Technology "carries with it human moral responsibility…one cannot understand technology outside its particular historical, economic and cultural context of design and use."

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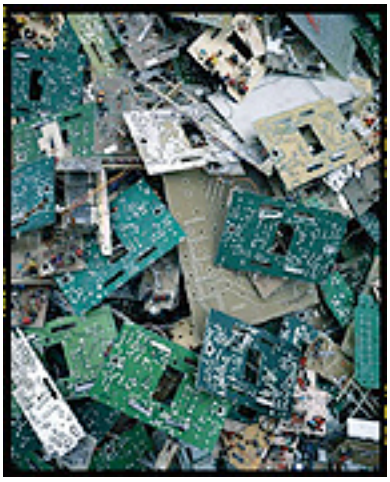
Processed Lives: Gender and Technology in Everyday Life



INTRODUCTION

Through the 1990s, I, like many young women interested in technologies and new media theory, read a lot of cyberfeminist manifestas. I digested their optimistic visions describing a world in which computer technology served as the bridge across the gender divide: the ride into cyberspace would be the ticket out of our gender-defined boxes. Our feminist foremothers certainly made them roomier for us, but those old patriarchal forces still too often held the keys to them. Computers, and particularly the internet, were going to blast the tops off.

I could see the dream being usurped as those same old power structures began to crowd cyberspace in the same ways that they dominate physical space. As long as the internet remained a free frontier, however, I figured that it at least provided more *options* for women. Therefore, no matter how many angry girlfriends I saw dumping or fighting with their boys over their addictions to male created, male defined, reductive images of women trapped compliantly behind glass, no matter how many on-line corporate ads I saw trying to socialize us into neat and tidy target market groups with one set of superficial male-defined desires and needs, I still believed that computers still had potential, overall, to serve as a further liberating force for women.

My eyes were opened to a wider reality, however, at the Whitney Museum of Contemporary Art. Over the summer of 2003, the Whitney hosted a show called *American Effect.* In this exhibition, artists from around the world expressed their opinions about the United States. I was particularly unsettled by the work of Chinese artist **Danwen Xing**. To this show she contributed a series of large photographs documenting electronic waste exported from the United States to Southern China. The towns were, in fact, nothing *but* landfills of e-waste. I was appalled at what I saw, the result of 225 tons of e-waste being exported from the U.S. each week.

As a digital artist who is concerned about the environment, I started looking into the issue more deeply. I found that both the production of silicon chips for computers AND the casual and irresponsible e-waste disposal methods of America are serious international public health issues. These hazards primarily effect women and children because they comprise the majority of chip producers and waste pickers. The problem is growing rapidly in the Third World because of the "liberalization" of international trade treaties that benefit transnational capitalism.

As I have been investigating these issues, I have reached the conclusion that, while I appreciate the contributions of cyberfeminists to the discourse, any discussion of technology+feminism is incomplete without including a critical look at how digital tools effect the lives of women who labor to create these machines and those who salvage their parts.

CYBERFEMINISM

Cyberfeminism emerged in the early 1990s as a feminist response to technoculture. Recognizing that "technologies can and often do produce gendered hierarchies through their design, availability and patterns of use," cyberfeminism took to task the differences in power afforded to men and women in the digital discourse. (Terry/Calvert, 4) It sought to undermine those power constructs. Its aims were political and inclusive. Its methods were artistic, scholarly, and based on building human networks within and beyond the computer networks. Its tone celebrated the strength, creativity, and power of women, women's myths and symbols, and the history of women in technology. In cyberfeminism, women were active agents of their own identities and destinies, not passive victims.

Cyberfeminism gave rise to a wave of groups like Australia's VNS matrix. They drafted one of the first cyberfeminist manifestas encouraging "woman centered technophilia." They drew from the feminist body art of the 1970s that celebrated the vagina and clitoris as loci of power and coined the slogan, "The clitoris is the direct line to the matrix" (Shade, 46.) This slogan, and cyberfeminism in general, played off the ideas that the world wide web, networks, systems-oriented thinking and nonlinear media mirrored what has traditionally been seen as one of women's strengths: building social and relational networks. Most importantly, cyberfeminism trumpeted that these ways of connecting and these ways of processing were powerful and important.

Sadie Plant is one particularly well-known cyberfeminist theorist who played with the associations between digital networking and the traditional associations with women. She linked the idea of networking to weaving, and pointed out that looms were "the vanguard site of software development". She said that both women and computers were matrices that mediated in the absence of the penis and its power (Shade on Plant, 62). Plant elucidated a long history of women of creators, producers and operators of computers, citing people like Grace Murray Hopper, inventor of the first computer piler during the Cold War. This history made sense to Plant because she saw systems-oriented thinking as a natural extension of the social networking and multitasking that women have always traditionally done.

