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Reaching the Limit

When Art Becomes Science

Beatriz da Costa

The politically oriented artist engaged in technoscientific discourses faces significant challenges. She has to be versatile within the theoretical framework developed in disciplinary areas such as science and cultural studies, acquire the technical and/or scientific skill base needed in her chosen area of investigation, and develop an artistic language appealing to peers in her field while remaining accessible to a nonexpert audience. In addition, for the more activist-inclined artists in this area, interactions with other (nonartist) activist groupings are often indispensable, resulting in yet another set of skills and modes of interaction to be acquired.

Given the limited funding opportunities for most artistic endeavors, especially the ones that dare to affirm politicized discourses as part of their creative processes and public manifestations, the acquisition of such a broad range of skills can be difficult. For the privileged few entering a flexible, multidisciplinary Ph.D. program, a long-term research residency, or other kinds of work environments designed to support these types of knowledge acquisition, the in-depth development of such a practice might be a possibility. But let's be realistic. Not only are the above options limited in their capacity but, in addition, most politically oriented artists became "radicalized" through real-life experience, commonly define their place of research outside the walls of academia, and only reluctantly admit their partial dependence on the latter to begin with.

However, given the educational system in the United States, which places art education, with the exception of a few independent art schools, inside the university, members of this more radical strain of artists often find their employment and source of income back in the academy itself, even if preceding activities which led to a mature practice took place in less sanctioned environments. Not only are job opportunities outside the university scarce (even more so than within it), but direct access to the locations where science is being conducted is often a necessity for those who wish to become active players

in the shaping of socioscientific discourses and their (mis)appropriation by cultural, political, and economic forces.

When we ask what type of role the intellectual should assume once she has rejected the impetus to function as the "bringer and master of truth" in our society, Foucault might urge us to consider the distinction between the "universal" and the "specific" intellectual.[1] Unlike the "universal" intellectual, whose duty was to serve as "the consciousness/conscience of us all" and whose primary task was to fulfill this mission through the written word, distanced and removed from the people who were identified as the supposed beneficiaries of such discourses, the "specific" intellectual emerged out of a group of people that was originally not given the status of intellectuals at all. Engineers, mathematicians, physicists, and other scientists were respected for their expertise and specialized knowledge, but were by no means given the role of transcendental context providers. Citing J. Robert Oppenheimer as an example, Foucault identifies a moment in history in which the intellectual was held accountable by political powers, not because of his {*sic*} discourse, but precisely because of his expertise and specialized knowledge.[2] Oppenheimer himself is described as one of the pivotal figures who simultaneously assumed both roles: the "specific" intellectual, given his knowledge and dedication to the discipline of physics, and the "universal" one, given the affect the nuclear threat had on the world at the time. His discourse became, by necessity, a universal one.

Today, we find ourselves in a university environment filled with "specific" intellectuals. Unlike the philosophers of the past, these individuals are confronted with everyday struggles and share similar adversaries with the working and middle classes outside of the academy: the ideological and economic influence of multinational corporations (on knowledge production, among many other things) and capital at large, as well as the judicial and police apparatuses.[3] Imposed cooperation with the forces described above, combined with the expertise held by the "academic intellectual," has influenced the intellectual's ability and responsibility to participate in the political shaping of society as well as in the "process of politicizing intellectuals themselves."[4] Direct confrontation with an "adversary" at hand is often all that is needed in order to reflect on one's own position of power and ability to act. The conduct of "objective" and "pure" research, independent from the political "outside," becomes a less and less plausible position to hold at a time in which industrial, military, and political interests are directly tied to funding provided by the respective institutions.[5]

What type of role is the artist engaged in the technosciences (certainly ranking among the most vulnerable disciplines subjected to the powers described above) to assume in this context? How can the artist function as an activist intellectual situated between the academy and the "general public" in an age in which global capital and political interests have obtained an ever-increasing grip on the educational and public environments where technical, scientific, and artistic knowledge production occur?

Before we delve into such issues, let us first look at the environment that gave rise to this type of knowledge production and examine more closely the figure that we might call the "political technoscientific artist."

"New Media Art" and the Emergence of the Artist as a "Specific" Intellectual

In the early 1990s we have seen the increased popularity of a new disciplinary area within the visual arts. Sometimes referred to as "new media art," "emergent technology art" or (at worst) "computer art," this area incorporates the use and critical examination of a range of new media, tools, and technologies that have become available with the advent of personal computing and the decrease in costs for anything electronic. "Net art," "interactive art," and "robotic art" are just a few of these recently emerged and newly categorized subfields. Whereas art since modernism has always had members who actively engaged in reexamining and expanding their forms and means of expression (from land art to fluxus, installation art, video art, sound art, etc.), the incorporation of digital technologies represented a shift of significant enough magnitude that entire programs, and by now even departments (rather than just isolated "special topics" classes), dedicated to the examination and expansion of these areas have been established.

Obviously, the willingness of universities and other institutions of higher education to invest in these areas did not stem merely from intellectual curiosity, but from the identified need to educate a generation of students versatile in both the technical and the aesthetic aspects of digital media. Equipped with these skills, they would be able to become active participants in the ever-expanding information society under capital. Parents who might previously have been opposed to supporting education in the arts, a field with dubious career options and a questionable placement record for economic prosperity, were suddenly willing to send their offspring to art school with the hope that their loved ones would one day stake a claim within the digital media and related industries.

Luckily, only a small subsection, if any, of the art faculty engaged in emergent technologies are in the business of educating the next generation of new media entrepreneurs. Rather, most faculty still attempt to equip their students with the same critical abilities that have been part of artistic education for decades. These include not only the rigorous examination of the qualities inherent in any media, but also their current use and status in society outside the realm of artistic production.

