not arguing for the elimination of visual pleasure. Tactically speaking, it may not always be useful to produce such sensations, but pleasure is an option that should be engaged whenever possible, and that is the grand majority of the time. The modernist split between beauty and pleasure on one side and ideology and critique on the other is a false dichotomy. Or, to put it in concrete terms, we do not support the John Henry Mackay model of production in which his love poems are written on a personal level for beauty's sake, and his agitprop novels are written on a social level for the sake of the proletariat. CAE is in no way suggesting that all cultural action in regard to biotech return to the all-too-often repulsive visual language of so much activist art. Capital should not have a monopoly on the attractive or seductive image, nor should resistant culture give the impression of being aesthetic puritans. What needs to be avoided is the idea of beauty for its own sake, for beauty is a tactical choice that can aid the critical dimension of a work or take away from it. After all, beauty is no more than a cultural construction that can be manipulated within given parameters. The idea that beauty is a supreme quality and that other qualities should be deintensified or eliminated from a work by reducing it to form is the problem. CAE is suggesting a rhizomatic model in which visual pleasure is not in opposition to critical discourse, but harmonizes with it on a multivariate plane of immanence. Put negatively, the rejection of transcendental categories is what is of concern to us. There is plenty of pleasure to go around within that which is common, and it does not have to exist at the expense of the transparent representation of power relationships within a given process/object.

Science Fiction

CAE would like to state at the outset here that we are not attacking science fiction as a legitimate literary genre, nor are we attempting to say that it is any better or any worse than any other genre. In fact, we are only interested in some basic narratives that would make many sci-fi writers cringe. Our concern in this section is only with the general usage (in art, film, TV, text, etc.) of biological sci-fi narratives in a tactical sense. At times, sci-fi has been extremely useful to resistant culture, particularly in the most repressive times. Ideas and discourse that authority deemed subversive could easily hide in sci-fi fantasies. A creator had plausible deniability. S/he could always insist that s/he was just telling a story, and that it had no allegorical intent nor even that it suggested what could not be spoken. For example, sci-fi was used tactically and exceptionally well in the 1950s as a means to speak about McCarthyist activities and tendencies. Of course, it was used by the other camp as well to promote military initiatives and further red paranoia. Given the current social/military environment, the need for tactical sci-fi may come back again, but there are some down sides to this very popular choice in cultural models.

While sci-fi has generally been a great ally in eliminating Edenic rhetoric, it has not done so well at disassociating itself from the recombinant and the monstrous. Perhaps we are asking too much here, since it is such a profound cultural code. Without it, is it even possible to have monsters (in the broadest sense of the term)? The monstrous seems prominent in many of the metanarratives involving mutation, invasion, and all types of biological corruption (technological, pharmacological, genetic, etc.) that are necessary for conflict in the sci-fi narrative. Replayed at a alarming rate (particularly at the pulp level and in Hollywood), the positive soul of the pure human either falls prey or finds a way of protecting he/rself from the agents of the above listed metanarratives. The sci-fi replication of this narrative of good and evil is a reinforcer of imperial ideology that justifies bourgeois constructions of "human" and "other." Such drama brings those who engage it to high mythic narrative which in turn functions as a deflector that moves considerations away from the pragmatic and into first principles and ethical/moral conundrums. Again, there is a tendency for the transcendental to assert itself at the expense of the plane of immanence.

The second concern is with the temporal. Works of sci-fi tend to locate themselves in the future to give them that extra bit of credibility. And why not? The future is open to any type of speculation. Any narrative moving between apocalypse and utopia is welcome. The future is a zone of free speculation, and that spells fun for the producer or participant. The down side is that such romps take away personnel who are needed to decipher the present. On issues like biotechnology in general and transgenics in particular, so much of the present is misunderstood, distorted, or hidden, that tactically speaking, it would be better for resistant cultural producers to focus on these difficult areas. The future appears to be overdeployed in a cultural sense (especially if we throw in the futurologists), while the present begs to be understood through accessible cultural action (the academics are not much help here). Many will probably say that through future fiction, we come to understand the present. Perhaps in a transcendental sense that is true—metanarratives of humanity or moral principles come into focus (partly because this is how people have been trained to read the future), but in terms of mundane everyday life process the future as the setting for these works is very inefficient in helping people learn anything. Moreover, the wild speculations that the talented are able to frame as plausible can end up fanning the flames of fear without injecting any actual information that could transform nonrational energy into political action. For the sake of ease and efficiency, CAE believes that sci-fi narratives are not the best of tactical choices at the moment.

Conclusion

Consciousness raising is generally a matter of aiding people in constructing new grids of interpretation that allow them to see the exploitive structures and processes around them, and to help them understand that their subjectivity does not have to be determined by these negative influences. To do this, activists, organizers, political artists, etc., could draw on the life experience of those undergoing the pedagogical process. Whether it is class relationships, worker exploitation, or prejudice and discrimination, the life experience of the individuals in these situations contains the means to understand how these structures and tendencies functioned and the ideology that justified and maintained them. With biotech in general and transgenics in particular, life experience is minimal or very indirect. Hence, while agents of cultural resistance may have clear objectives and know the pitfalls that lie in front of them, they are left with the difficult pedagogical problem of how to produce direct experiences for people that reveal the urgency of countering the molecular invasion. Experience and pedagogy (doing and thinking) have to occur simultaneously, thus making dialogue and individual participation key elements in resistant cultural initiatives regarding biotech. Simultaneity is not common in the pedagogical process. Usually one experiences an action in the world, and then can critically reflect upon it in a pedagogical space. These two stages now have to be compressed into a single experience. The space of everyday life and the space of pedagogy must become one and the same to make digestible, accurate information immediately connected to critical reflection. This is the new and experimental dimension that needs to be part of cultural projects that address key issues that are disconnected from everyday life experience.

Capital has chosen commodity envelopment as the best means to introduce biotech (by the time the people know what is going on, they will have internalized a feeling of dependency on various product lines, and will not want them taken away or regulated). The spectacle of biotech is still gentle and cautious, so there is a small chance for education to triumph over indoctrination on the issues. Hopefully, this opportunity will not be wasted.

Today, the new technologies convey a certain type of accident, one that is no longer local and precisely situated, like the sinking of the Titanic *or the derailment of a train, but* general, *an accident that immediately affects the entire world.*

—Paul Virilio

4

Transgenic Accidents

Paul Virilio has commented in a number of interviews that each new technology that is embraced by a culture is accompanied by a series of possible accidents particular to the given technology. With information and communications technology (ICT) or transportation technology, the accidents have increased in scale and in their intensity of violence, due to their intimate relationship with the intensification of speed. In the case of ICT, the accident has hit a zenith in scale and intensity of violence beyond which it cannot progress. With the introduction of global, real-time technology, the possibility of an accident that could occur simultaneously on a world-wide basis haunts the margins of the spectacle of techno-utopia. As the world braced itself for the disaster of the Y2K bug, the meta-accident lived as more than a theoretical concept, and the means by which such an upheaval could occur manifested in a detailed scenario that had a tremendous material impact on every socio-economic constellation using ICT.

Resource-driven, transgenic biotechnology has a particular set of accidents that accompany it. The nature of some of the accidents is already taking shape, but there is a shortage of details. There are, however, some loose analogies. For example, when nontransgenic species alien to a given ecosystem are introduced, the results are very difficult to predict. For the most part, these introductions have been neutral or positive, but there have also been a modest number of negative outcomes. Australia is a very interesting case, as it is one of the few countries that prefers biological environmental resource management to chemical management, and has remained committed to it over the past century. And while it has had many successes, there have also been many problems. Rabbits, feral cats, European carp, and myna birds are all examples of species that have been problematic in various ecosystems in Australia. Perhaps the most well known example is the introduction of the cane toad. In 1930, sugar cane farmers in the coastal regions of Queensland, Australia, became increasingly concerned about the rising threat to their crops from the cane grub. Their grumblings about this problem spurred the government to find a method to control this pest. It was determined that the cane toad, although not indigenous to Australia, would serve as a predator that could adequately hold down the numbers of cane grubs and beetles that plagued the farmers. In 1932 a colony of cane toads was collected in Hawaii and transported to a small pond in Queensland to breed, and breed they did. Much to the chagrin of the farmers, the toads failed to curb the grub population. It became clear that the cane beetle had two incarnations, an airborne manifestation as well as an earthbound form. The beetle in its flying form was not readily available to the opportunistic toad, which preferred to eat life forms on the ground that happen to be passing by. Further, the cane toad preferred to stay where there is good ground cover, but the grubs were available during the season when ground cover in the fields was at a minimum. Consequently, the toads and the grubs did not share the same territory. Thus, the cane beetle was completely unaffected by the introduction of the toad to Queensland. To make matters worse, it was soon realized that the toad had neither natural parasites nor predators in this environment. Now the population is out of control and has had a devastating effect on the environment. Cane toads are voracious eaters, and will eat anything that will fit in their mouths. They also are rapid breeders. Hence their ever-growing numbers pose a threat to numerous small insects that are productive in the Queensland ecosystem. The cane toad has now become a superpest whose territory is ever-expanding.

