Women and Computer Reticence • Nuclear Guinea Pigs

SCIENCE FOR THE PEOPLE

Vol. 20 No. 4 $2.50

Preserving Our Environment

Preventing Hazardous Waste

Letters

High-Tech Democracy

Dear SftP:

Bravo for publishing Gus Bagakis's "Teaching for a High-Tech Future" (March/April 1988)! Bagakis performed a valuable public service on two fronts. First, he offered three definitions of technology that focus upon the intimate relation between people and machines. Second, he provided a "Bill of Rights for the Use of Technology in Education" that should be read and digested by every art and chemistry teacher.

I am writing a book about the social impact of high technology that explores these issues in depth. *Science for the People* readers can greatly assist my research by giving me specific examples of how, when, and where they are helping to democratize technology.

Thanks for your humane struggle.

—Andre Bacard, Director
Affirmist Institute
P.O. Box 3009, Stanford, CA 94309

Anthology on Women & Cancer

Dear SftP:

I am soliciting manuscripts for an anthology on women and cancer, to be published by Cleis Press in the fall of 1990. Cancer has become an epidemic in the U.S., but unlike the AIDS crisis, the upsurge of cancer seems to be commonly regarded in our culture as an unavoidable misfortune which we as isolated individuals must accept. The general premise of this anthology by and about women who live with (or have had) cancer is that most cancers result from long exposure to a polluted environment, and that the effects of those cancers on our individual lives have social implications.

Among the issues that contributors are invited to address are access to and quality of medical care, support or lack of support from family, friends, community or social institutions, sexuality, self-acceptance, self-image, environmental questions, discrimination towards women with cancer, financial and legal problems resulting from the illness, job-related concerns, and death and dying. We are seeking contributions particularly from women who view their struggle with the disease in a social context.

Contributions of articles, essays, fiction, poetry, and personal narratives are welcome. Please submit two copies, typed, double-spaced, and no longer than 20 pages; include a self-addressed, stamped envelope if you would like your work returned. The deadline is August 1989.

—Judith Brady
62 Sussex St., San Francisco, CA 94131

Empowering Disabled Lesbians

Dear SftP:

A unique effort to link disabled lesbians nationally (and possibly internationally) saw the debut of its premiere issue this summer. *Dykes, Disability & Stuff* is one answer to the dearth of communication among members of this sizable community.

One goal is to put the lesbians', women's, and mainstream disability rights movements on notice that we will be taking our rightful place at the helm of our own destiny. The readers will also be the writers. *Dykes, Disability & Stuff* will be a readers' forum to address the gamut of concerns that women dealing with chronic disabilities are thinking about. My greatest wish is to see us create our own liberation...to make real, without interference or exclusion, the natural abilities with which we came into this life.

Braille and tape copies are available free through the courtesy of the Women's Braille Press, P.O. Box 8745, Minneapolis, MN 55408. Subscriptions for this quarterly newsletter are available on a sliding scale of $8 to $20 a year, and donations to meet publishing costs are needed. Contributions of art, graphics, news, discussions, and letters are welcome.

—Catherine Lohr, Publisher
Dykes, Disability & Stuff
P.O. Box 6194, Boston, MA 02114

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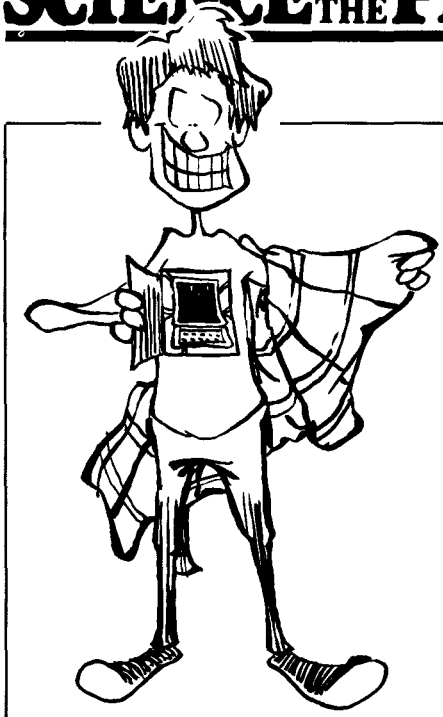

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Newsnotes

BIOWEAPONS PROTESTS HEAT UP

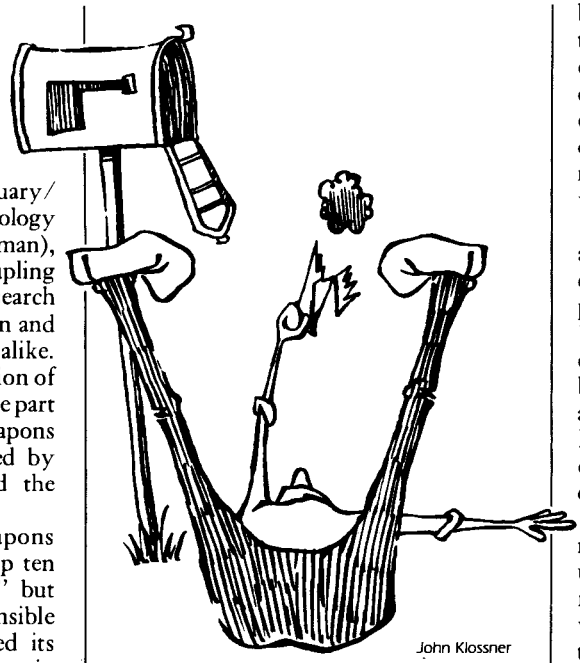
As we reported in the January/February 1988 issue (see "Biology Goes to War," by Seth Shulman), the Reagan administration's quadrupling of funds for biological weapons research is increasingly gaining the attention and ire of scientists and the public alike. Finally, it is also gaining the attention of the mainstream press, thanks in large part to the pledge against biological weapons research that has now been signed by more than 500 scientists around the country.