For digital technologies this presented a very interesting proposition. After all, students were trained to use, appropriate, and take apart the very machines and their electronic subsections that were in the process of transforming our society with great force and speed. Whereas some simply used their new abilities to further the expansion of artistic disciplines and their attached formulas for aesthetic expression, others attempted to redefine the very site of art itself.[6] In some cases, "site" simply implied venue. The World Wide Web has become one of such newly acquired venues for the arts. In other cases, however,

the usage of digital technologies has meant the exploration of topical areas and social phenomena intimately linked to the status and functionality of these very technologies themselves. Activities such as data categorization, (electronic) information distribution, electronic surveillance, collective action facilitated (at least partially) by electronic media, and collaborative information accumulation and distribution all have become "sites" for artistic investigation and action.

Obviously artists were not the only people present at these newly found sites. Programmers, activists, information theorists, academics, engineers, journalists, and others were involved in exploring and shaping instances of these newly available information technologies. Sometimes members of these fields would work together, at other times in competition, but everyone was certainly fueled by a sense of novelty and excitement.

What emerged among the more politically inclined early explorers of information technologies was a sense that previously established models of "DIY" media[7] had just obtained a whole new tool kit ready to be explored and expanded. Early listservs such as Nettime were dedicated not only to building a new platform for "open" communication,[8] but also to specifically using this arena to facilitate discussions to examine new capitalist formations made possible through the World Wide Web and to exchange information and ideas for potential subversion of this power at play. Other discussion forums and listservs focused on topics such as feminism in the digital age (*faces*)[9] or postcolonial developments under global capital (*undercurrents*),[10] to name just two. We also saw the formation of independent media outlets, such as *Indymedia*,[11] enabling the growing movement of citizen journalism to flourish.

A culmination of this shift in information acquisition and distribution, and thereby the construction of knowledge itself, was the framework developed for *Wikipedia*. Albeit not capable of hosting direct exchanges among people, *Wikipedia*, composed of articles by self-declared experts in given fields, collectively rewritten and edited by other individuals who declare themselves to be the same, is by now one of most frequently consulted encyclopedias of our time. While the contributions in *Wikipedia* may look similar when compared to its more "official" precursors, the open contribution platform—and thereby its contributor profiles—certainly don't. *Wikipedia* has changed the nature of collaboration with respect to knowledge production and greatly challenged the notion, definition, and status of the "expert." What a difference from the carefully nominated contributors to the *Encyclopaedia Britannica*, often carrying the weight of a Nobel Prize or similar award of distinction![12] Whereas opinions regarding the usefulness and/or the positive impact of *Wikipedia* certainly vary (celebrated by some, fiercely disputed by others), one thing is for sure: a resource that has become the one-stop reference for thousands of students and professionals (as well as other individuals) around the world has to be looked at seriously.

Much in the tradition of the "computer hobbyists" and analog electronic artists of the 1970s and 1980s, artist/engineer teams started building their own electronic hardware

tools as well as designing software programs and platforms. In this case the task is slightly more difficult, at least with respect to distribution. The open source approach used in many software initiatives doesn't translate as well into the world of resistors and diodes. The common black box, with its abilities to send software packages anywhere, is suddenly missing.[13] However, as communicative objects, hardware tools and projects have been shown to be very effective.

The Bureau of Inverse Technology (BIT)[14] was one of the early groups to explore the powers a functional tool could hold when being developed for the purpose of raising awareness around social injustice, rather than for commercial exploitation. The BIT Suicide Box[15] consisted of a motion detection video system designed to capture vertical activity. Once it had detected an object falling in front of its lens, it would trigger recording of the motion. The Suicide Box was installed on the Golden Gate Bridge in 1996, one of the most prominent suicide locations in the United States. Another example was the BIT rocket. It was designed to provide a clear video stream at six hundred feet altitude to a ground receiver. Launched from the ground, BIT rocket was used to document crowd attendance during demonstrations at a time when sanctioned news and media outlets appeared to have "accidentally" forgotten to undertake these estimates themselves.

The Institute for Applied Autonomy (IAA)[16] is another group invested in developing artist/activist inspired tools. GraffitiWriter,[17] the project that launched the group's public visibility, was a first instance of exploring the notion of a "contestational robotics." It consisted of an enhanced remote-controlled car equipped with spray cans, a microcontroller, and a type pad. Any message up to sixty-four characters could be typed in, and would be sprayed onto the street at a desired location, without its human controllers being present at the locale. Action could thus be undertaken removed from the eyes of authority and, even more important, individuals who might have had little interest in expressing their opinions publicly in the form of graffiti became involved through mere fascination with this new and unusual interface. For groups ranging from Girl Scouts to police officers, GraffitiWriter was successful in its mission to expand participant demographics and promote the notion of a contestational robotics.

So let us look at what lessons might have been learned by the "political technoscience artist in becoming" from the developments described above. On the one hand, we see increased sophistication in the use of digital and electronic technologies. Skills such as software development and electronic board design, commonly associated with disciplines other than the arts—namely, computer science and engineering—have suddenly become part of the artistic tool kit. With that have come not only an extension of possible media for artistic projects but also a shift in status for the artist herself. The disciplinary families of engineering and computer sciences enjoy a stronger economic foothold in our society than the arts traditionally did, and with that foothold comes a superior power base. Artists working between these disciplinary areas now had a choice, if they desired to obtain their piece of the economic pie; a career within the digital and media industries became a

lucrative option. This is rather different from the "starving artist" life and the never-ending hope to one day turn one's creations into highly traded commodities within the commercial gallery world.