In response to this problem, Australian biologists and resource managers attempted to find an organism that could control the menace. The first attempt was a study on a Venezuelan virus. Researching the potential for viruses to control cane toads involved isolating and purifying viruses from cane toads in their native habitats in Venezuela. The effects of the viruses on cane toads and native frog species were then tested in the secure biocontainment facilities at the CSIRO Australian Animal Health Laboratory. While the viruses proved effective in killing cane toad tadpoles, they also killed one species of Australian frog in the trial. This option was rejected. In a second attempt, the researchers identified two fungal pathogens that are lethal to cane toads and other amphibians. One fungus was thought to be responsible for frog fatalities in Australia and Panama, so this possibility was also dismissed. The cane toad problem is still unsolved.

Another problem is the accidental release of organisms alien to a given environment. This type of accident is also pertinent to transgenics, as many of the genetically modified organisms are designed to be robust and to have competitive advantages over wild species (transgenic fish and yeast are good examples). Consequently they have to be kept in containment facilities so as not to pollute wild environments. In this case, the probability of an accident is higher compared with species that have been designed to blend in with a given environment. Before transgenics increased the risk level, there were a number of cases of environmental pollution from accidental releases that served as warnings of what could be next. One of the classic examples of accidental release in the US is the gypsy moth, *Lymantria dispar*, one of North America's most devastating forest pests. The species originally evolved in Europe and Asia and has existed there for thousands of years. In either 1868 or 1869, the gypsy moth was accidentally introduced near Boston by E. Leopold Trouvelot. About ten years after this introduction, the first ecological disruptions began in Trouvelot's neighborhood. By 1890 the gypsy moth had become such a pest that the state and federal government began attempts to eradicate it. These attempts ultimately failed, and since that time, the range of the gypsy moth has continued to spread. Every year, isolated populations are discovered beyond the known range of the gypsy moth, but these populations are either eradicated or they disappear without intervention. It seems inevitable that the gypsy moth will continue to expand its range in the future.

The gypsy moth is known to feed on the foliage of hundreds of species of plants in North America, but its most common hosts are oaks and aspen. Gypsy moth hosts are located through most of the coterminous US, but the highest concentrations of host trees are in the southern Appalachian Mountains, the Ozark Mountains, and in the northern lake states. Gypsy moth populations are typically eruptive in North America; in any given forest stand, densities may radically fluctuate. When densities reach very high levels, trees may become completely defoliated. Several successive years of defoliation, along with contributions by other biotic and abiotic stress factors, may ultimately result in tree mortality. In most northeastern forests, less than 20 percent of the trees in a forest die, but occasionally tree mortality may be very heavy. Over the last 20 years, several million acres of forest land have been aerially sprayed with pesticides in order to suppress outbreaks of gypsy moth populations. Though some areas are treated by private companies under contract with landowners, most areas are treated under joint programs between state governments and the USDA Forest Service. The USDA, state, and local governments also jointly participate in programs to locate and eradicate new gypsy moth populations in currently uninfested areas. Most of these projects focus on populations of European origin, but recently several Asian populations have been discovered and eradicated in the US and Canada.

In eastern North America, the gypsy moth is subject to a variety of naturally occurring infectious diseases caused by several kinds of bacteria, fungi, and a nucleopolyhedrosis virus (NPV), which was inadvertently introduced with the gypsy moth or its parasites. There are six species of entomopathogenic (causing disease in insects) fungi known to infect the gypsy moth. As an alternative to spraying insecticide, pest managers turned to a biological means of control. In 1984, researchers isolated an entomophthoralean fungus (*E. maimaiga*) from the Asian gypsy moth in Japan and brought isolates to the United States. Stages of this fungus now could be maintained year-round in the laboratory using several different culture media, rather than having to be perpetuated on gypsy moth larvae. Host range studies have shown that *E. maimaiga* does not infect insects other than *Lepidoptera*.

There is general consensus among scientists and pest managers that *E. maimaiga* is probably responsible for the decline of gypsy moth outbreaks and damage over the last few years. It is effective in both high- and low-density gypsy moth populations, unlike the nucleopolyhedrosis virus, which is only effective on high-density moth populations. The fungus could play a significant role in the natural control of gypsy moths, especially in years with a wet spring. Only time will tell whether increasing the area where *E. maimaiga* is established will lead to constant lower populations of the gypsy moth in North America.

Examples of such accidents and responses to the accidents could be endlessly recounted. Kudzu, killer bees, purple loosestrife, catclaw mimosa, etc., all point to the kinds of accidents that can occur when humans play mix and match with ecosystems. Transgenic organisms, however, are in a very fuzzy position in regard to alien species introduction, because they typically exist at the intersection between the alien and the localized. For example, transgenic corn tends to be introduced in corn-growing localities. It is both alien and localized at the same time. The problem here is that comparing historical cases of alien organisms' release does not get the analysis very far; it only throws up abstract cautionary flags. Does changing a single gene or a single phenotypic characteristic really change the organism so drastically that the GMO deserves the designation of alien species? Not having an answer to this question makes argument by analogy very sketchy, so the debate continues. This leaves direct research as the best and only method to try and work through the transgenic puzzle. Such research takes a tremendous amount of time, particularly because so much of the study has to be cross-temporal, ranging over generations. Such studies are necessary because biological accidents tend to be low velocity and filled with numerous latent features (bio time-bombs). Seemingly, one of the new types of accidents that transgenics can potentially deliver is the germline or perhaps even the evolutionary accident of cultural origins (perhaps the biological equivalent of Virilio's ICT real-time meta-accident). Even though such accidents could be rendered extremely unlikely given proper time and research, profit-hungry corporations continue to operate according to a "fix it as you go" policy, with the idea that a product is safe until shown to be otherwise.

The Good, the Bad, and the Transgenic

While a tremendous amount of caution and study should be applied to transgenic organism release into the environment, there are strategies that reduce the level of risk. The use of *E. coli* for DNA replication in the various genome projects provides a good strategic model. In order to replicate DNA sequences in reliable mass quantities, scientists have developed a method that uses *E. coli* as a replicating machine. By placing the DNA sample desired for replication into plasmids (extra chromosomal DNA) within the organisms and then replicating them, scientists can retrieve as many samples as they want. The ecological question that follows is what if this strain of transgenic bacteria escapes from the laboratory and finds its way into the wild? To prevent any unforeseen disasters, scientists have placed safeguards into the bacteria. To be sure, this bacteria is not of great danger even without the safeguards, but this take-no-chances policy seems prudent all the same. The introduction of foreign DNA into bacteria puts it at considerable disadvantage when competing with wild bacteria. For the bacteria to replicate, it must not only replicate itself, but all the extra DNA in its system as well. This slows its reproduction process to such an extent that it would be overrun by wild bacteria, or, in other words, it would be at an extreme disadvantage in the competition for space. Scientists, however, have gone a step further in developing safety features by mutating lab-strain *E. coli* so that it is fundamentally incapable of nourishing itself outside of the lab environment. Lab bacteria is incapable of producing all the proteins that it needs without a specialized food source that they are very unlikely to find in the wild (i.e., outside the controlled conditions of the lab). Should they escape, they would again be unable to compete with wild bacteria because of this crippling feature.

This model of building in safety features has had some successful industrial applications as well. For example, the bacteria used for oil spill clean-ups is a very low risk for release because its termination has been engineered into its task. When an oil spill occurs and the bacteria are deployed, they only live as long as the food source (oil) is available. Once the oil is gone, the bacteria can no longer sustain themselves in the hostile ocean environment. The chances that they will find another food source are slim, so the ecological risk factor is quite low. Certainly, with both of these examples there is still an infinitely small amount of risk, but it is within acceptable parameters, given the benefits that these GMOs provide.

Unfortunately, this strategy of transgenic organism production and deployment is not the norm. A more common example is the socially and ecologically irresponsible corporations' production, marketing, and planting of *Bt* corn and cotton (and now potatoes and tomatoes as well). These crops are engineered using a gene from *Bacillus thuringiensis*. When this gene is mixed into the genetic structure of corn (or cotton), it allows the plant to produce a toxin that is hazardous to many of its insect predators. The promises from the corporate developers (Monsanto, Calgene, etc.) are that *Bt* crops will require less chemical management and produce higher crop yields. These positive characteristics are at least true in the short term, and hence *Bt* crops have been attractive to farmers. What is not mentioned by the corporations is the impact that this toxin could have on the environment. The primary problems are domestic and wild plant hybridization, the destruction of nontarget creatures, and unacceptable soil toxicity levels. For example, corn requires an airborne fertilization process to reproduce. The toxin produced by *Bt* corn is expressed in the pollen. Corn pollen can typically move up to 60 meters on the breeze (and even further, given less typical conditions). Like most primary domestic crops, corn has wild relatives with which it can cross-pollinate. Should the *Bt* gene be transferred to these relatives, they would have a considerable advantage in the wild. This could produce a superweed that could be very difficult to eradicate and that could overrun other species, thus affecting biodiversity. To make matters worse, many devastating weeds do not become problems immediately. Often it can take years before a weed becomes a real pest. Catclaw mimosa is good example. It took 30 years after its introduction in Australia before its powerful ability to overrun native species of plants became apparent. Currently, evidence is mounting that *Bt* corn is hybridizing not just with wild relatives but with non *Bt* corn as well (much to the dismay of organic farmers).