Lovers of feminine lore have often pointed out that the relationship between "webs" and women links to ancient feminine myths such as that of the Greek goddess Arachne, after whom spiders were named. Thus the World Wide Web became, to Cyberfeminism, an extension of this mythic idea. Psychoanalytically, writers have pushed the association between computers and the feminine even farther by likening cyberspace and virtual reality caves to internal womb-like spaces.

Thus self-identified, cyberfeminists put forth a plethora of ideas about what to *do* with computers to set them in the service of women's empowerment. Many used the web as an alternative exhibition venue, comparable to the alternative art spaces of the 1970s, spaces that emerged as a counter-strategy to the boy's club art world of the day. Young teenage women began to use the web to express themselves via personal web pages and through chat rooms where they could discuss things like identity, racism, college, food, and sexuality from *their* perspective. The digital realm became an avenue

for women to express their pro-creative powers and disseminate *their* ideas, without any mediation from any male dominated, male run, male value-oriented establishment. The internet also gave women another avenue for maintaining agency over self-representation and sexual expression. "Our site is to make it clear that we're not naked and waiting to chat with you!" (Wakeford quoting Crystal Kile, creator of PopTart site, 60). Those women who *did* consciously want to chat naked were freed to do so on their own terms, rather than being posed like paper dolls by male photographers to make men like Hugh Hefner and Larry Flint very very rich. (Whether this is still sexist, instead feminist, or neutral is one of those points over which Second and Third Wave Western feminists, for example, rage. I encourage readers to examine their own opinions, and share that mine is: It is contextual, and depends on the consciousness with which each woman constructs her self imagery.) With the computer, and particularly the internet, women had a new tool to subvert the constraints of the museums; mainstream political arenas; film and tv industries thriving on the exploitation of t&a and trying to tell women what their desires should be.

Computers via the internet gave women a platform for communication where they did not have to stand on a table with a bullhorn to be heard over men. It allowed them freedom from instant judgment based on their bodies, liberation from presuppositions about what kind/how much power they could carry, according to their society. On line, women could choose to be seen first, or even only, for their minds when they wanted to be. While discussing our experiences trying to claim a voice from within a female body when in the company of men, my undergraduate assistant at UC Berkeley shared:

> [Guys are] good at sounding smart and making me the listener, and just making me feel like I am not as smart as they are. I once was with a guy I actually really really liked…and I wanted to be [seen as] the girl that talked. But he seriously was not giving me the chance to speak! Finally he said, 'It's your turn to talk.' It made me really mad…being a girl it made me feel like he was telling me when to speak…I did have a professor who used to make a point of calling on girls and making them talk…I appreciated that she knew my name and wanted me to say something. I think more women teachers need to do that.

Sara's experience is not unique. "Feminist researchers find that men are more likely than women to control conversation while women do 'support work'…who express concern for other participants in talk. The organization of words and ideas was similarly conducted in a context of masculine power where women were made invisible, their existence either denied or distorted, and their ways of knowing and issues of interest labeled irrelevant" (Inayatullah/Milojevic, 83).

As Sarah Diamond from Banff Center or New Media puts it, *the internet,* unlike physical space, allows for mutable identities. This includes allowing for shape shifting in cultural industries and technology companies that "still remain rigorously masculine in bias and leadership." She cites:

> Men expect supervisors and regulators to be male and accept assertive behavior. At the 1994 Labor and Technology Conference…a female health and safety supervisor who used her surname to communicate with fellow workers in a distant site met a man who realized she was a regulatory officer…

> In a passionate intervention he expressed his sense of betrayal, "If only I had known (he would have not taken her so seriously?)" Ultimately this fellow and others in the room stated the need to know the biological identities of communicators in order to know how to appropriately respond. They looked forward to video conferences or visual identity on the net. The women expressed the opposite desire; they welcomed the freedom from their bodies. In a culture organized by gender, power lies in ambiguity (Diamond, 87).

Computers liberated some women by affording them more flexibility in making choices about locating their bodies in geographical space in relation to employment. Computers opened up options for working from home, for example, thereby making it a little bit easier to balance careers and childcare. (This point is not to insinuate that childcare should be primarily a female responsibility, but when it is Mom's turn to look after Jr., or if Mom is single…) Computers also created more opportunities for women to become entrepreneurs, and even run businesses from home if they so chose. However, it should be noted that even at the height of the dot-com boom in 1999, women represented only 6% of internet companies financed by venture capital firms (Shade, 65). Among them, the "one common complaint of prominent women in Silicon Valley is that, while they are trying to develop and promote exciting new technologies, the media remain obsessively and single-mindedly focused on thier looks and their gender (Shade on Brown, 65).