The issue of biological weapons research was named one of the top ten "censored news stories of 1987," but when the Committee for Responsible Genetics (CRG) publicly unveiled its pledge effort at a news conference in Washington this summer, the story hit the front page. Picked up by hundreds of newspapers around the country, the issue of the military use of biomedical research has finally begun to receive the attention it deserves.

According to the *Los Angeles Times,* Pentagon officials say they expect "no shortage of scientists" willing to accept funds from the Defense Department for biological weapons research. But as public sentiment against the military program grows, the Pentagon's pronouncements may well become less sanguine. Speaking at the CRG press conference, Dr. Jane Koretz of Rensselaer Polytechnic Institute expressed the sentiments of a growing number of scientists when she called the Pentagon's biowarfare funding a "perversion of our work," adding "we do not want our work to be used for purposes that are completely against our goals."

In a related development on the issue, Anthony Frank, the U.S. Postmaster General, announced that he intends to halt all Army shipments of biological warfare agents through the U.S. mails, a practice that the Army has followed for years. "I don't think biological warfare agents should be shipped through the mail, and unless the Army can convince me it's absolutely safe, we aren't going to let them do it," said Frank. As anti-biowarfare sentiment grows, it sounds to us like the Pentagon is going to have an awful lot of convincing to do—and not just to the post office.

—Seth Shulman



John Klossner

EDUCATING FOR ENVIRONMENTAL ACTION

The 1988 drought stimulated public interest in the buildup of "greenhouse" gases in the atmosphere and the effects this increase is having on the planet's climatic stability. There seems to be little doubt in the scientific community that major alterations in climate, like global warming, will continue—even if the burning of all fossil fuels were to stop immediately.

It's obvious that we need to eliminate greenhouse gas emissions as soon as possible. What's less apparent is how to achieve this goal. One organization has risen to the the task of ensuring that citizens are as knowledgeable as possible about the issue so that collectively they can design strategies and actions to stop the global warming trend. The Climate Protection Institute, believing in the value of education "as a means to mitigate the consequences of global warming and as the necessary step in effectively reducing the emissions of greenhouse gases," targets educators, particularly science teachers, with effective learning tools on the greenhouse effect.

One of these is a lesson produced by the National Science Teachers Association. Targeting high school students, the lesson employs two simple activities, utilizing everyday items like a lamp, baking trays, and soda water to illustrate the principles of absorption and reflection of infrared radiation and of carbon dioxide's role in producing the greenhouse effect. The lesson includes clear diagrams of the experiments, a list of materials needed, and background information with references.

The Institute also tackles questions about the social, economic, and political changes needed to cope with the problems of global warming. Its newsletter, *The Greenhouse Gas-ette,* reported on a conference in March 1988 which brought together 35 educators and atmospheric scientists at the Lawrence Livermore National Laboratory. What emerged from the gathering was a curriculum plan designed for grades 6 to 12 to educate students not only on the natural science principles involved in understanding the greenhouse effect and related global problems, but also about what the conferees termed the "science, technology, and society issues" involved in deciding what actions to take.

The conference also produced at least a dozen specific ideas for integrating the curriculum plan into the U.S. educational system. These included holding workshops for teachers and administrators and constructing schematics of the various state department of education to show how the curriculum meets each state's goals for education.

An informed citizenry is an absolutely essential element for any democratic process which attempts to deal with real-world problems. The work of the Climate Protection Institute offers hope that public education can help grapple with the problems of the greenhouse effect, which could be a model and useful strategy for cultivating an educated citizenry on many other urgent issues.

The Climate Protection Institute may be reached at 159 Thomas Paine Avenue, New Rochelle, NY 10804, telephone (914) 235-0223.

—Joseph Regna

ZAPPING ZIPPERS

Here's another innovation from the frontiers of technology: a microwave clothes dryer. No need to do your laundry at the end of a long day at the office anymore—just pop your pants in the micro while you're brushing your teeth, and you'll be off to work in a jiff.

Startup Micro Dry of Tulsa, Oklahoma is looking for a manufacturer to license its invention. Company president Paul

Kantor claims that the microwave will dry clothes 30 percent faster than the old-fashioned model in your basement. Kantor says that his appliance will eliminate wrinkles and shrinkage, those demons that live in many clothes dryers, for a cost 20 percent higher than the dryers now available at conventional department stores.

That truly outmoded drying method, fresh air, also avoids wrinkles and shrinkage. But since it takes up less space than a micro and doesn't even use electricity, do you think there might be a market for it?

HUMAN RIGHTS IN MALAYSIA

Heng Leng Chee, coeditor of the book *Designer Genes: IQ, Ideology & Biology,* was released from jail on August 25, 1988, ten months after she was arrested and detained for criticizing the eugenic social policies of Malaysia's prime minister, Datuk Seri Mahathir Mohamed. Mahathir is a biological determinist who justifies his economic program based on the purported genetic characteristics of the "weak" Malays and the "vigorous" Chinese peoples in Malaysia. (See "Repression in Malaysia" in the March/April 1988 issue of SftP.)

Since last October, Mahathir has jailed critics of his social policies under Malaysia's Internal Security Act. Many of these political prisoners, including Nashir Hashim, chair of the Institute of Social Analysis, are still in detention. But others, including Heng Leng and her colleague in women's development issues, Cecilia Ng, have been released with restraining orders on their movements and freedom of speech.

STUDY LINKS VDTs TO MISCARRIAGES

Researchers at the Northern California Kaiser Permanente Medical Care Program in Oakland found a doubling of miscarriages among office workers who used video display terminals for more than 20 hours a week during the first three months of pregnancy over those performing non-VDT work. They also found a 40 percent increase in birth defects among babies born to women who used VDTs more than five hours a week, although that finding was not termed statistically significant because the total number of birth defects was too small.

The study involved 1,583 women who attended three Kaiser Permanente obstetrics and gynecology clinics from 1981 to 1982. Authors Marilyn Goldhaber, Michael Polen, and Robert Hiatt published the results of their epidemiological study in the June 1988 issue of the *American Journal of Industrial Medicine.* They called for large cohort studies of working women to provide objective measures of VDT exposures, ergonomic design factors associated with health problems, and job stress.