The destruction of nontarget species has become a second issue of contention—most notably, the destruction of monarch butterfly larvae and green lacewings. On this issue there are at least some studies; unfortunately, the data are completely unreliable. The debate stems from differing opinions on and interpretations of the level of toxicity in the pollen landing on plants eaten by the above insects, and from the oldest of all criticisms of lab studies—can a lab study really reproduce wild conditions?— ending with each side accusing the other of doing *ad hoc*, impressionistic studies.

The issue of soil toxicity is in the same fuzzy position. There is agreement that the *Bt* toxin is expressed and secreted in the root structure of the plant, but beyond that, no consensus has been reached. Some studies argue that the *Bt* toxin can bind with soil particles, giving the toxin a much longer lifespan (up to 230 days) for its insecticidal properties, and that it can increase in concentration over time. Consequently, damage to the decomposition and nutrient cycles of the soil could occur, primarily due to the toxin's effect on the many organisms that inhabit the soil and function as catalysts for these cycles. As to be expected, there are just as many counter-studies.

Given the degree of scientific conflict over the use of *Bt* corn, it would seem prudent to err on the side of caution, but that is simply not happening. Biotech companies are taking the position that until there is conclusive evidence of a problem, no precautions need to be taken. Conclusive evidence takes a very long time to produce, if it can be done at all. By analogy, cigarette companies still do not believe that there is "conclusive proof" that smoking is a health hazard. Also, the funding for tests on such matters is lacking. This situation gives Monsanto the time it needs to sell as much *Bt* corn (and other *Bt* crops) as possible, until it is too late to stop the process without it having a devastating effect on the farming industry. (As of 1998, *Bt* corn already constituted one-fifth of the corn acreage in the US, and it is continuing to grow.) If history is any indicator, Monsanto is taking an almost sure bet that if this crop is fully interwoven into the market, economic demand will outweigh ecological responsibility.

Unfortunately, the *Bt* conflict does not stop at the ecological level. From the perspective of developing nations, a much different primary issue arises. In India, for example, there is not nearly as much concern over ecological or health risks from transgenic crops as there is in North America and Europe.[1] These are luxury issues generally reserved for industrialized nations. The promise of higher crop yields is very significant in countries where an adequate food supply is always a concern, and this potential must be balanced against the primary negative issue—neo-colonization. Monsanto is quite open about its goal to consolidate the food supply. In agrarian nations like India, where 700 million people are directly dependent on farming, the fastest way to control a country is to control the food chain. (Monsanto is also expanding its operations into water supplies as well.) If biotech companies in general are able to make the agricultural classes of developing nations dependent on corporate research, products, and knowledge, any possibility of food security for these nations will be out of the question. Moreover, the corporate method of focusing on product and production as a way to solve supply problems in locations like India is practiced at the expense of human capital. The strategy is to dumb-down the population by stripping them of traditional agrarian knowledge and to push farmers further into a serious debt so they will never achieve independent ownership of the means of production.

One of the countermodels to GM farming that offers a tremendous amount of hope in India is provided by the Deccan Development Society. This organization works with the poorest Indian women to reclaim land thought to be unusable. By investing in education to teach the women about seed banks, composting, inter-cropping, manuring, and soil fertility, they have produced self-reliant farmers and returned degraded land back to fruitfulness. There are two key points of great significance here: First, an obvious alternative to agricultural improvement through product is land redistribution and ownership! Ownership of *personal* property can have the effect of increasing production every bit as much (or more than) using high-tech seeds. The other point is the value of investment in human capital in this type of situation. A key part of this capital is the reclamation and maintenance of traditional knowledge. Take for example the use of the traditional farming method of planting a variety of crops. If one fails there are plenty more to sustain the farmer for the year. The biotech corporations have been insisting on the planting of single crops (mostly *Bt* cotton—not even a food). If the crop fails, it is a life-and-death situation for the farmers, which has led to situations like the mass suicide in Warangal, where over 500 farmers committed suicide by hanging or drinking their insecticide because they could not pay local loan sharks (the local agrarian product distributors who also loan money). While even the radical left of India does not totally reject GM farming, most insist that a hybrid between these new methods and traditional farming will serve India best; however, policy must be constructed around the farmers' needs rather than the corporations'. Only through such positioning can the colonial nightmare of the molecular invasion be averted.

Risk Assessment

If techno-accidents are taken as a given, and if transgenic products are accepted or rejected on a case-by-case basis, the questions must be asked, how should research be conducted regarding transgenic products and processes, and what constitutes acceptable risk? No one can say for sure what the fallout of any new technological direction may be, but some hypotheses are significantly more educated than others, and useful theories exist about what constitutes rigorous scientific study and statistical analysis in the various specializations in biology.

Currently, research standards for product safety regarding transgenic products that produce toxins in the US are unquestionably unacceptable for a number of reasons. The most obvious reason is that corporations do their own studies, which are used to apply for product and mass cultivation approval from the Environmental Protection Agency (EPA) and the United States Department of Agriculture (USDA). The conflict of interest is rather obvious. Allowing corporations to partially police themselves when the possibility of a potential accident is so high does not seem to be in the public interest. When a corporation wants a product approved, it does test studies and submits the results to regulating agencies. The agencies *review* the data (as opposed to replicating the study), and decide whether or not approval should be awarded. Testing from independent sources is not required, but it should be. The tests should not be left to the corporations, nor should they be left to even a single independent agency.

The problem appears worse when the nature of the studies themselves is examined. Problems arise both in sampling procedures and in study replications. The conflict among scientists over the danger level of *Bt* products stems from these very problems. The *Bt* studies (whether positive or negative results were obtained) were small in scope, and did not have the "statistical power" to yield convincing results. Moreover, the replications of the studies for purposes of comparison were typically very few in number. For example, Calgene's *Bt* cotton studies that were used to obtain product approval for commercial scale cultivation consisted of four replications, which is hardly enough to produce a basis for measurement and reliable data by any standard of scientific rigor. The EPA has recognized the problems of statistical power and study replication, and is at least working on guidelines to measure the impact of a product on nontarget organisms, but this alone will not be enough. The complexity of the systems under study cannot be successfully examined under general guidelines. Each product study will require its own unique set of guidelines. Even the scientific advisory panel appointed by the EPA believes this to be true. Neither the government nor the corporations want such guidelines, due primarily to cost.

The final problem is that these studies give only immediate data rather than cross-temporal data. To return to the Calgene example, its study of the effects of soil toxicity on earthworms was carried out over only 14 days. An earthworm lives for years. This study could not measure long-term effects, nor could it reveal what the toxin levels might do to subsequent generations. A proper study must at least last for the duration of an organism's lifespan, if not longer. If the studies have proper cross-temporal observation, sampling procedures, replications, and reliability studies, and find no negative results, the product could be construed as reasonably safe for mass cultivation. Will such cautionary measures be introduced? It is very unlikely.

The problem, of course, is that neither the government nor the corporations will cooperate with such safety standards. The biotech companies complain that they are being unfairly targeted by demands for impossible procedures that are placed as a burden upon them solely as a means to calm public hysteria. Further, they complain that other products are not put through such rigorous testing, and that to do so would raise the cost of bringing a product to market to unacceptable levels. However, most products do not appear to have the accident potential that certain transgenic products do. To compare a toxin-producing transgenic plant to even another insecticide is a false analogy. While they may both have the potential for ecological disturbance, an insecticide does not have the same potential for long-term disruptive genomic and reproductive consequences.

Given the financial power that biotech corporations have, their profound lobbying capabilities, and the grip that they have already gotten on the worldwide food supply, it seems unlikely that the public interest will play much of a role in policy construction, unless focused, informed resistance forces the issue. However, democracy, as useless as it usually is, is worth a try in this rare case. It would be possible to mount a popular front (from radicals to moderates) that could focus pressure on the EPA and USDA about testing procedures.[2] More stringent research would have the effect of slowing the spread of GMOs. But for the public to unite in this manner a great deal of consciousness raising has to occur. The corporate complaint that the public is "hysterical" is not totally without merit. This is where cultural production will play a major role. It has the pedagogical power to present information in a compelling way that can reveal the exploitive capitalist subtexts of GM production, teach the science at amateur levels, replace either/or, categorical judgments ("Are you for transgenics or against it?") with tactical analysis, and redirect fears into informed resistance. Of course, using resistant cultural production in the hopes of building a democratic popular front is more or less a utopian strategy. Other methods of direct resistance by small collectives and resistant cells have to be developed as well if inertia is to be introduced into the systems of GMO distribution.

Notes

1. Of all the arguments against rapid deployment of GM products, the health issue is the least convincing. Currently, the two main worries are the production of allergens and carcinogens in food. However, this concern is not grounds for an argument against the use of GM food in particular or GM technologies in general. The argument that can be reasonably made is for proper product labeling (another thing that food-producing biotech companies tend to resist). What the body can mingle with, carcinogen or not, should be a matter of individual choice, and not legislated. At the same time, the public should have the maximum amount of information available on a substance in order to make the decision that is best for each individual. Having such matters legislated just gives the security state more power in an area (body control) where it has far too much to begin with.

2. CAE cannot emphasize enough the need for focused pressure: Find the weak points and concentrate efforts there. Bioresistance will be most successful when the weakest link in the product chain is identified and popular political capital is focused upon it. These links tend to be at points where the corporations have the least amount of direct control.

....by any means necessary....