Computers have enabled women to network and disseminate information to each others for the purposes of scholarly exchange and for political activism promoting social change. Though Western-created cyberfeminism does not address the bias much, all of the topics thus described have pertained primarily to First World women who have the economic means, education, and infrastructure (i.e. phone lines and electricity) to support access to computers. More Third World women are also gaining access. Often, however, they need to share modems more, travel distances to get to them, and must tolerate slow connection speeds. (I spent two winters working in Luxor, Egypt. There the village of Habu had one computer, with a 14K connection.) Despite obstacles, women all over the world are now organizing via the internet. Zapatista women in Chiapas, Mexico, are organizing for democracy and social justice. In Iran, internet images are closely monitored and text is somewhat monitored by the government. Still, from their closed spaces, women exchange ideas on-line about arguments interpretations of religious texts. They seek to challenge traditions that suppress them (Farhi, 209). The APC's women's outreach program facilitated internet networking for women involved in the Beijing Women's Conference in 1995. This organization promoted the web as empowerment tool for organizing, finding and exchanging information, and self expression so women internationally could address issues of poverty, education, health, violence, militarism, power and decision making, human rights, media, the environment, and the well-being of girls.

It is important to remember, however, that even when Third World women do find access to computers, usually via elite university systems, they must confront imperialism. Though the situation is changing, most on-line material is in English. Many Third World women are not literate in *any* language as the result of systems of economic oppression. All the conventions on the net are set by the West, including Western male-created visual representations of women that are particularly offensive in the Islamic

world. And the whole darn invention of the internet is an outgrowth of the military industrial complex that has relegated Third World women's status on the globe.

Therein lies the heart of the contradiction of cyberfeminism. "…in feminist cybercultural politics, women struggle simultaneously against the control of cyberculture by male-dominated groups and against the restructuring of the world by the same technologies that they seek to appropriate." The same technoscience that cyberfeminism glorifies brings misery to millions of people on the planet because of its situation in the transnational capitalist patriarchal system (Escobar, 48). The vast majority of these people are women and children. These include the women who make computer chips and the poisoned children whom they bear, or cannot bear, because of the hazards of their work. These include the women and children who pick through the toxic waste of computers that the United States dumps on Asia.

WOMEN MAKE SILICON CHIPS

The reality of the digital revolution for labor class women, both in the industrialized world and in the Third World, looks a lot different than the utopian and liberating cyberfeminist universe envisioned by their theory-based sisters. From cradle to grave, computers pose grave risks to women who create silicon chips and to the women and children who dismantle e-waste components for slave wages. The web that links *these* women is spun from unfathomable toxins.

Let's first look at the production of silicon chips. As of 1992, 70% of the more than 35,000 chip production workers in the U.S. alone were women. This count was made up largely of Latino and Asian immigrant women. (Los Angeles Times, http://www-tech.mit.edu/V112/N62/briefs2.62w.html) This $150 billion industry is the world's largest manufacturing sector. "I think it is accurate to say that the world is seeing the largest industrial expansion in history," says Dan Herr, research director of the Semiconductor Research Association (Chepesiuk).

Intel reports that its chip factories change production methods 30-60 times a year to streamline output. These changes introduce hundreds of new chemicals before their short-term or long-term effects on workers or on the environment are understood (Chepesiuk). The effects of many of the chemicals used in the production of silicon chips, however, *are* known or suspected carcinogens or to be otherwise harmful. "The toxic materials needed to make the 220 billion silicon chips manufactured annually are staggering in amount and include highly corrosive hydrochloric acid, metals such as arsenic, cadmium, and lead; volatile solvents such as methyl chloroform, tolvene, benzene, acetone, and trichloroethylene; and toxic gasses such as arsine" (Chepesiuk). "What was once thought of as the first 'clean' industry is accurately one of the most chemical-intensive industries ever conceived," according to Joseph LaDou, Director of the International Center for Occupational Medicine at UCSF (Edwards, http://www.sctc.org/listserv/letter41.htm).

Inhalation and skin exposure are the most likely methods of absorbing toxins. Workers wear protective head-to-toe "bunny suits." "Clean rooms" where chips are produced are designed to protect against contamination by airborne *particles*. *Chemicals*, however, can re-circulate through the closed-loop air systems. Clean rooms "protect the silicon wafers from the people, not the people from the chemicals," says

Katherine Hammond, Associate Professor of Health Sciences at UC Berkeley (Richards/Wall Street Journal). 1999 US Department of Labor statistics state that semiconductor workers lose twice as many work days to occupational illness than other manufacturing sector workers (Richards/Wall Street Journal).

Around the world, chip manufacturing workers are suing large corporations because they say they are developing cancers from the chemicals they work with. Because cancers can take years to show up, many scientists expect an explosion of cases in the industry as it matures, especially in the Third World where the industry is picking up speed and where worker protection standards are not as rigorous or as consistently enforced. Companies such as IBM and National Semiconductor deny that cancer is a risk to their workers based on their jobs, but many chemicals used on those jobs are known carcinogens, such as arsenic and benzene.