However, for those individuals interested in employing their newly obtained skills in a different manner (which is most likely the case for our "political technoscience artist"), other opportunities were opening up. Armed with the lessons learned from public interventionist art practices of the 1970s and 1980s, artists now realized that with a shift in technology came the increased ability to create new forms of independent project and information distribution. This time not confined in museums or carefully selected sites for "public" art, but artists could infiltrate the very mechanisms designed to be the new interfaces between knowledge production and society outside the arts. In the end, it doesn't matter if *Indymedia* or *Wikipedia* had been brought into existence by artists or not. What matters is that they could have been. And many initiatives and artistic projects emerged on the basis of this realization.[18]

We could argue, then, that artists were put on the path of approaching the role of the "specific intellectual" characterized above. Rather than performing the role of an individual in search of a higher truth that will eventually be revealed and distributed to "the masses" in the form of paintings, sculptures, and other works, artists were now in the position to serve as interdisciplinary "experts" in an area that was considered to hold high economic status.

The Artist as "Dissenter"

When looking at artists' ambition to venture into the scientific realm, things become much more complicated. A common basic yet powerful skill, which allowed for the above-mentioned developments to happen, is now missing: coding.

An artist able to design custom software is by no means a computer scientist, but he or she is able to learn that trade within a couple of years and integrate it almost immediately into artistic production and other projects of choice. The same holds true for basic electronics knowledge. Even without formal training, artists have gained sophisticated enough knowledge to build their own electronic boards and implementations in an effort to design devices that will serve their particular needs. But let's remember here that the important question is not how good or bad a programmer an individual artist is, but the powers that are associated with that particular skill. It is programming under capital that we're interested in.

If we look at the sciences, and in this context I am specifically interested in the life sciences, where might we find the equivalent of "programming," a skill from which to venture out into all kinds of project ambitions? What is the trade of the life sciences that will easily translate across platforms, that puts you in command of the black box in order to conduct your future experiments? The answer is probably that there is no such trade.

Learning how to use a microscope, a pipette, or a polymerase chain reaction (PCR) machine will help you to ease your life around the laboratory, but unless you know what you are looking at, what substances you're about to mix together, or why a specific piece of DNA might be worth amplification, these skills will get you nowhere. Rather than a universal machine, what we find are highly specialized laboratories.

Another issue that must be taken into account is that scientific pursuit requires a very different relationship to time. Little or no immediate feedback is received when you're working in a wet lab, no error message, no debugging software assisting you in correcting your mistakes. While software assisting tools obviously exist and have made both pre- and postproduction in the lab much easier, in the end, organisms still need time to grow and chemical reactions need time to take place. Hours, days, weeks, or even months can pass (in the case of molecular plant biology, for example) before results of an experiment can be observed, analyzed, and the next step be put under way. Recent developments in biology have obviously attempted to "fix" these latency aspects inherent in conducting science. The Human Genome Project would not have been possible without the creation of the appropriate machinery and software applications, and fields such as bioinformatics wouldn't exist. We also have the emergence of synthetic biology, which attempts to push the mechanization of life one step farther by creating desired traits from scratch and to use lower-level organisms (such as bacteria) as input/output devices ready to be assembled into a functional living "circuit."[19]

Increase in time usually means an increase in money as well. Since artists are accustomed to work for free and are often happy not to outsource "lower division" labor tasks to other people, this might not be an issue, but to invest five years for a project to come to completion might be stretching one's involvement with the art world a little bit. Though the tolerance for production time needed has increased over the past years, there are certainly limits to this end.

So how is the artist to navigate these laboratories? How can she acquire the skills necessary in order to do anything meaningful with the organisms, solutions, petri dishes, and instruments found in the lab? How can she get access to a lab to begin with? And finally, how could she possibly finance the exuberant costs involved in conducting science? Is this really the right way to go?

A look at Bruno Latour's influential book *Science in Action* might be helpful in this regard, not only to learn more about the challenges involved but also to reaffirm the laboratory environment as one of the necessary places to investigate for artists wanting to be involved in the shaping of technoscience discourses.

Latour introduces us to the difficulties *any* outsider will encounter in the pursuit of understanding and retracing developments in the sciences. Starting with scientific literature, he reveals how the emergence of a scientific fact is brought to light. Rather than being the "simple" act of publishing a recent discovery, it is only through the careful referencing of related, previously published articles and, even more important, by through

the later referencing and rigorous examination by other members of the scientific community, that the discovery may eventually gain the status of a scientific fact. "When things hold they start becoming true."[20]

For the outsider attempting to retrace the emergence of this newly established fact, a significant problem arises. Not only does she have to familiarize herself with the terminology and language used in the paper, as well as the social and professional context in which the study was being conducted, but she also has to do the same for every referenced paper and every paper that references this paper. The curve is exponential.

Even worse, when research results are controversial, the published literature will become more and more technical. More experts will be asked to give their opinion and will, by mere reference and citation, advance the acceptance of the study in either one direction or the other (depending whether negative or positive modalities are used).[21] This shift toward the technical will make the penetration and understanding of literature even harder for the outsider, and is thereby fulfilling its desired function. Outsiders are to be kept *out* of this discussion. The number of people "allowed" even to formulate an opinion about the controversy at hand is intentionally kept low, until the controversy is resolved and ready to come to the surface as either a confirmed fact or a defeated one. Latour names our outside person, the person coming into the scientific world attempting to retrace as well as challenge a scientific fact, the "Dissenter."

Though challenging a scientific fact might not be the starting point, or even the motivation, for an artist coming into the sciences, an attraction to scientific controversies very well might be. After all, scientific controversies and the aspects of life we simply don't know about are the ones most vulnerable to exploitation in the public media and other interfaces designed to serve as mediators between scientific pursuit and political decision-making.