"The VDT-pregnancy issue needs more research," Goldhaber stated in the July/August 1988 issue of *VDT News.* "Not much is known about low-frequency, low-intensity magnetic fields, so we can't rule them out, nor can we eliminate the possibility that poor working conditions are responsible," she continued.

The Kaiser study was not designed to determine the causes of miscarriages and birth defects among VDT operators. But previous research has linked weak electromagnetic fields emitted by VDTs to fetal abnormalities. One Swedish study reported that offspring of mice exposed to simulated VDT fields had a statistically significant increase in serious malformations, and another study reported a significant rise in fetal deaths. A study funded by the U.S. Office of Naval Research reported that extremely small electromagnetic fields, similar to those emitted by VDTs, cause abnormalities in chick embryos.

Previous studies of pregnant VDT workers have linked miscarriages and birth defects to computer use, but researchers have dismissed the significance of their findings based on chance or possible recall bias: women who experienced miscarriages, problem pregnancies, or babies born with birth defects may have overreported their VDT exposures, and those with normal pregnancies and births may have underreported their exposures. Other researchers could not separate VDT exposures from other health factors, such as smoking and stress.

In addition to epidemiological studies, many clusters of miscarriages and birth defects have been reported among women who use computers. According to the Council on Scientific Affairs, half of the ten million people who used VDTs at work in 1987 were women of childbearing age. More than 15 million VDTs are used in the U.S., and about three million new computers are manufactured a year, contributing to an increase in health risks for a growing workforce of VDT users.

"There have been warnings that we now live in a world flooded with non-ionizing radiation, the long-term effects of which are largely unstudied," said Dr. Irving Selikoff of the Mt. Sinai School of Medicine, who is the editor-in-chief of the *American Journal of Industrial Medicine.* "Some of the most serious potential effects are reproductive hazards; the last ten years have seen hints that these may occur with VDT radiation," he continued.

Selikoff, along with researchers Michele Marcus and Philip Landrigan, is completing the pilot phase of the only prospective pregnancy study of reproductive health and VDTs. These scientists have been seeking funds for a full study since 1985. Lack of research funds and the belief by federal agencies and the American Medical Association that electromagnetic fields pose no threat for pregnant women have thwarted studies on the health effects of non-ionizing radiation on VDT users in the U.S. But according to Selikoff, "There are few research areas that deserve more urgent priority."

If there is a link between reproductive

John Klossner

hazards and VDT electromagnetic fields, the risk is probably greater than that suggested by the Kaiser study. That's because the highest fields are at the sides and rear of the VDT monitor. So the hours an operator sits in front of a screen may not be the best measurement of exposure. Workers who sit beside or in back of computers are exposed to electromagnetic fields from other VDTs. "Exposure can be dependent on office seating arrangements and coworkers' use of the machines. This fact, however, would only weaken our ability to detect any effect related to non-ionizing radiation," the Kaiser researchers report.

Responding to VDT health problems not related to problem pregnancies, legislators in Suffolk County, New York have enacted the first law regulating private employers' use of VDTs in the United States. The law focuses on ergonomic issues by requiring adjustable equipment and work stations, regular breaks from VDT work, improved lighting, and annual eye exams for employees. The law was won over the objections of county executives, high-tech companies, and manufacturers in the area.

—Leslie Fraser
information from VDT News

WHY THE ARMY IS SICK

Why do Army trainees get sick? It may be due to the poor indoor air quality in the barracks and not the Army food, according to researchers at the Walter Reed Army Institute of Research. Reporting in the *Journal of the American Medical Association* on April 8, 1988, Dr. John Brundage and his associates concluded that modern barracks designed for increased energy efficiency in the 1970s and 1980s have resulted in a 50 percent increase in acute respiratory diseases among Army trainees.

They compared trainees living in modern barracks with those living in older barracks, which have a significantly larger amount of fresh air. Between October 1, 1982 and September 1, 1986, the trainees in the modern barracks had 2663 more respiratory illnesses than those in the older barracks, costing the Army considerable money in medical bills and lost time. Could this be another way to cut the military budget?

—Scott Schneider

MORE POLLUTION FROM THE PENTAGON

More than a year since our "Pollution and the Pentagon" cover story (see the May/June 1987 issue of SftP), the U.S. military is coming under sharp attack from other quarters for its handling of hazardous and radioactive waste at its federal facilities. A recent congressional report cited a long list of blatant violations of federal hazardous waste laws by the U.S. government at its Department of Defense (DOD) and Department of Energy (DOE) installations. A separate two-year study by a public interest group targets what it terms a "massive radioactive contamination crisis" at DOE facilities which produce nuclear weapons.

The congressional report highlights several environmental atrocities. Among these are the Army's Picatinny Arsenal in New Jersey, where trichlorethylene (TCE) has been found in groundwater at levels 5,000 times higher than the maximum acceptable levels set by the Environmental Protection Agency (EPA). Also cited by the report is the McClellan Air Force Base in Sacramento, California, where similarly high levels of TCE and also unacceptable levels of arsenic, barium, cadmium, chromium, and lead have been found in a municipal well system that serves 23,000 people in the area. Twelve nearby wells have been shut to date.