Solvents used in chip manufacturing seem to be particularly troublesome for women's health. They seem to provoke miscarriages and cause birth defects. Companies also deny these allegations. However, "since 1988 there have been three major studies [as of 1999] of miscarriage rates in the American chip making industry. These suggest that women who became pregnant while working in semiconductor plants are between 40% and 100% more likely to suffer spontaneous abortions than pregnant women who do not work in these plants" (Edwards, http://www.sctc.org/listserv/letter41.htm). Women exposed to the chemicals also seem to have more trouble conceiving in the first place, according to a 1995 study by UC Davis and UC Berkeley (Hukill, http://metroactive.com/papers/metro/09.11.97/toxic-9737.html).

Health hazards of chip making for women and children extend beyond manufacturing because of the intense effects of chip making on the environment. Water is particularly degraded as it is contaminated with heavy metals. "The manufacture of just one 8-inch computer wafer containing hundreds of chemicals requires on average 27 pounds of chemicals, 29 cubic feet of hazardous gasses." It produces "9 pounds of hazardous waste and 3,787 gallons of waste water, which then requires extensive chemical treatment to remediate" (Chepesiuk). The EPA lists 29 sites in Silicon Valley as superfund National Priority List sites because of 100 different contaminants measured in the drinking water. Also, liquid waste from the chip industry has been stored in underground tanks that have leaked solvents such as 1,1,1-trichlorethane and 1,1-dichloroethene into the ground water.

The encouraging news is that the practice of storing waste underground has ceased and ethylene based glycol ethers (a solvent) are rarely used in the industry anymore in the industrialized world. These changes occurred after studies in 1992, sponsored by IMB themselves and not any public interest agency, found that 1/3 of their female employees who had been exposed to chemicals had miscarriages (Chepesiuk). Now the industry is monitored more closely, in the First World, because of findings like these and because of countless lawsuits against chip manufacturers globally. As late as 1988, however, some companies required proof of sterility as a condition of employment for women (Fletcher, http://www.safeworksillinois.com/news.php?newsID=11). This double standard did not apply to the lesser numbers of men in the chip manufacturing industry, even though solvents also adversely effect their reproductive health.

According to the National Institute of Occupational Safety and Health (NIOSH), 9 out of 10 North American industrial workers, regardless of gender, risk exposure to

hazardous materials. The chip industry appears to fit this pattern when one looks across numerous case studies of suits and complaints brought against companies by women stricken with breast cancer, uterine cancer, miscarriages and birth defected fetuses in high concentrations at or around semiconductor plants. In the industrialized world, these include cases such as the suit against IMB in East Fiskill, New York; statistics from the Hospital for Sick Children in Toronto, Canada; and the National Semiconductor case in Greenock, Scotland.

Cases in New York and Toronto support claims about birth defects. In East Fiskill, 140 workers sued an IBM semiconductor plant where workers claimed to be exposed to solvents. High incidents of birth defects were the motivation. In Toronto in 1999, the Hospital for Sick Children released statistics that 13 out of 125 women who were exposed to solvents birthed children with congenital malformations such as deafness and spina bifida. This was 13 times the normal rate for the city, according to the Journal of the American Medical Association, vol. 281, p 1106 (Edwards, http://www.sctc.org/listserv/letter41.htm).

One well-documented case of cancers and female health problems occurred near Glascow, Scotland. The case related to a plant in Inverclyde, a plant in which 95% of the chip makers are female. In this town an average of 88 women under age 65 die of cancer annually. This is 3 times the rate for women of the same demographic in NYC (Richards, *Wall Street Journal*). Women of this town also report high rates of birth defects and multiple miscarriages. "We all got a cocktail of gasses, acids and chemicals," shared Grace Morrison, a National Semiconductor worker for 16 years who developed uterine cancer (Richards, *Wall Street Journal*). In interviews "dozens of past and current workers describe scenes of bunny-suited employees stumbling off the chip production lines, bleeding from the nose, vomiting an clean room emergency showers, and passing out after chemical leaks" (Richards, *Wall Street Journal*). Part of the problem with this plant is that it is old, built in the 1970s. Years after these horrific episodes, women developed uterine cancer, intense uttering bleeding requiring hysterectomy, irregular pap smears, and leukemia.

National Semiconductor says there is no evidence of a relationship between these high rates of problems and their plant. Again, however, the plant uses hundreds of known and suspected carcinogens such as arsenic, benzene, and chromium. One worker, Ms. Clark, said she was once assigned to wash chemical residue off the walls of the clean room, and her supervisor told her, "You've already had your family." Three years later, she developed stomach cancer. Another worker, Sandra Miller, miscarried in 1988 while employed at the plant and again in1990. The latter miscarriage occurred in the production line, and there was so much pressure to keep producing that her supervisor asked her to finish her shift before leaving (Richards, *Wall Street Journal*)!