Eventually, after having followed the endless literature threads, Latour's "Dissenter" will have to enter the place where he believes the published results originated: the laboratory of the lead scientist. Whereas artists might not always be as diligent in reading all the involved literature first, they will find themselves at the same location. After all, science is best understood through practice!

What will the dissenter/artist find at this location? Instruments. Not really that much closer to the actual natural phenomenon being studied, instruments are serving as the interface between "nature" and its human interpreters. Graphs, curves, and images are provided by these devices in order to assist with the task of studying and interpreting, as well as fostering, a scientific claim at hand.[22]

Now instruments (as well as observation skills!) are something that artists are used to dealing with. Be it a scale to balance the right ingredients for paint or sculpture material, or an oscilloscope to observe voltage drops, artists are certainly accustomed to using them. It should come as no surprise, then, that former or current "new media artists" are by no means the only ones who make their way into the scientific laboratory.

Rather, they are being joined by installation artists, video artists, painters, and others, all arriving with the same interest in scientific inquiry and its relevance to their particular practice.[23]

However, as we have seen above, knowing how to operate the instruments found in a laboratory, from simple ones such as pipettes to more complicated ones such as PCR machines, doesn't get you all that far in your ambitions to understand scientific processes—let alone conduct your own science/art experiments. In addition, getting access to a scientific lab for more than a one-time visit can be tricky, and any conduct of science quickly becomes very expensive.

Artists have found a number of responses in order to attack these problems, and many of these are still in the process of being developed. One example is the SymbioticA research lab at the University of Western Australia. Here, a team of artists (Oron Catts and Ionat Zurr) and scientists has convinced officials and administrators within the School of Anatomy and Human Biology to house a collaboratively run research lab dedicated to the development of artistic science projects. Rather than using the facility just for their own research, Zurr and Catts have opened the doors to other interested artists, ready to invest the necessary time and training in order to conduct projects in this arena. Interested individuals can apply for extended residencies in order to achieve their goals.

In addition, Zurr, Catts, and their scientific collaborators have developed cheap do-it-yourself techniques to build usually very expensive lab equipment (such as a laminar flow hood) out of readily available home construction materials, and are conducting workshops around the world in order to spread their knowledge. These types of workshops are contributing to a larger model developed and experimented with by a number of artists in the field.

Public Amateurism

Practicing and theorizing the notion of *public amateurism* is a task that a number of artists have undertaken in recent years. Rather than attempting to achieve expert status within the sciences, artists have ventured to find help in the realm of hobbyism and do-it-yourself home recipes for conducting scientific experiments.

The *Biotech Hobbyist*[24] attempted to combine a hobbyist approach with artistic projects. Available as an on-line as well as a print publication, it consists of contributions from the artists Natalie Jeremijenko, Heath Bunting,[25] Eugene Thacker, and others. The magazine offers descriptions of DIY artistic-scientific experiments combined with step-by-step instructions and advice on how to obtain the necessary materials. The print edition, *Creative Biotechnology: A User's Manual*,[26] includes theoretical writings by the authors. One of these contributions, "Notes Towards a Sociology of Computer Hobbyism,"[27] examines the analogies between computer hobbyism of the 1970s and the proposed biotech hobbyism in the 1990s.[28]

Critical Art Ensemble (CAE) developed its notion of amateurism from its discourse on *Tactical Media* and the lay-expert relationship it observed taking place within ACT-UP. CAE translated this notion into its scientific projects initially with *Cult of the New Eve* (with Paul Vanouse and Faith Wilding)[29] while writing their book *Digital Resistance.*[30] However, the project series that fully merged theoretical discourse with practical implementation was probably its work on the politics of transgenic organisms that culminated in three projects. In their accompanying book *The Molecular Invasion*,[31] the collective developed a seven-point plan meant to serve as a guideline for negotiating the relationship between transgenic production and cultural resistance:[32]

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.

Points 1 through 4 were certainly enacted throughout all three projects, with *GenTerra*[33] being the one most closely looking at point 2. Points 5–7, however, the ones of most interest to us in this context, found their biggest manifestation in *Molecular Invasion*[34] and *Free Range Grains.*[35] *Molecular Invasion*, a project by CAE, Claire Pentecost, and myself, examined the possibilities of reverse engineering Monsanto's highest cash crop, the Roundup Ready (RR) plant line.[36] We attempted to sensitize Roundup Ready crops to Monsanto's herbicide Round Up, the very poison they were designed to resist. Through the application of the compound pyridoxal 5 phosphate (a compound often found in vitamins, harmless to humans and the environment) onto the leaves of RR crops and exposure to sunlight, we undertook this task. Experiments to test our hypothesis were conducted publicly within museum spaces and with the inclusion of interested students and other groups ready to participate in this particular instance of amateur science *in action.*

With *Free Range Grains* (CAE, da Costa, and Shyh-shiun Shyu) we went one step farther, and in addition to conducting scientific experiments publicly, we included a public lab. Specifically designed to test for transgenic reminiscence in processed food products, visitors were invited to bring in recently purchased groceries, and we would test for them. This project was of particular importance in Europe, where foods containing traces of transgenic materials have to be labeled. However, the materials and lab equipment used in *Free Range Grains* were also the ones that contributed to raising initial suspicions by the police and the FBI at the beginning of the still ongoing federal investigation of the group.[37] In this case, enacting amateurism clearly didn't go without punishment.