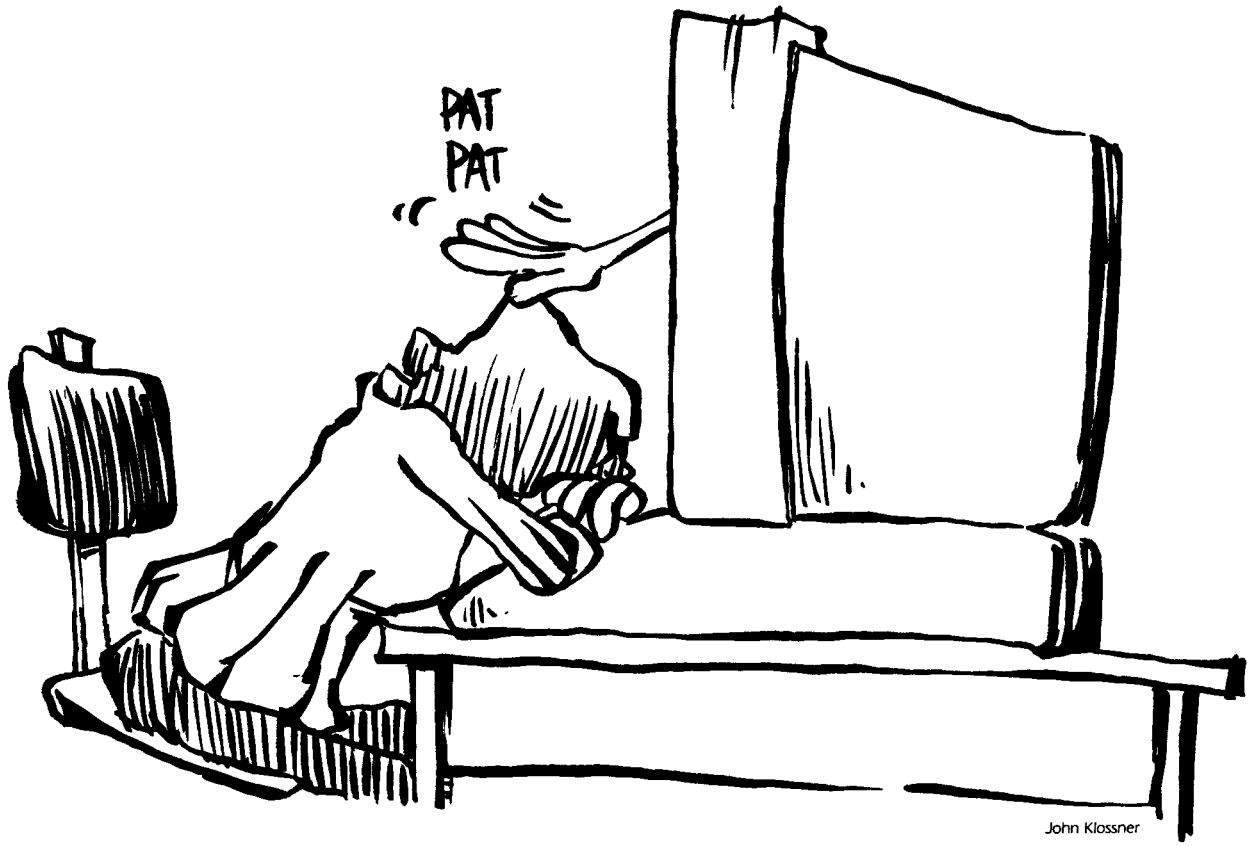
In addition to finding high levels of contamination, the congressional report strongly criticizes the defense and energy departments for their failure to comply with EPA cleanup orders. In one case cited, involving an Army installation in New Mexico, nearly three years have elapsed with little or no action since cleanup was mandated. Rep. John Dingell (D-Michigan), who chairs the House subcommittee which released the report, calls military facilities "among the worst violators of our hazardous waste laws," and adds that "the [Defense] Department's attitude varies between reluctant compliance and active disregard for the law."

As the congressional report notes, the EPA does not have the same leverage over federal agencies that it does with private firms in violation of environmental laws. While the EPA's enforcement problems often involve DOD facilities,

the report found similar noncompliance at DOE installations. For example, the Department of Energy's nuclear fuel processing center in Fernald, Ohio reportedly dumps 109 million gallons of highly radioactive wastes into storm sewers illegally every year. The report finds that four years after uncovering such serious violations, DOE has yet to even finish installing a groundwater monitoring system to analyze the extent of the problem. (See Scott Schneider's "Fighting Radiation Hazards in Fernald, Ohio" in the September/October 1985 issue of SftP.)

Glaring violations of environmental laws at DOE nuclear facilities were the specific focus of a second report issued recently by the Radioactive Waste Campaign, based in New York. The group's study, titled *Deadly Defense: Military Radioactive Landfills,* claims to be the first independent analysis of the environmental impact of the entire nuclear weapons complex. Among the group's findings are that serious levels of radioactive pollution exist at all sixteen of the nation's major nuclear weapons production facilities, and that the total cleanup cost may be even higher than the DOE's estimate of $100 billion.

—Seth Shulman



COMPUTATIONAL RETICENCE

Why Women Fear the Intimate Machine

BY SHERRY TURKLE

The computer has no inherent gender bias. But the computer culture is not equally neutral. This essay looks at the social construction of the computer as a male domain through the eyes of women who have come to see something important about themselves in terms of what computers are not.

There is much talk about women and "computerphobia." My research suggests that women's phobic reactions to the machine are a transitional phenomenon. There is the legacy of women's traditional socialization into relationships with technical objects, for many of them best summed up by the admonishment, "Don't touch it, you'll get a shock." There is the legacy of a computer culture that has traditionally been dominated by images of competition, sports and violence. There are still computer operating systems that communicate to their users in terms of "killing" and "aborting" programs. These are things that have kept women fearful and far away from the machine. But these are things that are subject to change. More persistent are reactions that touch another and deeper set of issues. I believe that the issue for the future is not computerphobia, needing to stay away because of fear and panic, but rather computer reticence, wanting to stay away because the computer becomes a personal and cultural symbol of what a woman is not.

Since 1976 I have been involved in studies of computers and people using a methodology both ethnographic and clinical. My concern has been with the detail of people's relationships with computers and with the social worlds that grow up around them. In order to best make the distinction between phobia and reticence I will take my examples from interviews with women who are involved with computers, women who do not fear them but who take their distance in a way that inhibits their creativity, and that ultimately will impoverish the computer culture as well. In particular, I draw my examples from a study of twenty-five Harvard and MIT women taking and succeeding in computer programming courses. And I focus on one women, who here I call Lisa, who speaks in a particularly clear voice to a set of widely shared concerns. The central issue for these competent and talented women is not phobia or lack of ability, but a reticence to become more deeply involved with an object experienced as threatening.