Each of these examples, however, point to incidents in Europe and North America, where people have economic, educational and community resources to launch such suits. What about workers in the Third World?

Increasingly the "dirtier" processes of high-tech production are taking place in lower income communities and communities of color throughout the Third World, creating a whole system of environmental injustice…high-tech firms have led the lobby efforts to promote new globalization structures such as NAFTA and GATT which have gone hand

in hand with…substandard development throughout Asia and many other parts of the world (Smith, http://www.svtc.org/icrt/darkside.htm).

What health horrors await chip production workers, or are already happening but underreported, in China, India, Indonesia and Malaysia?

WOMEN AND E-WASTE

As Danwen Xing documented and showed at the Whitney, Asia is already facing hazards from the other end of the computer life cycle. Electronics waste, or e-waste, is now a widely recognized problem in places such as the Guangdong province in China. In 2002, the Switzerland-based Basel Action Network (BAN), the Silicon Valley Toxics Coalition, and Toxic Link India released evidence that the US government has no controls on the export of hazardous waste. Much of it goes to Asia, particularly Asia. There peasants recycle the parts and metals form the circuit boards in extremely hazardous conditions and by extremely dangerous methods. BAN has accused that the US EPA policy allowing the export of cathode ray tubes, found in tvs and in computer monitors and laden with lead, is illegal. Not only does the policy perpetuate environmental injustice, it is also counter to an accord signed by the US and other nations belonging to the Organization of Economic Development (OECD) in 1986 (Basel Action Network, http://www.ban.org/ban_news/toxic_trade_CRTs.html). The EPA "…sweep[s] America's toxic waste problem out the back door and very cynically they do this using the pretext of promoting 'recycling,'" says Jim Puckette of BAN.

The US, however is the only industrial country to refuse to sign the Basel Convention, created in 1989 and amended in 1994, to ban all hazardous exports from the First World to the Third World (Pontoniere, http://www.ncmonline.com/news/view_article.html?article_id=532).

Exactly what hazardous materials are in computers that are trashed? The platinum in circuit board, the copper in transformers, the nickel and cobalt in disk drives, the barium and cadmium that coat computer glass, and the lead solder on the circuit boards and video screens are all materials that pose environmental public health concerns (Chepesiuk).

Obviously when computers are left in landfills, the leaching of chemicals into the ground and consequently the ground water is an enormous danger. Greenpeace China found lead levels in the drinking water in Guiyu to be *190 times higher* than limits set by the World Health Organization (Schoenberger, http://www.bayarea.com/mld/mercurynews/2002/11/24/news549...). Zinc and chromium levels were also dangerous. Miscarriages are again associated with such contamination. So too are respiratory, skin and stomach problems. Children are at greatest risk when exposed to heavy metals. Exposure leads to learning disabilities, motor dysfunction and behavioral disorders. Women with high levels of lead in their bodies pass it to children they are nursing or to their fetuses (http://www.envirohealthaction.org/children/heavy_metals).

Groundwater is not the only means of transmission of hazardous metals into the body. In Guiyu, peasants scavenge through e-waste pits without any protection. In

China's Pearl River Delta, young women from the country side work day and night for 30 cents an hour at electronics workshops. In Guiyu, along with dumps in India, Pakistan and the Philippines, workers crack apart and sort toxic computer parts (lead, cadmium, mercury) for mere pennies. By dipping circuits and chips in acid, they extract small bits of gold. Then they dump the acid in the river. They also burn cables to reclaim copper (Schoenberger, http://www.bayarea.com/mld/mercurynews/2002/11/24/news549...).

Most of the peasants engaged in the scrap picking are women and girls. Kneeling in the pits, they heat lead over coals, a process that of course volatizes the lead and releases toxic fumes. They soak circuit boards in the molten lead solder, remove the chips, and resell them.

The Chinese government has indeed banned the acceptance of this electronic waste. Local crime bosses, however, bribe local officers. Peasants defend their lethal practices, citing computer waste as their only means of income.

WHAT CAN WE DO ABOUT IT?

"Feminists cannot afford to stay out of the game of technoscience if we want the future to look different" (Terry/Calvert, 8). Humanity, however, cannot afford to keep playing the technoscience game the way we have been without suffering increasingly dire consequences for the environment and for women. As computer users in the US, we are the largest consumers of electronic goods in the world. As a corollary, we cast off more e-waste than anyone in the world. Our consumption of computers and electronics adversely effects the health of workers, particularly women, who create the goods. Our methods of discarding that same equipment adversely effect peasants in China, India, Pakistan, Malaysia and the Philippines, especially women. If we have any humanity at all, how can we reduce this harm, knowing that we as a culture will never give up the technology itself?