Claire Pentecost has developed the notion of amateurism in her own right and has been working on theorizing the figure of the *public amateur* for quite some time. She writes:

> In such a practice the artist becomes a person who consents to learn in public. It is a proposition of active social participation in which any nonspecialist is empowered to take the initiative to question something within a given discipline, acquire knowledge in a noninstitutionally sanctioned way, and assume the authority to interpret that knowledge, especially in regard to decisions that affect our lives. The motive is not to replace the specialist, but to augment specialization with other models that have legitimate claims to producing and interpreting knowledge.[38]

SubRosa is another group that has embraced practicing amateurism within the life sciences. Though actual engagement with life materials isn't always the case in its projects, the demystification of science and the critical examination of its political repercussions is certainly at the center of its work.

Embracing demystification by and for amateurs was thus one of the ways in which artists approached the difficult task of developing science-based projects.

Lay-Expert Relations

It should be clear by now that by *political* I don't mean local party politics or involvement in "get out the vote" campaigns. Whereas I wouldn't object to these activities, what I believe to be of interest here is not the active involvement in changing the people at play in taking command of the various institutions through which power is executed, but rather the radical undermining and redefinition of these institutions themselves.

Within the life sciences and for our "political technoscience artist," these would be the institutions that provide the contemporary grounding for the "Right of Death and Power over Life"[39] to be enacted. The sites for action now become the research and businesses involved in the agricultural, environmental, and biomedical domains.

Once again, artists obviously are not the only people found at these sites. Next to academic, political, economic, and artistically motivated individuals, we now also find a very different group of people. Namely, those who have in one way or the other been negatively affected by the institutions mentioned above and who are in search of collective organization for means of survival.

This group of people, who often develop an expert knowledge in their own right, tends to act from a position of distrust in whatever governing and decision-making forces might be held responsible for a particular situation of concern—be it available medications and funding for disease research or the environmental conditions in one's own neighborhood. Involvement within the institutions of science and their related policy-making becomes a necessity for those whose concerns aren't adequately addressed by the current social and economic system. Gabriella Coleman's analyses of the psychiatric survivor movement and

Mark Harrington's survey of activities conducted by the Treatment Action Group, found elsewhere in this anthology, provide excellent examples of the types of forces and challenges at play when a group of "dissenters" converges and organizes to resist, negotiate, and change existing governmentalities[40] responsible for the framing and treatment of disease.

The lay-expert relationship and the interfaces used to stimulate participation at these sites vary among the examples cited above. The *Biotech Hobbyist* invites interested individuals to open their own biotech kitchen in a home environment. Either by enhancing existing educational science kits commonly used in high and middle schools (which can now be found even at places like *Toys'R'Us*), or by distributing its own kits, the *Biotech Hobbyist* is clearly a resource developed by practicing amateurs for inspiring new recruits. No top-down approach is to be found, no "outreach" from an academic environment down to the "ignorant" public. The emphasis here is on fun and play.[41]

Though Critical Art Ensemble embraces a similar notion of nonhierarchical interaction with any interested participant, the production and development involved in order to bring these projects into existence are clearly dependent on active cooperation between scientific experts and the group itself. The identification of pyridoxal 5 phosphate as a potential candidate to help render RR crops vulnerable to Monsanto's herbicide would not have been possible without the help of Mustafa Unlu, at the time a Ph.D. student in the department of biology at the University of Pittsburgh. Similarly, we would not have been able to select and order the lab equipment needed in order to run the experiments involved in *Free Range Grains* without the assistance of Shyh-shiun Shyu, at the time a Ph.D. student in biology at the State University of New York, Buffalo. Expertise was needed in both cases in order to select the right materials and learn how to use and operate the equipment.

SymbioticA's research lab goes a step farther. In this case, collaboration between scientists and artists is not a temporary alliance, but the permanent institutionalization of this alliance within the university environment itself.[42]

In a lecture given a few years back in Germany, Latour talked about the eroding boundaries between research conducted within scientific laboratories and experiments taking place on the "outside."

> The sharp distinction between scientific laboratories experimenting on theories and phenomena inside, and a political outside where non-experts were getting by with human values, opinions and passions, is simply evaporating under our eyes. We are now all embarked in the same collective experiments mixing humans and non-humans together—and no one is in charge. Those experiments made on us, by us, for us have no protocol. No one is given explicitly the responsibility of monitoring them. This is why a new definition of sovereignty is being called for.[43]

Critical Art Ensemble's public experiments, the *Biotech Hobbyist*'s call for home experimentation, and SymbioticA's promotion of self-designed and cheaply assembled laboratory

equipment all rely on public participation. "Audience" members become active players forced to take responsibility and assume their roles as part of publicly designed collective experiments. In that sense, artists operating at the nexus between the laboratory and the public are staging the new articulation of sovereignty being called for by Latour.

I would like to end this chapter with a personal account of the conception, production, and development of a recent project of mine, which served as a catalyst in getting me to rethink how the "political technoscience artist" might have to act when starting to become identified as a part of the educational system called the university, and associated with the role of the "specific" intellectual. Having myself experimented with various formations of lay-expert relations and their associated places for production, distribution, and creation of knowledge, I have come to ask myself at which point the political potential, so clearly inherent in the arts in their ability to consciously work with matters of presentation and representation, might break apart when approaching the sciences too closely.

PigeonBlog: Interspecies Co-production in the Pursuit of Resistant Action

—a project by Beatriz da Costa with Cina Hazegh and Kevin Ponto

"To make people believe, is to make them act."
—Michel de Certeau.[44]

PigeonBlog[45] was a collaborative endeavor between homing pigeons, artist, engineers, and pigeon fanciers engaged in a grass-roots scientific data-gathering initiative designed to collect and distribute information about air quality conditions to the general public. Pigeons carried custom-built miniature air pollution sensing devices enabled to send the collected localized information to an on-line server without delay (Figure 21.1). Pollution levels were visualized and plotted in real time over Google's mapping environment, thus allowing immediate access to the collected information to anyone with connection to the Internet.