REJECTING THE INTIMATE MACHINE

Lisa is 18, a first-year student at Harvard, and surprised to find herself an excellent computer programmer. Not only is it surprising, but "kind of scary." Most "scary" is protecting her involvement with

Sherry Turkle teaches in the Science, Technology and Society program at the Massachusetts Institute of Technology. She is the author of The Second Self: Computers and the Human Spirit.

computers from the idea of seeing herself "as a computer science type."

> "You know, the typical stereotype; I had a home room in high school that just happened to be the math lab and there were these little kids who walked around with pants that were too short and they had little calculators with all these fancy functions and they wore them on their belt and they played chess incessantly and talked about their gambits and the things they were doing in their advanced calculus courses and all the great hacks they were doing on the computer; and they were always working with their machines. I was contemptuous of them. They stayed away from other people. They took the computers and made a world apart."

Women look at computers and see more than machines. They see the culture that has grown up around them and they ask themselves if they belong. And when, in high school and college, they look at the social world of the computer expert, they see something that seems alien. At the extreme, they see the social world of the "hacker," a culture of computer virtuosos. It is a world, predominantly male, that takes the machine as a partner in an intimate relationship.

The computer is a medium that supports a powerful sense of mastery. As people develop their mastery of things and their relational skills with people, most strike a balance. They balance the need for mastery of skills and concrete materials with the desire to do things with people where the results are never as clear. For some people, striking this balance becomes a difficult struggle. Relationships with people are always characterized by ambiguity, sexual tension, the possibilities for closeness and dependency. If these are felt as too threatening, the world of things and the world of formal systems becomes increasingly seductive. They turn to formal systems in engineering, in chess, in mathematics, in science. They turn to them for their reassurance, for the pleasures of working in a microworld where things are certain and "things never change unless you want them to." In other words, part of the reason formal systems are appealing is because they provide protective worlds.

Pride in mastery is a positive thing. But if the sense of self becomes defined in terms of those things over which one can exert perfect control, the world of safe things becomes severely limited—because those things tend to be things, not people. Mastery of technology and formal systems can become a way of masking fears about the self and the complexities of the world beyond.

This pattern of using formal microworlds as protective worlds existed long before computers were dreamed of. But the computer offers some new possibilities. The computer offers its users a formal system, but it is also active and interactive. It is easily anthropomorphized. Its experts do not think that it is "alive." But it is a medium onto which lifelike properties can be easily projected. It supports the fantasy "that there is somebody home." It is, of course, only a machine, but because of its psychological properties it supports an experience with it as an "intimate machine."

When people fear intimacy, they are drawn to materials that offer some promise, if not for a resolution of their conflict between loneliness and fear of intimacy, then at least for some compromise. The computer offers this promise. It offers the promise of perfect mastery. And in its activity and interactivity, it offers the illusion of companionship without the demands of friendship (Turkle 1984).

Computers become particularly seductive at a certain moment in psychological development: the moment of adolescence. There are new sexual pressures and new social demands. The safe microworlds the child has built—the microworlds of sports, chess, cars, literature, music, dance, or mathematical expertise—can become places of escape. Most children use these havens as safe platforms from which to test the difficult waters of adolescence. They move but at their own pace. But for some, the issues that arise during adolescence are so threatening that the safe place seems like the only place. They come to define themselves in terms of competence, skill, in terms of the things they can control. It is during adolescence that the "hacker culture" becomes born in elementary schools and junior high schools as predominantly male—because, in our society, men are more likely than women to master anxieties about people by turning to the world of things and formal systems.

In high school, Lisa saw young men around her turning to mathematics as a way to avoid people and describes herself as "turning off" her natural abilities in mathematics. "I didn't care if I was good at it. I wanted to work in worlds where languages had moods and connected you with people." And she saw some of these young men turning to computers as "imaginary friends." She decided to avoid them as well. "I didn't want an imaginary friend in a machine. If I was going to be alone, if I needed to withdraw, well, then I wanted to read, to learn about human psychology by reading about it, if I didn't always have the courage to learn about other people by being with them."

The computer is rejected as a partner in a "close encounter." When women are introduced to it in cultural contexts where the most successful users seem to "love the machine for itself," they define themselves as relational women in terms of what the "serious" computer users are not. Although hackers are a small part of the general population, the culture of young male programming virtuosos tends to dominate the computer cultures of educational institutions from elementary schools to universities. Hackers are not great in their numbers, but they are visible, dedicated and expert (Kiesler *et al.* 1984; 1985; Turkle 1984).

THE NEGATIVE IMAGE OF THE HACKER

The hacker's relationship with computers is often characterized by a violent form of risk taking. This violence is not physical, rather it is psychological: there is intensity, turbulence, aggression. There are the pleasures of flirting with destruction. The hacker at his computer constantly walks a narrow line between "winning" and "losing." Hackers talk about complex computer systems as places where you can let things get more and more complicated, until you are on the edge of being out of control, but where the pleasure is in the challenge of being able to pull them back.

Joe is 23. He has dropped out of a computer science degree program in order to devote himself more fully to MIT computers. He contrasts his love for the violin ("it can only do so much and your fingers can only do so much") with the limitless possibilities of the computer.

> "With programming, whatever you think of—and you are always thinking of something—it can be immediately translated into a challenge. That same night. You can set yourself up to do it some really esoteric, unusual way. And you can make a deal with yourself that you won't be satisfied, that you won't eat or go out or do anything until you get it right. And then you can just do it. It's like a fix. I couldn't get that kind of fix with the violin. I could be obsessed, but I couldn't get the high."

With the computer as your medium there is no limit to how much you can flirt with losing in your pursuit of winning. There is no limit to the violence of the test. The computer becomes a medium for playing with the issue of control by living on the narrow line between having it and losing it. MIT hackers call this "sport death"—pushing mind and body beyond their limits, punishing the body until it can barely support mind and then demanding more of the mind than you believe it could possibly deliver.

Anthony, 20 years old, an MIT senior, is a computer hacker who is very aware of the pleasures of sport death and its lack of appeal for women.