—Malcolm X

5

Fuzzy Biological Sabotage

If the left has learned anything from resistance against capital-driven technocracy, it is that the democratic process is only minimally useful for slowing the profit machine of pancapitalism. Since corporations and other capital-saturated institutions own the process, and tend to function outside national democratic imperatives, other methods of power appropriation have to be developed. In the case of biotechnology, the resistance is unfortunately in a position of reactivity. Corporations have already infiltrated most governments and markets at such a furious pace that all that can be done is attempt to slow them down, while cells and organizations regroup and decide on a way to address the many problems that have already arisen, and the many potential accidents that are in front of us. Assuming that inertia is always useful in disturbing capitalist production and distribution, one must ask how this principle can be applied to the current molecular invasion. Certainly, traditional tactics have some use, and electronic civil disobedience (ECD) will be of value, although it should be added that this is a time for hard-core ECD (blockage of internal communication systems, blockage of databases, the disruption of routers, etc.) Soft-core tactics like denial of service (DOS) can be of use in disrupting retail services such as assisted reproductive clinics (eugenics clinics by any other name), but most of the biotech industry is not about retail, so DOS is not much use in these cases except as a low-quality theatrical tactic with little pedagogical value.

In the end, however, resistant culture always needs to find a means to fight fire with fire. In other words, how do we develop tactics using biological materials and processes? In response to this question, CAE and some rogue scientists set about trying to form a model of direct biological action. The first unfortunate conclusion that we came to is that civil disobedience (CD) will not work in this situation. While inertia will always disturb a society of speed, it cannot be implemented on the biological front by blocking methods partly because the boundary and territorial models that CD was developed in response to typically have no place in the organic realm. Moreover, since our focus is on trying to intervene in the production of transgenic life-products, almost any action will have some destructive effect. This problem puts resistant agents in a very difficult position. We do not want to make it easy for capitalist spectacle to label resisters as saboteurs, or worse, as eco-terrorists. These terms are used very often and generously by authority and tend to have the profound effect of producing negative public opinion, which in turn allows state police and corporate posses to react as violently as they desire while still appearing legitimate and just. Escaping these labels completely seems nearly impossible; however, we can at least reduce the intensity and scope of these forms of labeling, and hopefully escape the terrorist label altogether. In any real sense, the association with terrorism is completely unwarranted, since it is not possible to terrorize plants, insects, and single-celled organisms. The problem with GMOs, however, is that they are not open to the kind of destruction that occurs when someone kills a fly or swats a mosquito, because they are more than organisms—they are private property. Since capital values property over all (humans included), one can only expect the strongest types of denunciation and response to its destruction.

In addition, there is already a very reactive history in regard to transgenic crops that can be of symbolic use to authorities. Test sites for new product lines of GMOs in the US, France, and India have been burned. This was and is flagrant sabotage. The location attacked was right. Test sites are a key location to disrupt, because if the studies being done at the sites are corrupted, they have to be redone, thus causing a very costly type of inertia in the developmental system. However, tactical arson plays right into the hands of the authorities. Such action gives them the examples of hard-core sabotage that they need to label, harass, and arrest potential transgressors, as well as individuals and groups opposed to sabotage who have little more than a modest philosophical association with violent resisters.

One interesting element does emerge from the Indian burnings. The group responsible paid the farmer hosting the test site for the crop before burning it. The message here is clear: Do not hurt the farmers/workers physically, psychologically, or financially. Agrarian complicity, in many cases, is nearly a given, because people have no real alternative to the markets dominated by the coercive power of the biotech industry. Grass-roots harassment is an unacceptable tactic that the left has debated and is hopefully pushing aside as the Indian example shows. In the 1980s, some AIDS activists suggested that pharmaceutical salespeople should be harassed as a means of disrupting distribution and thereby leveraging a price reduction of the astronomically expensive medicines needed to combat HIV. This was a terrible idea then, and it is a terrible idea now. From the corporate perspective, workers are expendable and there is a large enough reserve labor army to fill the ranks, so this would have no effect other than making a working family miserable.

CAE believes that the best response to these ultimately unsolvable problems is the idea of fuzzy biological sabotage (FBS). The fuzzy saboteur situates he/rself in the in-between—in the areas that have not yet been fully regulated. This situational strategy was very well developed by Brian Springer in his backhaul video work and in his laser information conduit interventions. His idea was to take what was considered private property, but functionally was public property. A backhaul (off-air live satellite video feeds) was considered the property of the media, but since it was in the public domain of the reception of airwaves and existed without copyright, it could be copied, replicated, and even marketed (now backhauls are scrambled to stop this process). Springer was brilliant at finding these little cracks in the system and exploiting them. The fuzzy saboteur has to stand on that ambiguous line between the legal and the illegal (both criminally and civilly). From that point, the individual or group can set in motion a chain of events that will yield the desired final result. The opening activity—the only one to which the saboteur should have any direct causal link—should be as legal as possible and hopefully within the rights of any individual. The more links in the chain, the better from a legal standpoint, but extending causal chains increases the difficulty of controlling all the exponentially growing number of variables that could doom the action. For the most part, such actions will only have two phases—the legitimate or fuzzy act and the upheaval it causes. The authorities then have the legal conundrum of proving guilt by indirect action—an unenviable task for any attorney. Moreover, unlike CD, fuzzy sabotage does not require a physical confrontation with authority, and in many cases does not require any type of trespass.

If an action is done correctly, the fuzzy saboteur has an additional safety net supplied by the various governments of the world—plausible deniability. For centuries state forces have sabotaged one another by various means that cannot be proven within any judicial system other than by military field justice. Simply by creating a nonaggressive scenario, or denying activity all together, agencies of discord have avoided direct charges. This symbolic shield can be reverse-engineered to serve resistant culture. With any luck, the fuzzy saboteur will never have to use this shield, but if this is necessary it can create a platform for public attention where "tactical embarrassment" (to use the RTMark term) can be employed. It may be nostalgically reminiscent of 19th-century anarchism, when it was incumbent upon any member of the movement who was arrested to use the court or any other public stage to denounce the bourgeois system, but practically speaking, and for the health of the tactic, such public displays should be avoided at all costs. A single publicity battle can potentially be won through deniability and campaigning; however, a series of these occurrences will dilute the plausibility of the denial and allow the development of spectacular countertactics by the authorities. Like hard-core ECD, FBS is not a public process. CAE requests that those groups and individuals whose goal it is to spectacularize hacking and perform as activist pop stars to do the movement(s) a favor and leave this method alone—particularly in its testing stage.

The final question then is, who are the agents of FBS? CAE suggests the use of wildlife to do the deed. Microorganisms, plants, insects, reptiles, mammals, tactical GMOs, and organic chemical compounds can all be a part of the resistance. The use of living nonpathogenic biological agents as disrupters will depend on each individual's or group's particular relationship to these creatures, as well as on localized conditions. Obviously, considerable arguments will erupt between the various positions on what constitutes an acceptable relationship between humans and other living creatures, and how various creatures will be employed, but let us say at the outset that we are not proposing that sentient organisms be considered for suicide missions or other incarnations of sacrificial economy.

Pranks

If FBS has roots, it is in the realm of pranks. Most readers probably have a story of a prank that they or someone they knew did involving a biological agent. Placing a dead rodent or fish (nature's stink bombs) in a heating duct at school or some other offending institution is one of the classics. However, these are not among the class of pranks that are of interest to the fuzzy saboteur. FBS pranks are not done for a good laugh, for public embarrassment, or simply to be annoying; rather, they should be done as a form of psychological disturbance—more along the lines of LSD in Castro's cigars and liquid refreshment before a public address (to use an example from the CIA's book of practical jokes). Pranks can be used to stir up internal institutional paranoia, or they can be used to divert attention toward useless activities. Pranks can provide their own unique blend of inertia.

For example, the release of mutant flies in research facilities and neighboring offices can potentially have a disturbing effect. There are all kinds of mutated flies available on the market. They come in various colors with almost any type of deformity one might desire. Labs use them for cross-generational study because they are easy to raise, reproduce quickly, and maintain unusual genetic codes. Choose a set of mutated flies and begin a steady release of them into biotech facilities (it also works well in nuclear facilities). They can be set free in lobbies, parking garages, parked cars, almost anywhere. One does not have to challenge a fortified site—the flies themselves will do the infiltration. If enough flies are acquired or produced, you just have to be near the site and release swarms of them. Trespassing is not really necessary, unless there is a need for specific targeting. It only takes the occasional observation of them on a regular basis for people to start wondering what might be causing the appearance of these strange creatures. Needless to say, the first conclusion will not be that some fuzzy saboteur must be letting mutated flies go in the offices. The imagination will provide more exotic scenarios. The key here is consistency, not quantity. Moreover, relying on the power of the rumor mill that develops in any workplace, we can be sure that the fear and/or conspiracy factor will be considerably amplified. A paranoid work force is an inefficient work force. This approach thus creates inertia in the system. In the best-case scenario, an investigation into the origins of the flies would be launched, which would burn more cash and waste even more employee time. In the worst-case scenario, the prankster would provide a topic of conversation at breaktime.

If there are other businesses near the research facility, let the flies loose in there too. Restaurants are particularly good locations, since customers are sedentary for a while there, and flies call attention to themselves in environments where food is served. This can have the effect of aiming local business owners' and workers' suspicions at what may be occurring in labs nearby. Needless to say, local tensions could easily increase, and those who never would join a movement could become unknowing cohorts or willing allies.