There are several levels at which to address this problem and work towards solutions. There is the personal level, the policy level, and the research and development level.

As individuals, we have most immediate control over making conscious choices at the personal level. Quite simply, do not buy what you do not need. Share what you can. Planned obsolescence is part of the marketing strategy of the electronics industry. They want us all to believe that we need every latest update, upgrade and gadget. If they cannot psychologically barrage us into thinking that we will fall behind without these new toys, computer companies make new products incompatible with old ones. When you reach a point of checkmate in this strategy game, invariably come out on the losing side, and have to upgrade, ***DO NOT THROW YOUR COMPUTER AWAY*** so that it ends up in a landfill. Donate it to a friend with less sophisticated digital needs. Donate it to a church, a school, a nonprofit organization, a library, a child in a low income neighborhood. Especially as multimedia artists, our tools are far more advanced than what most people need in an office for writing memos and sending e-mails. "The Computer Recycling Center in Santa Clara, California gave away 30,000 computers in a 3-year period" (Chepesiuk). To find places near you where you can donate, go to www.microweb.com/pepsite/Recycle/recycle_index.htm/ . When you finally recycle computers or electronics of any kind, consult the Electronics Industries Alliance:

www.eiae.org . They have information on how to recycle properly so that your cast offs do not end up in a Third World pit.

One strategy that can start at the personal or local level and extend to the wider arena of public policy entails encouraging the remanufacture, repair and reuse of goods. It is a nod towards shifting to a service based economy over a "stuff" based economy. These practices generate less waste than making new products perpetually. They also create jobs. "The Institute for local Self-Reliance in Washington, D.C. estimates that computer repair and refurbishing create an estimated 68 times as many jobs as a landfill does" (Gardner/Sampat, 54). Though changing the whole focus of the US economy is not something that is easy to do overnight at a grassroots level, it is not unrealistic for neighborhoods to set up and support repair shops or co-ops.

In drafting creative policy for managing the creation and destruction of computers, it is helpful to look at other countries with more progressive environmental laws. In Europe and Asia, governments require producer responsibility for products, including computers. This means that manufacturers are responsible for environmentally conscious designs, and they are responsible for taking computers back at the end of their "lives." Greener design can include strategies like creating designs that are easier to upgrade instead of replace. They are designs that are easier to dismantle so that legitimate parts can be separately repaired or recycled. Look into the Campaign for Responsible Technology and Clean Production Action to learn more: http://www.un.org/esa/sustdev/sdissues/consumption/cppnt9.htm.

Producer responsibility can also extend to materials used in products. In June 2000, the European Commission adopted a Directive on Waste Electrical Equipment (WEEE). The directive prohibits the use of mercury, cadmium, hexavelent chromium and brominated flame retardants by 2004 (Sheehan, http://www.worldwatch.org/live/discussion/81/). Access WEEE's site at: http://www.weee-recycle.com/.

Producer responsibility can be promoted in two ways. Governments can offer economic or tax incentives for voluntary producer responsibility. Alternatively, they can impose penalties on manufacturers or suppliers who do *not* conform to mandatory responsibility laws. As of 1999, at least 12 countries were drafting producer responsibility plans for electronics (Garder/Sampat, 57). The Netherlands and Germany have strict producer responsibility laws to use as models.

In theory, in America we have a democracy, and our elected officials are supposed to respond to our demands. So try writing to your legislators to tell them that you want to see more producer responsibility drafted and enforced for the purpose of human rights, environmental preservation, and environmental public health. To the representatives for your district by simply entering your zip code, go to: http://www.leginfo.ca.gov/yourleg.html . If you need help with the protocol of how to contact your local legislators or how to write letters to government, this site will help you: http://www.calchamber.com/biz%20issues/2003/03-protocolprocess.pdf . Gathering grass roots support and sending letters en masse is always more effective than writing alone. Representatives do not pay more attention to phone calls and traditional letters than to e-mail letters.

In reality, however, our strongest political power in a capitalist society is how we spend out dollars. So talk to and inform the people from whom you purchase. Also, purchase from the people who run their businesses with an environmental and social ethic. Silicon Valley Toxics Coalition is a good site to visit to keep up with what is going on in terms of efforts to green the computer industry: www.svtc.org . They look at both legislation and at companies.

Because Asian producers must legally take back electronics, and since many of those electronics contain lead as discussed earlier, many Asian companies are investing in research and development to find ways to eliminate lead. These companies include Sony, Panasonic, Hitachi, Sharp, NEC and Toshiba. If you buy from these companies, tell vendors that you support these efforts.

At the research level, materials science is a good place to start. "Materials substitution can be made safer by introducing strict environmental criteria into substitution strategies. Because the use of material, especially petrochemicals, is ultimately unsustainable, some analysts maintain that these should be replaced with biomass-based materials, shifting economies from a 'hydrocarbon' base to a 'carbohydrate' one. [For example], starch or sugar can substitute for petroleum in making plastics" (Gardner/Sampat, 55).