> "Computer hacking is kind of masochistic. You see how far you can push your mind and body.... Women tend to be less self-destructive—hackers are somewhat self-destructive. They don't take care of their bodies and are in general, flunking out. Burnout is common. Women are not so into sport death; they are more balanced in their priorities. The essence of sport death is to see how far you can push things, to see how much you can get away with. I generally

John Klossner

wait until I have to put in my maximum effort and then just totally burn out."

There are very few women hackers. Though hackers would deny that theirs is a macho culture, their preoccupation with "winning" and with subjecting oneself to increasingly violent tests makes their world peculiarly male in spirit. There is, too, a flight from relationship with people to relationship to the machine—a defensive maneuver more common to men than to women.

The hacker's relationship with the computer is filled with technical risks, but it gets much of its emotional charge because it offers respite from personal ones. Hackers talk a lot about "getting burned." Because if you are primarily motivated by a need to feel in control, "getting burned" is one of the worst things that can happen to you.

Anthony has "tried out" having girlfriends:

> "I used to get into relationships that usually led to me getting burned in some way.... With computers you have confidence in yourself and that is enough. With social interactions you have to have confidence that the rest of the world will be nice to you. You can't control how the rest of the world is going to react to you. But with computers you are in complete control."

Sex and romance are desirable, but they are risky. "Sport death" is risky too, but it is a special kind of risk where you assume all the risk yourself and are the only one responsible for saving the day. It is safe risk. Anthony sees sex and romance as another, more disturbing kind: "Hacking is safe in that you are in complete control of your computer world, and sex and relationships are risky in that the rest of the world has control."

Anthony compares human relationships to the sense of accomplishment and control that he can get from a machine. This does not mean that he sees machines as a "substitute" for women. But he is not sure that he can function in the worlds where you can get burned.

The men in the hacker culture see it as incompatible with a life with women. "Computer hacking is almost pure pleasure with very little risk. But it is not as fulfilling as romance because in the end you have just made a few lights blink. But you only have so much energy. You can either spend it on computers or you can spend it on people." The women who watch these men observe their obsessions, observe their antisensuality, observe the ways in which they have put things rather than people at the center of their lives and count themselves out. This does not mean that these women are not computer-competent. But along with their competence comes a fear of the machine as a potentially destructive force.

Robin is a sophomore at Harvard, a musician who has gone through much of her life practicing the piano eight hours a day. But she rebels against the idea of a relationship with the computer. She doesn't want to belong to a world where things are more important than people.

> "I saw people being really compulsive but really enjoying it. I saw that these guys sort of related to their terminals the way I relate to the piano and I thought, maybe I can do that too. I saw all these people running around with the same intensity as I have with the piano and they tell me that I'll probably be good at computers. These are the guys who are helping me do this course. And they keep telling me, yes, you're going to be real good at it. Don't worry about it, but you're going about it in the wrong way. They tell me I'm 'not establishing a relationship with the computer.' And to me that sounds gross. It is gross to me, the way these guys are. I don't like establishing relationships with machines. I don't like putting it that way. Relationships are for people."

I ask Robin to talk to me about her relationship with her piano, a machine, but she insists that it was a completely different thing. The piano took her away from people, but then it brought her closer to them. The involvements of her male peers with the computer only shut people out. "These guys are incredibly drained. You can't talk to them. I don't want to be part of their world."

> "I know this guy, this computer person. He never had a friendship at Harvard. He'd come to breakfast saying that he'd stayed up all night with his terminal and he got frustrated and burned out but he seemed to enjoy it somehow. It was better for him, I guess, than staying up all night talking to a friend. That seems really sad. There's a lot of communication going on around here. People stay up all night talking to friends. But, Mike would not do that. He managed with his terminal."

How does the hacker look to non-hacker men? Many men are critical of the hacker's single-minded devotion to computers, critical of his lack of social skills. Men's reactions to the computer are similar to those of women, but there is a difference in men's reaction to the hacker's style of exploring the machine in a manner close to abandon and which celebrates it. Men identify with it. They recognize it as a learning strategy which they find admirable and of which they are capable. Women tend to be more defensive.

FIGHTING AGAINST COMPUTER HOLDING POWER

The computer is a "psychological machine." On the border between mind and not mind, it invites its anthropomorphization, its psychologization. It does this almost universally, for children and grown-ups, men and women, novices and experts. This does not mean that people see it as "alive," but rather, there is a pull to psychologize the machine, to give it an intellectual and aesthetic personality. The computer facilitates a relational encounter with a formal system.

I have found that many women are drawn towards a style of programming that is best characterized as such a relational encounter (Turkle 1984; in press). It is marked by an artistic, almost tactile style of identification with computational objects, a desire to

"play with them" as though they were physical objects in a collage. A fluent use of this programming style can be a source of creativity. But many women fight against something that needs to be distinguished from programming style. They fight against the computer as psychologically gripping. They experience anthropomorphization as seductive and dangerous. Paradoxically, in rebellion against feeling "too much" they develop an attitude towards the computer that insists it is "just a tool."

The "just a tool" response is widespread in our culture. It is certainly not associated primarily with women. But I believe that when women use it, it is with a special force; particularly strong feelings stand behind their insistence on the "neutrality" of the technology.

First, insisting that the computer is just a tool is a defense against the experience of the computer as the opposite, as an intimate machine. It is a way to say that it is not appropriate to have a close relationship with a machine. Computers with their plasticity and malleability are compelling media. They have a psychological "holding power." Women use their rejection of computer holding power to assert something about themselves as women. Being a woman is opposed to a compelling relationship with a thing that shuts people out.

Contemporary writing about women's psychological development stresses the importance of connection in the way women forge their identities. Women are raised by women. Unlike men, they do not need to undergo a radical break to define their sexual identity. Unlike men, they are allowed, even encouraged to maintain a close relationship with the woman, the mother they had an early experience of the closest bonding. Girls grow up defining their identity through social interaction; boys, through separation (Chodorow 1978; Gilligan 1982; Keller 1983; 1985).