Pranks such as this one are easy and inexpensive. As for the flies, they really don't care where they are, as long as it's a location that corresponds to their adaptability range. As for environmental danger, this is negligible. Mutant flies have no adaptive advantage in the wild and their recessive characteristics are not likely to be selected for. They are not overachievers when it comes to survival, so there should be few worries about environmental pollution in any ecological sense. The pollution will be in the human psyche. And isn't it better for a mutant fly to soar free for the resistance than serve a lifetime in laboratory servitude?

For those who would like to have their own mutant fly hatcheries, they are fairly easy and inexpensive to start and maintain. The flies are free, and can be obtained on the web from the Bloomington Fly Center. To maintain the flies you will need fly bottles (they hold about 100 flies); however, if you are on a small budget, you can substitute milk bottles for this function. The fly food is made from molasses, yeast, and apple juice. To get the perfect consistency requires a little human power, but a machine to do this is also available (but they are costly). For optimum breeding an environment with a relatively stable temperature is necessary. The flies should be kept at a temperature between 18-25 Celsius with humidity between 40% and 50%. Flies are fairly robust, but must be kept away from extreme temperatures (especially heat). The life cycle is about one month, so producing a swarm (10,000) is a laborious, assembly-line like task; however, maintaining a small amount over a long period of time is relatively easy.

Test Site Disruption

Over the past forty years, resistant groups have made tremendous strides in terms of organizational principles. Many have said a happy farewell to central committees, unions, and parties, and replaced them with autonomous cells and temporary, single-issue coalitions with ever-shifting rotational leadership. "The people united will never be defeated" has given way to the more practical idea that tactical unity among resistant political configurations for an immediate and specific purpose can have a systemic impact in spite of differences and contradictions within coalitions. Such immediatism and decentralization has proven to be the best defense against infiltration and cooptation, as well as aiding in the creation, albeit temporary, of powerful popular fronts. Unfortunately, resistant tactics have not always maintained the same level of sophistication and complexity. This is not necessarily the fault of activists since tactical possibilities do not always present themselves as clear and easy. Further, as new contestational situations arise, the reactive tendency of radical subjects pushes them toward immediate action. There is little time to think matters through, because with each passing moment, the object of activists' political offense becomes increasingly entrenched in the system both materially and ideologically. Radical research and development is something of a luxury process, and so the balance between direct action and R&D is one organizational element that remains underdeveloped.

Such is the case with the response to GMOs. There has been a good deal of hard-line direct action, but the tactics are incredibly crude. The use of arson and vandalism by radicals as a means to insert inertia into corporate initiatives is a sign of desperation and a robust imbalance between thinking and acting. Whether one considers the examples of Professor Najundaswamy and his followers in

India, José Bové and his followers in France, and especially the Earth Liberation Front (ELF) in the US, the destruction of assets has been of limited impact, and has functioned primarily as counter-spectacle ripe for recuperation. This is not to say that there are no advantages to such tools. Fire, for example, works on all crops; it is inexpensive to produce, and insures a devastating kill ratio. The problems, however, are also clear. The illegality of direct incendiary sabotage creates a host of difficulties for the perpetrators. As previously stated, this kind of sabotage allows for corporate culture to cry "terrorism," so they can represent themselves as the victims of extreme injustice. In turn, the state and corporate security apparatus grows in strength because sabotage also creates the opening for the successful petitioning by security agencies for increased funds and human resources. Moreover, pancapitalist spectacle can cast guilt through association on all resistant organizations, leading to more segments of the movement coming under direct investigation. This also helps create the public perception that all greens are at least potential eco-terrorist wackos. At the other end of the spectrum, saboteurs can count on long-term incarceration if apprehended. The loss of committed activists to the prison system is not helpful in the long term. A short-term stay in jail for purposes of civil disobedience is fine, since those confined are returned to the ranks rather quickly. Political prisoners as living martyrs do not have a desirable or very useful status as long as other options are available.

If one examines the example of state military sabotage, an optimized set of attack principles is revealed. First, only use the minimum amount of force necessary to accomplish an objective: Mosquitoes should not be killed with a shotgun.

Second, focus the attack on the weakest link in the system. The classic example is the Allies' strategy during World War II of bombing all the German ball bearing factories. These metal spheres were necessary for all vehicles. By focusing on their elimination, vehicle manufacture and field maintenance was brought to a near halt. Another principle that was reinforced during these bombings was the need for accurate and precise targeting systems (a wing of military research and development that has only accelerated in scope and sophistication to this day). Even from the military perspective, deficient as it is in financial logic, carpet-bombing a city to destroy one factory is an unfortunate waste of assets. While activists have done well on the second principle, they have done poorly on the first and third. Burning crops and labs is certainly overkill. Targeting is just as bad. One of the things that greens complain so much about is the potential death of nontarget species due to certain GM products. Fire has the same nontarget effect.

In using the above principles and combining them with fuzzy sabotage, what is the best way to disrupt GMO research? The choice of research sites as a site of resistance is an excellent one. In spite of the fact that corporations generally get a free pass from the EPA and USDA to market their products, as long as they can produce minimal research that demonstrates that a product is "safe," they still must produce *some* research. If they fail to do so, the product line completely stalls. Since this type of research is incredibly protocol-laden in order to achieve accepted standards of scientific rigor, test contamination is very easy. Samples and study replicants are two fragile areas. If either are corrupted, the study has to begin anew, because the research will not generate the statistical power necessary to produce confidence in its validity. For example, when the growth of worms is studied as an indicator of safety in regard to soil toxicity related to *bt* products, all that is necessary is to add more worms of varying weights to the sample. While researchers will probably notice that the sample has been tampered with, they would be unable to clean the sample. The study would have to start again. The facility does not need to be burnt to the ground to place the desired inertia into the system. There is no need to kill nontarget organisms (humans included), nor disrupt or destroy other research initiatives that are not causing any harm that may share a given facility. Such an action is cheap, requires minimal human resources and minimal force, and is specifically targeted.

The lack of organic boundaries in ecological systems allows radical subjects to use corporate culture against itself for purposes of distribution. Canadian organic farmer Percy Schmeiser had his fields corrupted and seed banks contaminated by neighboring Monsanto "Roundup Ready" crops. In Canada, biotech corporations have the right to inspect anybody's crops. After sampling Mr. Schmeiser's canola crop, they discovered this hybridization and slapped the farmer with a lawsuit for patent infringement. Mr. Schmeiser had been growing canola the "traditional" way for 53 years and wanted no part of GM cropping. Unfortunately, not only is he now a part of this system, he is now being used as a example of what will happen to those who refuse corporate crops. You will be attacked one way or the other. As this case has shown, the option for a countersuit is available, but private citizens fighting against capital-saturated corporations in costly court battles do not have significant chances of winning.

The part of this sad story that is of interest to fuzzy saboteurs is that private boundaries are not recognized as sovereign if a nonhuman organic agent crosses them. Have a problem with a test site crop? Go into free-range rat ranching (reasonably low cost), and release as many as possible near the offending site. Moles, gophers, ground hogs, rabbits, mice or any pest not susceptible to given toxins could also be released *en masse* near the test site. After all, laws of private property, trespass, and vandalism do not apply to them. Again, the whole crop does not have to be destroyed; the sample just has to be damaged to the extent that it is no longer representative of the population from which it was taken.

High-Intensity Resistance and Precision Targeting

The question which must now be answered is what to do about the wide variety of potentially dangerous GMOs already fully distributed? In this case, the use of fire or other limited means is totally useless. It simply does not produce the kind of threat that would convince any major corporation to change policy, because it has neither the scope nor the impact on profits (at least not as long as there is corporate insurance and tax write-offs). Offensive mechanisms such as artificial selection are a possibility. For example, feeding *Bt* to a population of pests that is supposed to die from contact with it would eventually yield a subpopulation of pests that are immune to it. This subpopulation could then be bred to create a population that could be released into the wild where it would hopefully spread the resistant gene(s).

While this method would be good only as a long-term strategy, it could eventually have an impact in that it would force corporations to increase the speed (which always costs money) at which they had to respond to shifts in the pest population. At the other end of the spectrum, this type of breeding would not have a destructive impact on the environment, nor increase the pest rate for organic farmers. The downside to this potential strategy is that it is a low-efficiency method, and thereby would probably not be a great enough threat to corporate profits to leverage a change in safety policy and research methods.

The real solution, however, is precision in targeting systems. Any offending organism has its weak link, and it is precisely the same trait that supposedly makes it strong. The gene(s) or biological process that modify the organism can be targeted, and *turned from a trait of adaptability into one of susceptibility*. For example, Roundup Ready (RR)* could fall prey to this strategy. The herbicide Roundup (glyphosate) kills every plant in its path, including unmodified crops.