PigeonBlog was an attempt to combine DIY electronics development with a grass-roots scientific data-gathering initiative, while simultaneously investigating the potentials of interspecies co-production in the pursuit of resistant action.[46] How could animals help us in raising awareness of social injustice? Could their ability to performing tasks and activities that humans simply can't, be exploited in this manner while maintaining a respectful relationship with the animals?

PigeonBlog was developed and implemented in Southern California, which ranks among the ten most polluted regions in the country. Its aims were (1) to reinvoke urgency around a topic that has serious health consequences but lacks public action and commitment to change, (2) to broaden the notion of a citizen science while building bridges between scientific research agendas and activist-oriented citizen concerns, and (3) to develop

Figure 21.1 A homing pigeon in the *PigeonBlog* project. Photo copyright 2006 Susanna Frohman, photographer of the San Jose Mercury News. All right reserved.

mutually positive work and play practices between situated human beings and other animals in technoscientific worlds.

When thinking of pigeons, people tend to think of the many species found in urban environments. Often referred to as "flying rats," these birds and their impressive ability to adapt to urban landscapes aren't always seen in a favorable light by their human cohabitants. At least by association, then, *PigeonBlog* attempted to start a discussion about possible new forms of cohabitation in our changing urban ecologies and made visible an already existing world of human-pigeon interaction. At a time where species boundaries are being actively reconstructed on the molecular level, a reinvestigation of human to nonhuman animal relationships is necessary.

PigeonBlog was inspired by a famous photograph of a pigeon carrying a camera around its neck taken at the turn of the twentieth century. This technology, developed by the German engineer Julius Neubronner for military applications, allowed photographs to be taken by pigeons while in flight. A small camera was set on a mechanical timer to take pictures periodically as pigeons flew over regions of interest. Currently on display in the Deutsche Museum in Munich, these cameras were functional, but never served their intended purpose of assisted spy technology during wartime. Nevertheless, this early example of using living animals as participants in surveillance technology systems provoked the following questions: What would the twenty-first-century version of this combination look like? What types of civilian and activist applications could it be used for?

Facilities emitting hazardous air pollutants are frequently sited in, or routed through, low-income and "minority" neighborhoods, thereby putting the burden of related health and work problems on already disadvantaged sectors of the population who have the least means and legal recourse (particularly in the case of non-citizens) to defend themselves against this practice. Recent studies have revealed that air pollution levels in Los Angeles and Riverside counties are high enough to directly affect children's health and development.[47]

With homing pigeons serving as the "reporters" of current air pollution levels, *Pigeon-Blog* attempted to create a spectacle provocative enough to spark people's imagination and interest in the types of action that could be taken to reverse this situation. Activists' pursuits can often have a normalizing effect rather than one that inspires social change. Circulating information on "how bad things are" can easily be lost in our daily information overload. It seems that artists are in the perfect position to invent new ways in which information is conveyed and participation is inspired. The pigeons became my communicative objects in this project and "collaborators" in the co-production of knowledge.

PigeonBlog also helped to provide entry into the health and environmental sciences. The largest government-led air pollution control agency in Southern California is the South Coast Air Quality Management District (AQMD), covering Orange County and the urban areas of Riverside and Los Angeles counties. Despite AQMD's efforts, in addition to major air quality improvements achieved since the 1970s, pollution levels in the region still surpass national regulatory health standards. In 2005 ozone levels exceeded the federal health standard for ozone on eighty-four days, or nearly one quarter of the calendar year.

Besides the actual numbers, it was the way in which air pollution measurements are currently conducted that the project hoped to address. The South Coast AQMD controls thirty-four monitoring stations in its district. These are fixed stations that cost approximately tens of thousands of dollars per station. Each station collects a set of gases restricted to its immediate surroundings. Values in between these stations are calculated based on scientific interpellation models. Stations are generally positioned in quiet, low-traffic areas, not near known pollution hot spots, such as power plants, refineries, and highways. The rationale behind this strategy is to obtain representative values of the urban air shed as opposed to data "tainted" by local sources in the immediate surroundings.

PigeonBlog's birds had the potential to test these interpellation models. Not only were they collecting the actual information while "moving" around, but they also were flying at about three hundred feet, an area that has proven difficult to assess through other means. Most flying targets are themselves sources of pollution. Airplanes in particular have this problem, and obviously cannot fly at such a low altitude.

Recent behavioral studies of pigeons have revealed that in addition to the commonly accepted theory that pigeons orient themselves in relation to the Earth's magnetic field,

they also use visual markers such as highways and bigger streets for orientation.[48] Flying about three hundred feet above the ground, pigeons are ideal candidates to help sense traffic-related air pollution, and to validate pollution dispersion in those regions. Depending on the location of the initial release, the pigeons could also report ground-level information at locations were AQMD-sanctioned monitors were not available.

The pigeon "backpack" developed for this project consisted of a combined GPS (latitude, longitude, altitude)/GSM (cell phone tower communication) unit and corresponding antennas, a dual automotive CO/NOx pollution sensor, a temperature sensor, a subscribes identity module (SIM) card interface, a microcontroller, and standard supporting electronic components. Because of its design, we essentially ended up developing an open platform, short message service (SMS) enabled cell phone, ready to be rebuilt and repurposed by anyone who is interested in doing so. While the development of the basic functionality of this device took us about three months, miniaturizing it to a comfortable pigeon size took us three times as long. After some initial discomfort, many revisions, "fitting sessions," and balance training in the loft, the birds seemed to take to the devices quite well and were able to fly short distances (up to twenty miles).