The boy's experience of early separation and loss is traumatic. It leads to a strong desire to control his environment. Male separation from others is about differentiation but also about autonomy, "the wish to gain control over the sources and object of pleasure in order to shore up the possibilities for happiness against the risk of disappointment and loss" (Gilligan 1982, 46). Women grow up differently. Men "shore up possibilities for happiness" by autonomy, rules and hierarchy; women look to affection, relationships, responsibility and caring for a community of others. In *In a Different Voice,* Carol Gilligan talks about "the hierarchy and the web" as metaphors to describe the different ways in which men and women see their worlds. Men see a hierarchy of autonomous positions. Women see a web of interconnections between people. Men want to be alone at the top; they fear others getting too close. Women want to be at the center of connection; they fear being too far out on the edge. Men can be with the computer and still be alone, separate and autonomous. When women perceive this technology as demanding separation, it is experienced as alien and dangerous.[1]


John Klossner

Lisa began her work with computers by thinking in terms of communicating with them, "because that's the way I see the world." But her communication metaphor began to distress her: "The computer isn't a living being and when I think about communicating with it, well that's wrong. There's a certain amount of feeling involved in the idea of communication and I was looking for that from the computer." She looked for it, and she frightened herself: "It was horrible. I was becoming involved with a thing. I identified with how the computer was going through things."

> "Wait a minute, a machine doesn't go through things; going through things is a very emotional way of talking. But it is hard to keep it straight. It seems to you that they are experiencing something that you once experienced. That they are learning something and you lose sight of the fact that this whole ability...I don't even want to say the computer's ability. I don't like anthropomorphizing; I fight very hard against attributing emotions to that machine."

For Lisa, success with the computer has meant a process of alienation from it. Her efforts go towards depersonalization, towards developing a strategy towards computers that is "not me." "I need to become a different kind of person with the machine." This is a person who commands rather than communicates.

When Lisa psychologized the machine and thought of programming in terms of communication, she was responding to the computer as many people do. The computer responds, reacts, "learns." And the machine allows you to externalize your own thought. As one 13-year-old told me: "When you program a computer you put a little piece of your mind into the computer's mind and you come to see it differently." The experience is heady and encourages anthropomorphization.[2] But if Lisa's impulses to psychologize the computer were commonplace, her reaction to them was more typical of women than men—to rebel against the feeling of mind speaking to mind, almost to punish herself for it: "You are working with the computer and you can almost identify with what a computer is going through. But then, that is awful. It's just a machine. It was horrible. I was becoming involved with a thing."

Lisa's "identification with what a computer is going through" is an identification with the computer as a mind. The computer is an "evocative object" (Turkle 1984). It upsets simple distinctions between things and people; there can no longer be simply the physical as opposed to

the psychological. The computer, too, seems to have a psychology—it is a thing that is not quite a thing, a mind that is not quite a mind. By presenting itself as an object "betwixt and between," the computer provokes reflection on the question of minds and machines. Very soon after meeting a computer, even the novice programmer learns to write programs that he or she perceives as more complex than the rules used to create them. Once people build these kinds of rule-driven systems, questions about the relevance of the idea of program to the working of one's own mind acquires a new sense of urgency.

ROMANTIC REACTIONS

The position toward which children tend as they develop their thinking about people in relation to computers is to split "psychology" into the cognitive and affective, into the psychology of thought and of feeling (Turkle 1984). And then they can grant that the machine has intelligence and is thus "sort of alive," but distinguish it from people because of its lack of feelings. Thus, the Aristotelian definition of man as a "rational mind" (powerful even for children when it defined people in contrast to their nearest neighbors, the animals) gives way to a different distinction. Today's children "appropriate" computers through identification with them as psychological entities and come to see them as their new "nearest neighbors." And they are neighbors which seem to share in or (from the child's point of view) even excel in our rationality. People are still defined in contrast to their neighbors. But now, people are special because they feel. Children will grant the computer a "sort of life," but what makes people unique is the kind of life that computers don't have—an emotional life.

Many adults follow the same path as do children when they talk about human beings in relation to the new psychological machines. This path leads to allowing the possibility of unlimited rationality to computers while maintaining a sharp line between computers and people by taking the essence of human nature to be what computers can't do. This is precisely what Lisa does when she confronts the machine that seems to have a mind:

> "I suppose if you look at the physical machinery of the computer mind, it is analogous to the human mind. We were looking at a bare machine and how all the little wires could be compared to neurons. So, in that sense, yes, the hardware is the brain and I can see how the software could be the mind. But, the saving grace, the difference is emotion. Now I haven't heard anybody yet reduce emotions to a series of electrical impulses. I hope I never do. And I think that's the line you can draw. That's where you can say, 'We can emote, this thing may be able to do something like thinking, but it can't love anybody.' "

The Freudian experience has taught us that resistance to a theory is part of its cultural impact. Resistance to psychoanalysis, with its emphasis on the unconscious and the irrational, leads to an emphasis on people as ultimately logical beings. Resistance to computers and the ideal of program as mind leads to a view that what is essential in people is what is ineffable, uncapturable by any language or formalism. For Robin, people have "great flashes of abstract thought without any logical sequence before it. If you tried to do that with a computer it would tell you it's a system error or illogical! People have two ways of thinking—one of them without logical steps. The computer only has one." Lisa boils down what computers can't do to a starker form. Most simply stated, it is love.

There is a "romantic reaction" to the computer presence. As people take computers seriously as simulated mind, they resist the image of the human mind that comes back to them in the mirror of the machine. Simulated thinking may be thinking, but simulated love is never love. Women express this sentiment with particular urgency. It is more than philosophical opinion. A conflict stands behind their conviction. The more they anthropomorphize the machine, the more they express anxiety about its dangers. The more it provokes them to reflect on mind, the more they assert that the computer is just a neutral tool for getting from A to B. In sum, the more they experience the subjective computer, the more they insist that it doesn't exist and that there is only the instrumental machine.

RETICENCE ABOUT FORMAL SYSTEMS

Lisa reacted with irritation when her high school teachers tried to get her interested in mathematics by calling it a language. "People were always yakking at me about how math is a language—it's got punctuation marks and all that stuff. I thought they were fools and I told them so. I told them that if only it were a language, if only it had some nuance, then perhaps I could relate to it."