The field of nanotechnology is one where enormous amounts of energy are being invested in research and development. According to Charles Ostman, Senior Fellow at the Institute for Global Futures and Chair of the Nanoelectronics and Photonics Forum, computers will likely be one of the first applications of nanotechnology. There is obvious reason why nanotech will lead to less e-waste: nano-scale computers will occupy far less volumes in or out of landfills. Ostman explained tome, however, that there are far more complex and profound reasons why nanotechnology will lesson the burden of e-waste.

Nanotechnology involves engineering at a molecular level. It directs the interactions of molecules to create different structures, or devices. Ostman enthusiastically pointed out that nanotech is not just about reducing scale; rather, nanotech fundamentally readdresses the production process. It subverts the current manufacturing paradigm and economic model that promotes centralized, top-down, megalithic plants such as those used in the silicon chip industry. Operating these plants consumes a lot of goods and natural resources, and thus contribute to environmental degradation before even accounting for the toxic by-products they produce. Because they cost so much to run, they must produce a lot of silicon chips to offset operating costs. It follows that they need to move all those goods, so planned obsolescence of electronics becomes part of the marketing strategy. This leads to the frequent disposal of "outdated" digital devices, and they end up in these Third World landfills.

With nanotechnology, however, manufacturing processes will take place in a lab on an as-needed basis only, without high overhead and without a need for hyper-production. This will radically change the whole economic and investment structure of the manufacturing sector, according to Ostman.

This visionary scientist points to a particular technological development to watch: a nanotech version of Field Programmable Gate Array (FPGA). FPGA works rather like memory in that it allows computer chips to be reprogrammed by changing the

configuration of “gates” through which information flows. This allows for easy upgrading of the chip over disposal of the whole computer system.

FPGA already exists in a traditional silicon chip version. It is used in networks, high-end supercomputing, and in some reprogrammable cell phones. In its current form, however, wide-scale employment of the technology is cost prohibitive. Nanotech versions will be cheaper, easier to produce, and probably available to the general public in about 10 years. These small-scale circuits will be completely different functionally, also. They will be “soft-wired” rather than “hard-wired,” thereby mimicking mutable biological processes through their flexible architecture. Ostman described how the updated FPGA circuits will produce a high degree of “fault tolerance.” This means that if one gate stops working, there will be billions of others through which information will be able to reroute, again lessening waste by lessening obsolescence. This is the technology that is supposed to bridge us into ubiquitous computing, i.e. invisible integrated computers that allow for “smart” environments in which everything around us is programmable and digitally responsive.

I asked Ostman about nantotechnology’s *own* perceived risks to the “natural” world as we know it. He acknowledged that there is a lot of fear in the popular imagination about nanotechnology running amok like the “nanobots” in Michael Crichton’s science fiction. In his view, however, this fear comes from ignorance about how the technology works plus media hype. Ostman is optomisitc about how the new technologies will be regulated. He was recently at a conference in Washington, D.C. debating these very matters. Wisely, policy makers are inviting nanotechnologists to work with them from this early foundation point in the technology’s history. The goal is to collaboratively figure out what safeguards can be put in place from the start. If you would like to learn more about nanotechnology and formulate your own opinions about whether it will help the environment, Ostman recommends starting with the site www.nantech.sig. His own site is at http://members.aol.com/charles000/alifeart/nanobiox.htm.

CONCLUSION

The situation is grave but efforts to reverse the tide are snowballing. Technology offers many benefits to humanity. This includes benefits that further the goals of a diverse array of feminisms. However, be wary not to be lulled away from recognizing the pitfalls of computers as they are currently produced, marketed, and disposed of. The hazards are especially pronounced for women globally. Only by facing the dark side of technology head on can we expect to challenge and change the situation. Challenging and changing the status quo is, after all, what feminism at its core is all about.

BIBLIOGRAPHY—GREEN COMPUTING IS A FEMINIST ISSUE

Alshejni, Lamis. "Unveiling the Arab Woman's Voice Through the Internet." *Women@Internet*: *Creating New Cultures in Cyberspace*. Ed. Wendy Harcourt. London/NY : Zed Books, 1999.

Basel Action Network Press Release. "Toxic Trade Watchdog Calls US EPA's Proposal on Electronic Waste Illegal and an Affront to Environmental Justice." Seattle: September 13, 2002. http://www.ban.org/ban_news/toxic_trade_CRTs.html

Bautista, Rhona O. "Staking Their Claim: Women, Electronic Networking and Training in Asia." *Women@Internet: Creating New Cultures in Cyberspace*. Ed. Wendy Harcourt. London/NY: Zed Books, 1999.