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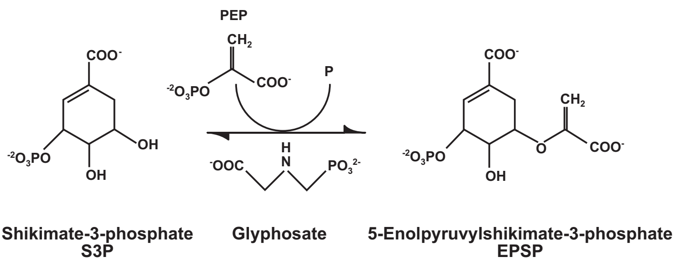
* CAE is not suggesting that RR is necessarily the best target relative to its potential for environmental danger; the example given here just illustrates the point. The preponderance of evidence (although it is not conclusive) does not show any real problems with RR. The primary reason RR could be considered as a target is because it is so common. The creation of an organic substance or creature that could have a devastating affect on RR would get the attention of all food source biotech companies. However, it is just as likely they would use force as a response. In the era of pancapitalism, only the corporations have the right to manage and control the food supply. If anyone else intervenes, it's terrorism. The danger with this roll of the dice is as significant to individuals as the potential dangers from undertested GMOs are to the environment.

Glyphosate works by inhibiting the enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSP synthase), which is found in plants and microorganisms but (as far as we know) not in any other life form. EPSP synthase is a necessary enzyme for the organisms that do have it. It is used to synthesize aromatic amino acids, without which the organism cannot survive. In nature, EPSP synthase makes EPSP by bringing shikimate-3-phospate (S3P) and phosphoenol pyruvate (PEP) together. Glyphosate binds the enzyme better than PEP and prevents this reaction from occurring, as shown below.



Thus, Roundup kills by literally starving the plants that it attacks. However, Roundup Ready plants have been genetically modified to produce a version of the enzyme EPSP synthase that protects the plants. This version of EPSP synthase is a natural enzyme found in some bacteria and does not bind glyphosate very well. By genetically modifying the target plant to overproduce the resistant enzyme, the GMO producers insured that the RR plants are immune to the effects of glyphosate. Using pro-drug theory as a model, it may be possible to produce a biochemical intervention that could either specifically inhibit the resistant EPSP synthase that is present in the GMOs, or one that could set off a cascade of physiological effects that could retard or mutate the plant.

Two compounds already exist that may fulfill this function, both of which were developed or discovered by Monsanto itself. The best option seems to be pyridoxal 5 phosphate (P5P). This compound, when mixed with Roundup and exposed to light, will kill the enzymes that protect the plant. CAE knows it works in the lab, but we have yet to field-test it. Killing an enzyme in a test tube is not the same as killing one in a plant. CAE does not know how well a given RR plant can defend itself against the introduction of the compound (either from protection from the cell walls or from increased manufacture of the enzyme by the plant at a rate faster than the compound can inhibit the enzymes). However, if it works, this compound is simple, safe (it is used in vitamins), and fairly inexpensive when produced in bulk. Because it is such a simple compound, it cannot be patented, so no civil liabilities are associated with it. Instructions for the creation of the photocombustible compound are available from the US medical library. This defense system is available for field testing now, and the real strength of this system is that it will only affect the targeted plants (those using Roundup).

The best civil action that CAE has in development is a model to bond a colorigenic compound (dye) onto the RR enzyme. A colorigenic compound is one that has been synthesized so that it is initially colorless. Upon reaction, the compound is modified and releases a dye. Again, we would exploit the fact that GMOs carry a specific EPSP synthase that transforms chemical compounds. The trick is to create either a PEP or a S3P look alike that is actually a colorigenic compound that only binds to resistant EPSP synthase, but not to the plant's natural EPSP synthase. Upon binding to the enzyme this compound could then release a dye, thus making all RR crops an undesirable color from the point of view of the consumer.

There are three requirements for this application to be successful: 1) That a colorigenic compound can in fact be created; 2) that the compound has an affinity for the active resistant RR enzyme that is substantially greater than its affinity for the endogenous enzyme; and 3) that the compound and the effects that emerge from its application are harmless to living creatures. The best case scenario is that the compound can be made using FDA-approved food coloring already available and deemed safe for human consumption, as opposed to producing the dye from scratch. If the dye can be developed, it would function as a contestational marker in the fields, and possibly in supermarkets and homes. Home testing kits are a viable possibility. This marker would act as a DIY labeling device that could potentially force a better labeling policy out of the corporations. Finally, it would demonstrate to corporate culture that the future of biotechnology and transgenics in particular will be made a matter of public policy one way or another.

The hope in transforming this potential into reality would be to demonstrate to all corporations that they are vulnerable, and that the public interest must be a part of their testing and distribution procedures. With such leverage, it is possible that the corporations would begin kill switch and other safety feature research on their own simply to avoid any such potential profit disruptions (it would make great public relations advertising at the very least). One must remember, however, that this plan is not a quick fix; development could take years, but it can be done. Precise targeting is very difficult to do. Much like advanced electronic hacking, genetic hacking and reverse engineering are very specialized tactics. This is why corporations do not at present fear reverse engineering. The GMO revolution has been bloodless, because resistance does not have the capital to mount a counter-offensive on the molecular level. Much like fighting nomadic (virtual) power with nomadic tactics, the current molecular invasion has to be confronted in the molecular theater of operations. For the resistance to progress on any credible, effective level, rebel labs and rogue human resources in molecular biology have to be developed.

With the combination of traditional, electronic, and biological means of resistance, hopefully enough inertia can be introduced into the biotech industries that there will be time to do long-term, replicated studies that will sort out the useful products from the pollutants for profits. We can only hope that the processes and products that pose a threat to the environment will eventually go the way of DDT, but now what is needed is time in order to produce the cautious attitude and the rigorous science necessary to introduce GMOs into fragile ecosystems.

This nowhere gives a tactic mobility, to be sure,
but a mobility that must accept the chance offerings of the
moment and seize on the wing the possibilities that offer
themselves at a given moment.

—Michel de Certeau

6

The Question of Access

When speaking about bioresistance, the questions of who will be able to do what and how individuals will be able to participate in the movement are crucial. Techno-utopians would have the public believe that biotechnology will follow the example of ICT, meaning that as these technologies are developed, they will become less expensive to manufacture and slowly make their way into affordable common usage. While there is some truth in this belief, there is far more room for skepticism. While we can expect the products of biotechnology to appear as common commodities (pharmaceuticals, food products, home test kits, etc.), the likelihood that individuals will get tools or access to tools that could lead to public empowerment is very low. Even in the case of ICT, the celebratory moment is minimal. Western bureaucratic and technocratic access to information has improved, as have communication and organizational possibilities at the national and global levels for these demographics. However, a high price has been paid by those who seek these privileges—increased levels of surveillance and work intensification are but two examples. In the case of biotechnology, the public has not been empowered in any way, and the current trajectory of development indicates that that is how conditions will remain.

What can be expected from biotechnology? Certain processes and tasks will become a little more convenient, and out of that, some levels of micro empowerment will occur. In reprotech, for example, less expensive home pregnancy tests should emerge. Tests that provide reliable and early detection are certainly a boon to family planning. Less money will be spent on visits to the doctor (much to insurance companies' delight), and time will not be lost going to clinics for testing. More products like the pill and RU486 could emerge, giving women better control over their reproductive process and sexual practice. Pharmacology and gene therapy will in all likelihood lower the rates of invasive surgery and reduce the occurrence of a small number of inherited illnesses. Biotechnology does offer some desirable advantages; however, the advantages will be extremely costly on both the individual and collective levels (increased environmental pollution and the resurrection of eugenics are just a couple of examples). At the end of the day, the public will not have any more control over medical policy, nor any means by which this new technology could be used for resistant purposes on a general level. The commodity always favors capital, not the consumer.

The Personal Computer and Video

The personal computer is a very interesting case of empowerment as a necessary evil from the perspective of capital. Since capital needed to intensify labor to reduce production costs and thereby expand market possibilities, the worker's body had to be modified to accommodate this requirement. The easiest modification is to extend its capabilities through electro-mechanical technology. The PC was extremely useful to this initiative. Not only did it create a more efficient cyborg, it also created the means by which cyborgs could be networked. The downside for capital is that now the worker has a powerful technology over which s/he has relative control. The device could be used for other tasks besides work. To make the best of a bad situation, this carrot of power was dangled in front of workers so that they would be less resistant to the involuntary transition into becoming work machines—that is, into becoming organic-based labor stations. The next task for capital was to increase the odds that workers would use their free time during which they controlled their information options for activities that best suited its own needs—primarily consumption and training. Even more so than work, these activities cannot be perfectly policed, and in this small remaining slice of time people could use their computers for deviant or resistant activitites. More importantly, because of the networking component these activities could occur at a collective level. This possibility is what makes this tremendously oppressive technology simultaneously exist as the most empowering.

Video is well-known for offering hope for technological democratization. Its history of disappointment is well documented, and in this sense it is slightly more analogous to the trajectory of biotechnology than is the PC. While consumer home studios are possible, and in some classes somewhat common (especially now with video's interconnectedness to computer hardware and software), they have yet to show themselves to be a very strong tool of resistance. At the same time, video's advantage should be acknowledged. It has been useful as a means to create a compelling alternative record of events. Activists can stay in better visual communication, and its use in the courtroom has also saved many from prison by offering counterevidence to the "official story." However, video consistently remains little more than a weak alternative to mainstream media. The problem of distribution has never been solved in spite of the tiny steps made due to streaming media. Mainstream spectacle is still overwhelmingly dominant in the formation of the public record and opinion. The great hope that video would decentralize media practice into more anarchistic zones of contention has not occurred at any point. Video has even less room for subversive intent than the PC, and when one considers its function as an eye of authority in increasingly complex and monumental surveillance and broadcast systems, the potential for the disruptive use of video appears of minor concern to capital.