The pigeons that worked with us on the project belonged to Bob Matsuyama, a pigeon fancier and middle school shop and science teacher, who became a main collaborator in the project. He volunteered his birds for *PigeonBlog* and helped the pigeons train and interact with us.

After many trials and test flights in Southern California with Bob and his birds, we felt ready to introduce the project to a larger audience. Pigeons flew on three occasions, once as part of the Seminar in Experimental Critical Theory, an event sponsored by UC Irvine's Humanities Research Institute, and twice as part of the Inter Society for Electronic Arts (ISEA) Festival in San Jose. All three of these events took place in August 2006 and the observing human audience members got a chance to interact with the birds and retrieve the collected pollution information. The birds that worked with us in San Jose belonged to a local San Jose pigeon fancier.

The reactions to *PigeonBlog* were diverse. The human-animal work was embraced and applauded by many, but there were also critical comments by the People for the Ethical Treatment of Animals (PETA), who accused *PigeonBlog* of animal abuse and conducting nonscientifically grounded experiments. PETA's campaign didn't result in action beyond the public statement issued by the group, but it tainted the experience for a brief moment. Animal abuse was not "practiced" as part of the project, nor was animal rights a topic that the project was hoping to create public dialogue around. *PigeonBlog* was not animal rights in action but political cross-species art in action, and the collaboration with the birds was organic to the project. However, on a more positive note, PETA's critique raised very important questions regarding the legitimacy of arts/science experiments. PETA's accusations were built on the assessment that *PigeonBlog* was not scientifically grounded and should therefore cease its activities. Is human-animal work as part of political action

less legitimate than the same type of activity when framed under the umbrella of science?

In addition to technophile "fans" of the project who simply admired the "coolness factor" of putting electronics on birds, environmental health scientists raised questions about the technology used and wondered if the device could be used for their own research, which for the most part was geared toward tracing personalized pollution exposure to humans.[49] Another group of people who inquired about the project were ornithologists (professional and hobbyists) looking for cheap and feasible ways to track birds of all kinds. Then there were the many e-mails from pigeon fanciers around the country wanting to become involved in *PigeonBlog* itself, as well as green/environmental activists simply being supportive of the project's goals.

All of these inquiries had a logic to them. Whereas the technophile approach to anything electronic was certainly the least interesting or relevant to the project's aim, the technophile community is at least partially linked to the type of work that technoscience artists engage in. The specific questions regarding the technology and its potential usefulness for other research endeavors made sense. After all, the project did produce a very small, lightweight, and inexpensive device that couldn't be purchased commercially.

We also received an invitation to participate in a Defence Advanced Research Projects Agency (DARPA) grant geared toward the development of small, autonomous aerial vehicles designed around the aerodynamics of birds,[50] as well as inquiries regarding the feasibility of "measuring pulmonary artery pressure in birds during flight." How could *PigeonBlog* possibly be of help to these people? Isn't it obvious from this work that a DARPA grant is the last thing its authors would want to be involved in, and that da Costa is neither a biologist nor a veterinarian? Why was I suddenly being associated with areas of expertise that I was in no way qualified to respond to?

PigeonBlog received a lot of media coverage. Major national and international newspapers covered the project, and so had national television news channels. In nearly every instance, I was being referred to as "Beatriz da Costa, *researcher* at the University of California, Irvine." "Researcher" seemed to imply "scientist" in many people's minds, rather than "creative," "social," or "artistic" researcher. Suddenly I was put under a scrutiny and questioning similar to what scientists have to go through after publishing their work, and the association of the "political technoscientific artist" with a "specific" intellectual seemed to have gone one step too far.

This realization and thoughts about the future of *PigeonBlog* made me pause for a while. Did the project lose its political potential by becoming too closely associated with the university and myself being an actor within it? How should *PigeonBlog* continue? Should *PigeonBlog* data be linked to existing air pollution models in order to justify the project's scientific validity to criticism raised by groups such as PETA? And what would this approach entail? Would large amounts of money now have to be raised to conduct a "scientifically sanctioned" study? Would pigeons have to be flown for several years, even-

tually accumulating enough data to publish results in a scientific journal rather than at an arts festival? Wouldn't this end up creating the same trap of eventually developing expertise while becoming less accessible to a nonexpert public?

At this point, *PigeonBlog*'s future remains uncertain. Perhaps the most inspiring and gratifying inquiry came from the Cornell University Ornithology Lab, which asked me to serve on the board of its current "Urban Bird Gardens" project, which is part of its citizen science initiative.[51] The citizen science initiative involves bird observation and data gathering conducted by nonexpert citizens, ranging from the elderly to schoolchildren. Unlike other "outreach" programs conducted by universities around the country, Cornell's citizen science initiative actually uses the collected data as part of its research studies. Several projects conducted under the citizen science agenda, such as "PigeonWatch," "Urban Bird Studies," and now "Urban Bird Gardens," overlap in their aim and audience with the ambitions *PigeonBlog* set out to address.

Rather than dedicate myself to a scientific justification of *PigeonBlog* built within the university research environment and its related publication venues, I am hoping that this approach will be more true to *PigeonBlog*'s original aim in situating itself between the academy and nonexpert participants.

Notes

1. Michel Foucault, "Truth and Power," in *The Foucault Reader*, ed. Paul Rabinow (New York: Pantheon Books, 1984).

2. Ibid.

3. Ibid.

4. Ibid.

5. For more information on this topic, see Jennifer Washburn, *University, Inc.; The Corporate Corruption of American Higher Education* (New York: Basic Books, 2005).