Chepesiuk, Ron. "Where the Chips Fall: Environmental Health in the Semiconductor Industry." *Focus: Environmental Health Perspectives*. Vol. 107, No. 9, September 1999.

Children's Environmental Health: Toxics and Heavy Metals. http://www.envirohealthaction.org/children/heavy_metals

Diamond, Sarah. "Taylor's Way." *Processed Lives: Gender and Technology in Everyday Life.* Ed. Jennifer Terry and Melodie Calvert. . London/NY: Routledge, 1997.

Edwards, Rob. "Chips, Health, and IBM: The Chips are Down." *Campaign for Responsible Technology*. CRT List Serve Letter #41, May 1999. http://www.sctc.org/listserv/letter41.htm

Escobar, Arturo. "Gender, Place and Networks: A Political Ecology of Cyberculture." *Women@Internet: Creating New Cultures in Cyberspace*. Ed. Wendy Harcourt. London/NY : Zed Books, 1999.

Farhi, Farideh. "Information Technologies and Identity in Iran." *Women@Internet: Creating New Cultures in Cyberspace*. Ed. Wendy Harcourt. London/NY: Zed Books, 1999.

Fletcher, David J. "Health on the Job." *Medical Selfcare*, Jan. 1, 2001. http://www.safeworksillinois.com/news.php?newsID=11

Gardner, Gary and Payal Sampat. "Forging a Sustainable Materials Economy." *State of the World*, Worldwatch Institute, 1999. http://www.worldwatch.org/topics/energy/materials/

Hukill, Tracy. "Leak No Evil: Fairchild Toxic Contamination." *Metroactive News and Issues*, Sept. 11-17, 1997. http://metroactive.com/papers/metro/09.11.97/toxic-9737.html

Inayatullah, Sohail and Ivana Milojevic. “Exclusion and Communication in the Information Era: From Silences to Global Conversations.” *Women@Internet: Creating New Cultures in Cyberspace*. Ed. Wendy Harcourt. London/NY : Zed Books, 1999.

Morse, Margaret. “Virtually Female: Body and Code.” *Processed Lives: Gender and Technology in Everyday Life*. Ed. Jennifer Terry and Melodie Calvert. . London/NY: Routledge, 1997.

Ostman, Charles, Senior Researcher, Institute for Global Futures and Chair, Nanoelectronics and Photonics Forum. Phone interview from Los Angeles to San Francisco, December 14, 2003.

Pontoniere, Paolo. “Silicon Valley Group Spurs China to Ban E-Waste Imports from US.” *NCM Online*, June 16, 2002. http://www.ncmonline.com/news/view_article.html?article_id=532

“Reproductive Hazard Found in Computer Chip Industry.” *Los Angeles Times*, Vol. 112, No. 62, Dec. 4, 1992. http://www-tech.mit.edu/V112/N62/briefs2.62w.html

Richards, Bill. “Semiconductor Plants Aren’t Safe and Clean Billed, Some Say.” *Wall Street Journal*, October 5, 1998.

Shade, Leslie Regan. *Gender and Community in the Construction of the Internet.* NY: Peter Lang Publishing, 2002.

Schmidt, Charlie. “Exported E-Waste Results in ‘Environmental Wasteland.’” *New Scientist*, February 25, 2002. http://forums.transnationale.org/print.php?t=866&view=previous

Schoenberger, Karl. “Poor Cities in China Collecting E-Waste.” *San Jose Mercury News*, Nov. 24, 2002. http://www.bayarea.com/mld/mercurynews/2002/11/24/news549...

Sheehan, Molly O'Meara , Senior Researcher Worldwatch Institute. “The Hidden Costs of the E-Economy.” July 18, 2003. http://www.worldwatch.org/live/discussion/81/

Smith, Ted, Executive Director of Silicon Valley Toxics Coalition. “Dark Side of High Tech.” *SVTC Action Newsletter,* 1994. http://www.svtc.org/icrt/darkside.htm

Terry, Jennifer and Melodie Calvert, ed. *Processed Lives: Gender and Technology in Everyday Life*. London/NY: Routledge, 1997.

Wakeford, Nina. “Networking Women and Girls: Grrrl Space with Information/Communication Technology.” *Processed Lives: Gender and Technology in Everyday Life.* Ed. Jennifer Terry and Melodie Calvert. . London/NY: Routledge, 1997.

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Homepage: http://www.danwen.com/

Noorderlicht photofestival 2003: http://www.noorderlicht.com/eng/fest03/global/xing/

"Whitney To Present *The American Effect*, A Look At How America Is Seen By Artists Around The World." Press Release, February 2003.
http://www.whitney.org/information/press/118.html

Conner, Jill. "The American Effect." *The Brooklyn Rail*.
http://www.thebrooklynrail.org/arts/sept03/whitney.html