If the more utopian political aspects of the PC and video were never realized, biotechnology will probably never even have any such aspects on a general collective level, for the simple reason that the means of production will not be given to the public. Biotech will never be offered as a reasonably priced public tool with which individuals and groups may do what they wish (even within legal restrictions); rather, they will be offered only readymade products or services for use on a personal level.

Technical Specialization

Having just said that the tools for research and production in biotechnology are not truly available for amateurs, we should make certain qualifications. To be sure, the "free market" allows individuals to purchase most lab supplies and equipment, and many organic materials are available for free or at a low cost. One can even rent a lab (including the necessary labor), so why isn't the public really empowered? The first reason is the cost factor. Any major piece of equipment costs the equivalent of anywhere from the average person's annual paycheck all the way to a lifetime of earnings. Part of the reason for the exorbitant cost is that the market for such products is so small. For a complex, specialized piece of equipment, manufacturers would count their blessings to sell 10,000 units. Hence the markup on these near-custom-made products is astronomical, and the possibility of mass manufacture that would lower prices seems very unlikely.

Now let's say that a mysterious patron has donated the money to an amateur scientist to buy an electron microscope. Now what? Nothing can really be done with it. This piece of equipment is only useful if you have a lab apparatus as a whole in which it is a functioning part. In spite of the fact that a miniature polymerase chain reaction kit can be purchased for approximately 10,000 USD (prices are coming down), it's pretty much a useless technology unless plugged into a larger system. Even simple tasks are costly, leaving lab construction and maintenance to capital-saturated institutions.

The problem doesn't stop there; another layer of economic bunkering rests on top of the first two. Labs are also very specialized in their totality. There are no generic labs. Each has a specialized function, and to transform one lab into another type is a complete remodeling job. So once again, let's say that our mystery patron purchases an entire lab for public use. One would need to make very careful choices in this purchase, because after they are made, the lab is functional only within very narrow parameters. For the contestational biologist, this type of material lockdown is not acceptable. In order to respond to the many situations that rapidly emerge in biotechnology, various kinds of labs are required. Since the modular lab does not as yet exist in any practical form, contestational biology can only exist in a nomadic, parasitical form.

Public Resources

This is the saddest part of the question of accessibility. With regard to biotechnology, there are no public resources. Many were fortunate with ICT, because the tools needed to be distributed in order to further corporate models of work and consumption (i.e., capital had to be placed in the hands of the workers). Further, the Internet had to be made available for similar reasons. Mass marketing of the equipment brought down the manufacturing and distribution costs, and opened general access to Internet usage for free or at an affordable cost for those classes for which it was designed. Certainly, discrepancies in processing speed, bandwidth, and so on will continue to be hot issues in terms of public access, but there is at least an everyday life level of active integration between the public, the technology, and the manufacturers and providers. Biotechnology, on the other hand, has nothing to show for itself. The separation between specialist and nonspecialist (the public) is almost complete, and there seems to be no initiative to construct an intersection in this territory. The complacency exists on both sides. The public is convinced that this specialized area should remain in the ivory tower, and the specialists are happy to stay there.

Even entrepreneurs do not seem to have any interest in finding a way to capitalize on this divide. The appearance of biotech cafes seems to be a very unlikely prospect (except, perhaps, as an ironic one-liner in the art world). This type of commercialization is unlikely not just because it is not cost-effective, and there is no demand for the service, but also because it is beyond the limits of bodily regulations in regard to leisure. Having a cup of coffee next to an transgenic bacteria incubator stretches the codes of leisure to their breaking point.

Nor is it likely that we will see public labs any time in the future. One would think that this could be a reality. The model for this type of public education and access has already been created in public access TV and public access computer centers. Public labs could be of tremendous use for contestational biology both on direct action and cultural fronts. However, technical and knowledge-based specialization rears its ugly head again. Equipment and personnel would be difficult to get. Sponsorship in general for such initiatives would be hard to acquire, because the fundamental assets are not connected to public markets. Computer companies are willing to sponsor public access facilities because it is a way to reach potential buyers. Scientific equipment manufacturers and distributors do not have this incentive, nor any other.

Finally, there are no popular education outlets for scientific knowledge. The educational structure in both Europe and North America is geared toward the production and improvement of specialists only. Conversely, in the US, computer education has been stratified into many different layers. One can access expert knowledge at a reasonable cost, and classes are offered at almost any level of difficulty. Anything from basic usage to advanced programming can be learned on an *ad hoc* basis. However, when it comes to scientific knowledge and skills, there are no alternatives. So, even if the dream public lab was opened, who would know how to use it? At present, no pedagogical model for amateur science, a necessary component to contestational biology, is available or even under discussion. The whole notion of scientific education would have to be reconstructed in order to accommodate the current need for amateur science on political and cultural fronts.

Essentially, the situation is bleak. The only empowering element available to the public is a reasonable amount of accessible information on current issues from organizations such as Greenpeace. While this is a good first step, it does not help to develop the means for intervention at the level of knowledge and technological production that is needed. Nor does it explain how to appropriate and use scientific tools as resistant mechanisms that can reinforce resistant political and cultural action.

The Organic and the Synthetic

The final lack of access is due to the very nature of biotechnology. Since its subject is life, it is much more carefully guarded. Life-engineering will not be a public activity, and if we assume the future to be like the past, it will not even be publicly discussed. No better power/capital is available than the control of life configurations (genotypic, phenotypic, ecological systems, etc). How "life" is represented is a cornerstone of identity and cultural mythology. It is the heart of ideology. Consequently, the manifestations of life (bodies) are the locus of authoritarian inscription, discipline, and control. Biotechnology, which falls into this area of authority, is already so well bunkered that it does not even reside in the illusion of democracy, and is openly represented as residing in the realm of benevolent authoritarianism (although the general tendency is for power vectors not to call attention to this characteristic).

A more public example of this general process of creating authoritarian forms of body politics in allegedly democratic zones is in the "war on drugs." When America's first drug czar, Harry Anslinger, first began the war in the 1930s, political structure regarding illicit drugs was still democratic. Proposals and laws regarding drugs had to go through congress at both the federal and state level. When Nixon intensified the war in the late 1960s, his plan was to remove drug policy from the realm of democracy once and for all. Nixon had two reasons for doing this: One, to appeal to his law-and-order constituency; removal of drug laws from democratic process would allow him to make sweeping, immediate, autocratic changes. Two, he would be able to attack his enemies in the counterculture through lifestyle, since he could not think of a way to jail them simply for dissent. Removing drug policy from the democratic process would allow him to set the penalties. Nixon accomplished this goal through the use of scheduling. A bureaucratic schedule of dangerous drugs was created and connected to felony activity. More drugs could be added as needed. Prior to this initiative, each drug required a specific law. To make marijuana illegal, a specific law was passed; to make LSD illegal, a specific law was passed; to make patent medicines illegal, a specific law was passed. Under these conditions, public intervention was possible. If citizens didn't like the law or thought penalties were unfair or overly repressive, they could try to persuade their representatives to bring their demands to congress. With scheduling, no specific law needed to be passed. Drugs could be added to the list by closed bureaucratic decision.

For the most part, we are in a similar place with biotechnology. Pharmacology and gene therapy are deep in the medical bunker, as are assisted reproductive technologies. In the case of the subject of this book, transgenics, GMOs are completely outside of the democratic process. Corporations have the power to engineer life free of public input. Allegedly, the public is protected, not by elected officials, but by the bureaucrats (of agencies like the EPA or USDA) who decide on whether GMOs should be licensed. Clearly, this is a very thin line of defense. Given this arrangement, corporations have no reason to cooperate by providing public education on biotechnological matters. It is in their best interests to keep the public misinformed or to say nothing at all, and to maintain judicial territories that forbid amateur entry. For this reason, we cannot rely on the democratic process to make any kind of change. Direct action and cultural resistance is the only option left open. Attempting to access tools and knowledge that are deep in the bunker of bioauthority is perhaps the most difficult task facing resistant culture at present because of the dearth of resources. Whether a popular front can be constructed in matters of transgenics or any other biotechnological issue is still wide open for debate.

Organizing and Accessing

Assuming that a technically armed popular front is not going to emerge any time in the near future, and that DIY is not going to work in this situation, we have to ask how the research necessary to confront imperial powers on the molecular and biochemical levels will be done. CAE knows of no organizational models that have been tried or are under construction in this area of contestation. At present, all the group can offer is personal experience. Happily, our experience leaves some room for optimism. The majority of scientists who are in control of labs are 1960s-generation baby-boomers who still have a sense of political engagement. While many of those we have met are extremely focused on their immediate research tasks, with a little nudge, their former political sensibilities can be reawakened. Others are already concerned, but don't really know what to do or how to do it, and they feel they have no time to think through the nature of their worries. This position is understandable given that being a principle investigator on a research project is an unbelievably high-pressure, time-consuming job. However, if an alternative project just falls in their laps, often they will take it on as a side project, allow access to their facilities, and/or provide expert knowledge.