6. For an excellent history on site-specific art and the changing notion of the term "site specificity," see Miwon Kwon, *One Place After Another: Site-Specific Art and Locational Identity*, new ed. (Cambridge, Mass.: MIT Press, 2004).

7. Deep Dish Television and Paper Tiger TV are good examples of pre-www DYI media initiatives. For more information, see http://www.papertiger.org and http://www.deepdishtv.org.

8. Nettime is a moderated listserv. For more information, see http://www.nettime.org.

9. For more information, see http://faces-l.net.

10. Undercurrents is an invitational listserv.

11. For more information, see http://www.indymedia.org.

12. For more information, see www.wikipedia.org. It should also be noted that Larry Sanger,

co-founder of *Wikipedia* and its precursor *Nupedia*, has started to build a *Wikipedia* "fork" project called www.citizendium.org. *Citizendium* will employ "officially" sanctioned experts who will function as editors for the project.

13. Tracing the relationship between open source software and open source hardware is not the purpose of this chapter. However, for recent developments in open hardware, see http://www.opencollector.org/Whyfree.

14. For more information about the Bureau of Inverse Technology, see www.bureauit.org.

15. For more information about *Suicide Box*, see http://www.bureauit.org/sbox.

16. For more information about the Institute for Applied Autonomy, see http://www.appliedautonomy.com.

17. For more information about *GraffitiWriter*, see http://www.appliedautonomy.com/gw.html.

18. For examples, see http://www.howstuffismade.org and http://www.txtmob.com.

19. For more information, see http://syntheticbiology.org.

20. Bruno Latour, *Science in Action* (Cambridge, Mass.: Harvard University Press, 1987).

21. Ibid., p. 22.

22. Ibid., chap. 2.

23. A number of these artists are included elsewhere in this anthology.

24. For more information, see http://xdesign.ucsd.edu/biotechhobbyist.

25. For more information on Heath Bunting's work, see http://www.irational.org.

26. To download available pdfs on-line go to http://www.locusplus.org.uk/biotech_hobbyist.html.

27. Ibid.

28. A good reference for the history of computer hobbyism is Steven Levy, *Hackers: Heroes of the Computer Revolution* (New York: Penguin Books, 2001).

29. Documentation of the project can be found at http://www.criticalart.net/biotech/cone/index.html.

30. *Digital Resistance* is available for free download: http://www.criticalart.net/books/digital/index.html.

31. *Molecular Invasion* is available for free download: http://www.criticalart.net/books/molecular/index.html.

32. Critical Art Ensemble. "Transgenic Production and Cultural Resistance: A Seven-Point Plan," http://www.criticalart.net/books/molecular/chapter3.pdf. In *The Molecular Invasion* (New York: Autonomedia, 2001), p. 59.

33. Documentation of *GenTerra*, *Molecular Invasion*, and *Free Range Grains* can be found on Critical

Art Ensemble's Web site in the biotech projects section: http://www.critical-art.net/biotech/index.html.

34. Ibid.

35. Ibid.

36. Roundup is a herbicide, made by Monsanto, that is designed to kill any plants the Roundup Ready line. For background materials regarding the Roundup Ready controversy, see publications by the Etcgroup, http://www.etcgroup.org.

37. For more information regarding the case, see www.caedefensefund.org.

38. http://www.clairepentecost.org/publicamateur.org/index.htm.

39. Foucault, "The Right of Death and Power over Life," in *The Foucault Reader,* ed. Paul Rabinow (New York: Pantheon Books, 1984).

40. Michel Foucault, "Governmentality," in his *Power*, ed. James D. Faubion, trans. Robert Hurley et al. (New York: Penguin, 2002).

41. The recent appearance of biotech science kits in toy stores is interesting in this regard. Obviously, sparking the scientific interests of children might be one of the reasons why adults are looking through the science kit shelves at local toy stores. But I wouldn't be surprised at all if playing with forensic DNA and running electrophoresis experiments at home wasn't as intriguing to parents as to the children for whom these kits were originally designed. Similar to the pleasures of cooking one's dinner or fixing up one's house, the act of making, building and simultaneously learning seems to be an appealing and desirable way of spending spare time for those who can afford doing so. So here we have one reason to become involved with scientific knowledge acquisition by non-experts: pleasure and the desire to "make things." Interestingly, these are often the same motivations which steer young high school graduates toward an education in the arts. However, in addition to "making something," "saying something" with what you make obviously has to become part of this equation very quickly.

42. SymbioticA is now offering a Master of Science degree in biological arts.

43. "What rules of method for the new socio-scientific experiments?" http://www.bruno-latour.fr/poparticles/poparticle/p095.html.

44. Michel de Certeau, *The Practice of Everyday Life*, trans. Steven Rendall (Berkeley: University of California Press, 1984), p. 148.

45. *PigeonBlog* was developed in conjunction with Preemptive Media's (Beatriz da Costa, Jamie Schulte, Brooke Singer) *AIR* project.

46. Another example is the *Zapped*! project by Preemptive Media, www.zapped-it.net.

47. Nino Künzli et al., "Breathless in Los Angeles: The Exhausting Search for Clean Air," *American Journal of Public Health* 93, no. 9 (Spring 2003): 1494–1499.

48. Hans-Peter Lipp, "Pigeon Homing Along Highways and Exits," *Current Biology* 14, no. 14 (July 27, 2004): 1239–1249.

49. Preemptive Media's *AIR* project addressed the pollution exposure to humans in more detail.

For more information, see www.pm-air.net.

50. This inquiry came from the University of Arizona.

51. For more information regarding Cornell's citizen science initiative, see http://www.birds.cornell.edu/LabPrograms/CitSci.