CAE has discovered only one way to build a connection, and that is the cold call. Preparations can be made to make your inquiry fairly effective. Go to the websites of local universities. Find out who is working on what. Just by looking at a given scientist's project you can often make a pretty sound determination of who will be sympathetic. Individual email addresses are usually on these sites as well. Write an email, explain your project in diplomatic terms, and explain that you would like to have a meeting if possible. CAE usually starts with asking for aid in an "art" project to scope out the potential for cooperation, because art usually appears fairly innocuous. As we get to know people, we move on to other projects. Trust and friendship have to be built first, then access just naturally follows. CAE also suggests that this process not be done in a cynical manner. Initiatives work better and for longer terms when the relationship is genuine, rather than just being a means to an end. In addition, trust is extremely important, because those who cooperate also need to know that you will protect them by not publicly exposing them in a manner that could jeopardize their funding.

Finally, you have to have amateur knowledge of the language and literature of the specialization of interest. CAE's experience is that the experts are fairly patient, and are happy to act in a pedagogical capacity, but they expect some effort from the learner as well. In all, to do research, you have to do adequate preparation. Often it will be rewarded. The cooperation rate for CAE has been around 50%—pretty decent odds. Also, once you break the ice, introductions to other sympathetic scientists in different fields is usually just a request away.

For those interested in contestational biology, making these connections and organizing is not a difficult process. Take the matter into your own hands. Do not take the institutional route and wait for some sanctioned opportunity for collaboration to come about. Not only are there very few, but the likelihood that you will get stuck with some person that you cannot work with is high. For example, the history of art and science/engineering collaborations reveal a series of disasters for this reason. Disney and Claes Oldenburg is a classic case study of a failed institutionally sanctioned collaboration. When the corporations agree to do these initiatives, they do it because they want something, and not out of any notion of public good or cooperation. The anarchist words of wisdom here are "work with individuals, not with institutions."

The location for the agents of bioresistance is in the in-between. To some extent, institutional capital has to be appropriated on the levels of both knowledge, material, and human capital. This is a parasitic enterprise due to the lack of public support systems. DIY is not a viable option nor in most cases is working with an institution; however, nonsanctioned appropriation is available. By locating oneself in the in-between, the liminal, and the infra-thin, the possibility exists that one can create the pressure needed to pry open the bunkers of biotechnology, and in this manner attain public access to initiatives and policy constructions that will affect everyone.

No one invents a recipe.
We have been using the same old things since
Cave Man stirred his first stew.

—Helen Corbitt

Appendix 1

Betty Crocker 3000 Presents Food for a Hungry World

Americans must face facts. Even in the most prosperous nation on earth, the grand majority of people cannot afford organic and organic-certified foods. Their cost is extraordinary, because their production requires luxurious amounts of time, land, and human resources. Even with all these resources, the yield of organic crops is relatively low, which raises the price even higher. To make matters worse, these foods are usually only distributed locally or sent to urban areas for distribution in select markets that further exploit the low supply and/or modest accessibility. For those of us without access to the organic bounty and culinary luxury, we have no choice but to embrace the genetically engineered (GE) foods provided by the food industry. To help make the best of this situation, the following selection of menus and recipes is offered in order to show that with a little imagination, GE foods can be so delicious and appetizing that you will never miss the certified organic products you cannot afford. This cookbook includes easy recombinant dishes created with the new GE foods. They are guaranteed to impress even your most resistant foodie friends, and help you gain maximum pleasure and value from them.

Orientale Fusion Appetizer:

Monarch wings orientale:
1 package Tyson's chicken wings
1 package corn dogs
Kraft Thick and Spicy BBQ Sauce mixed with soy sauce. With toothpicks fasten chicken wings to corn dogs to resemble butterflies. Baste with BBQ sauce and run under broiler till brown and bubbly.

(Cost comparison: GE $ 9.08/Organic $11.27)

South of the Border GE Lunch

Casta casserole with pork and mole sauce
Country Inn Mexican Fiesta Rice (Uncle Ben's)
Heinz beans Mexican Style

Casta Casserole (serves 4-14)
Remove the pork chops from 1 Marie Callender's Country Fried Pork Chop with Gravy Frozen Dinners. Defrost and dice into small pieces. Finely chop one medium Spanish onion, 1 medium green chili pepper. Prepare 1 package of Uncle Ben's Chef's Recipe Fiesta Rice. Mix all ingredients

thoroughly. Place in oiled heavy casserole dish and cook in microwave for 20 minutes, or until a brown crust forms on top.

Meanwhile, prepare the mole sauce: In a small saucepan stir together:

1 can of Old El Paso Picante sauce,
4 tbsp. Hershey's Chocolate Syrup
1 tsp. curry powder.

Heat gently for 5 minutes stirring constantly. Spoon over Casta casserole and serve hot with heated Heinz beans.

(Cost comparison: GE $10.58/Organic $15.57)

Nouvelle Cuisine LMO (Living Modified Organism)

Even a sophisticated French-style dish can be prepared using select GE foods.

Mock-Lobster recombinée (serves 4)
1/2 Package Mrs. Paul's Fish Sticks (thawed)
1 Package Agri-Link Shrimp Voila!Garlic (thawed)
1 Package Knorr Classic Hollandaise Sauce (prepared according to directions)
1 large egg (beaten)
1 cup Wonderbread (crumbled)
Parsley, Paprika to taste

Defrost fish sticks and simmer gently in a little water until very soft. Put in blender with one large egg and breadcrumbs. Puree until mixed into a pliable "dough." On an ovenproof baking platter shape the mock-lobster dough into a lobster shape. Arrange pieces of Voila!

Shrimp Garlic around mock-lobster. Cover with prepared Hollandaise sauce. Sprinkle generously with paprika for that nice red lobster color and garnish with parsley. Heat under broiler for 10 minutes until bubbly. Serve at once with split soft dinner rolls.
(Recipe approved by the Society for the Prevention of Cruelty to Animals).

(Cost comparison: GE $9.82/ Organic $15.61)

Kids' Korner

(Easy heat and eat combinations)

Hormel spaghetti rings with Fishsticks
(Cost comparison: GE $3.69/ Organic $7.28

Power Rangers Pasta with ConAgra corn dogs
(Cost comparison: GE $3.48/ Organic $5.28)

Ore-Ida Tater Tots with Heinz Ketchup
(Cost comparison: GE $2.89/Organic $3.89)

Antibiotic bananas with Hershey's chocolate syrup
(Cost comparison: GE $ .81/ Organic $2.09)

Future Feast GFP Banquet

This menu introduces the public to Green Fluorescent Protein (GFP). It is derived from jellyfish genes, and has the characteristic of fluorescing green when exposed to UV or blue light. It is frequently used as a marker to detect genetically transformed cells in crops. GFP has no known allergenic or toxic properties in humans, and should appear more and more frequently in our diet. Hit up your scientist friends or molecular biology students for some of the ingredients that are not yet available in supermarkets.

Suggestion: Serve the dinner under UV lights to enjoy the full effects of its glow.

Glowing champagne cup with GFP protein strands
Green cheese ball with soy chips
Ragout Alba la Provencale
Green mashed potatoes
(mashed potatoes with GFP parsley)
Salad of GFP greens
Star Link crepes flambée with GFP amoeba sprinkles

Green cheese balls: Soften equal amounts of sharp American, white cream, and Roquefort type cheese. Mix in generous amounts of chopped GFP parsley and green onions. Form into large ball. Roll in more GFP parsley. Arrange on platter surrounded by GFP soy chips.

Ragout Alba la Provencale

(GFP rabbits are being raised in select labs that will not release them into the wild but might sell them to enterprising cooks for a special banquet.)

1 GFP stewing rabbit cut into chunks (about 3 pounds)
(Marinate the rabbit in a mixture of wine, vinegar, olive oil, mashed garlic cloves, a bay leaf, and pinch of thyme for 4 hours.)
2 cups canned chicken broth

2 cups each chopped onions, carrots, celery and red, ripe tomatoes
1/2 cup chopped GFP parsley

In an oven-proof casserole layer the chopped vegetables with pieces of marinated rabbit. Pour broth over the top. Cover tightly and bake in a medium hot oven for 3-4 hours. Arrange on a platter surrounded by green mashed potatoes. Sprinkle generously with GFP chopped parsley for maximum fluorescence.

(Cost estimate: GFP rabbit and other ingredients free to participating biotech families)

*The turn to biotechnology from their [CAE's]
earlier work on communication technology offered a site
for direct interrogation of the relations of digital capital culture
and the "loop" to material everyday life.*

—Rebecca Schneider

Appendix 2

For the past six years Critical Art Ensemble's work has focused on the vast field of biotechnology. The group has tried to identify key problematic issues and inspire and focus public discourse in an effort to exploit the current vacuum of authority. As tactical mediaists, the group has completed five major participatory theater projects that examine particular aspects of biotechnology. These projects pinpoint extreme problem areas in the field, in associated representation, and in the social policies guiding application development and deployment. These works raise questions concerning (1) eugenic traces in assisted reproductive technology (*Flesh Machine*); (2) extreme medical intervention in reproduction and the death of sexuality (*Society for Reproductive Anachronisms*); (3) flesh materials acquisition (*Intelligent Sperm On-line*); (4) the utopian rhetoric spinning off of the Human Genome Project (*Cult of the New Eve*); and (5) transgenics and biological environmental resource management and its relationship to the ideology of fear (*GenTerra*). Through the collective's activity, members hope to replace a general fear with critical tools and replace public impotence with tools for direct action.

For more information and documentation visit <http://critical-art.net>.