Lisa's reticence has many facets, but she keeps coming back to two themes. First, formal systems don't bring people together, they rupture what Gilligan called the "web of connectedness" that dominates women's way of seeing the world. Second, formal systems allow for "only one way" of doing things.

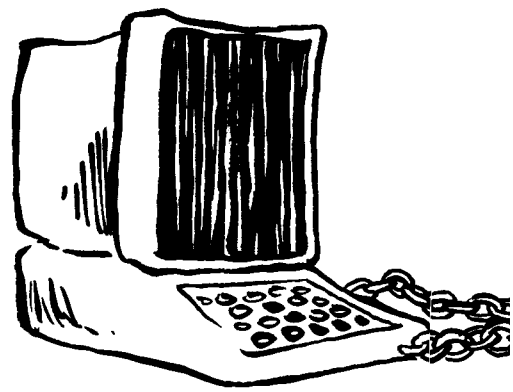
> "When they used to talk to me about mathematics as a language I would say, 'Well, look, if I were speaking Spanish, I could say that thirty million different ways.' Here, it's either right or it's wrong and that's it. And I don't like the regimentation."

Lisa dislikes anything where there is "only one way." She loves language for its "shades of meaning." Ambiguity and nuance make her feel at home. Erik Erikson, writing from within the psychoanalytic tradition, has suggested how women's experience of their bodies as an "inner space" that is hidden, diffuse and ambiguous affects their experience of the world (Erikson 1963). The "nailed down" quality of formal systems feels unfamiliar and threatening.

Clearly, women's feelings about formal systems go deep. Erikson's work on body image suggests a terror of the nonambiguous; Evelyn Fox Keller's work on women and science suggests that women's early and (relative to men) unruptured experiences with closely bonded relationships alienates them from the traditional "male" stance toward formal systems, a stance characterized by the separation of subject from object (Keller 1985).

The issues that are raised by looking at gender and formal systems are complex, but something about the computer's contribution is becoming increasingly clear. When people are put in computer-rich environments, supported by flexible and powerful programming languages, and encouraged to use the computer as an expressive material, they respond in a diversity of styles. In such environments, the computer, like other powerful media including paints, pencils and words, becomes a screen for the projection of differences. Unlike stereotypes of a machine with which there is only one way of relating, the computer can be a partner in a great diversity of relationships.

People make the computer their own in their own way. For example, some take to the computer in a way that emphasizes planning and structure. Others naturally move toward a different style. They prefer to "grow" their programs from small elements, often changing their goals as they go along. The programs that result from using these two styles can be equally effective, clear and easy to use. The difference is not in the product but in the process of creation. With the computer, there is not "one way." On the contrary, the range of styles of appropriation suggests the metaphor "computer as Rorschach" (Turkle 1980). Like the Rorschach inkblot



test, the computer presents an ambiguous material that encourages the projection of significant inner differences.

In relatively unconstrained settings, the computer facilitates a new basis for engagement in technical and mathematical thinking, one that allows for their appropriation through a "close encounter" with an interactive, reactive "psychological machine" and with computational objects that can be experienced as tactile and physical. It is a style that emphasizes negotiation rather than command of computational objects, a style that suggests a conversation rather than a monologue. This is a port of entry into the world of formal systems for many people who have always kept at a distance from them. It is a port of entry with particular significance for women. The computer offers a new cultural opportunity to expand the social base of mathematical and scientific fluency.

But people are not always introduced to computers in a way that exploits this opportunity. In fact, it happens all too rarely. Lisa and Robin are taking an excellent and imaginative introductory programming course, but even there, both of them are experiencing it as a place where they are being told the "one right way" to do things. This "one right way" emphasizes "structured programming" with its aesthetic of control through structure, specification and planning. There is much virtue in this computational aesthetic, but both Lisa and Robin say their learning styles are at war with it. Robin wanted to play with the smallest computational elements and build things from the "bottom up." Lisa was frustrated by the strategy of "black boxing" that helps the structured programmer plan something large without knowing in advance how the details will be managed. Both rebelled against the regimentation of there being "one right way" to do things.

Lisa sums up her computer experience with the word "regimentation." She is afraid of children learning to program because she wouldn't want them equally regimented. She wouldn't want children "tied down to being very careful and very regimented and very concise and syntactically correct." Lisa says that her best moment in her programming course was when she saw, through the computer, something she might have missed in mathematics. "In mathematics I could never see that it didn't have to be just one way. But I can see that a little with the computer. And I am starting to get very excited about that." And then she came back to the question of children with a more optimistic tone: "I think maybe kids could bring, well, they could open up new frontiers for computers, because they have such wild ideas that they could do great things if people just let them."

The children may indeed lead us.[3] The computer that could support "wild ideas" is the computer as an expressive medium. We must ask if the vehemence behind women's insistence that the computer is "just a tool" will be as great when they have greater opportunities to experience it as material which allows highly differentiated styles of mastery and personalizes the world of formal systems for men and women alike.

NOTES

1. From this perspective, computers become much more attractive when they are used to support communications through networks. The question here will be whether particular computer networks bring people together—who would not normally have been together—or whether they "deteriorate" communication—that is, people who would have spoken face to face now speak screen to screen.

2. The holding power of a mind-to-mind connection is there even for the non-programmer. When you use someone else's program, software someone else has written, there is still the fantasy of a mind-to-mind communication between you and the software writer.

3. A leading computer visionary who has long stood for the "personal appropriation" of programming has done much of his work with children. See Seymour Papert, *Mindstorms: Children, Computers and Powerful Ideas,* New York: Basic Books, 1980.

REFERENCES

Chodorow, Nancy. 1978. *The Reproduction of Mothering.* Berkeley: University of California Press.

Erikson, Erik. 1963. *Childhood and Society.* New York: W.W. Norton.

Gilligan, Carol. 1982. *In a Different Voice: Psychological Theory and Women's Development.* Cambridge, Mass.: Harvard University Press.

Keller, Evelyn Fox. 1983. *A Feeling for the Organism: The Life and Work of Barbara McClintock.* San Francisco: W.H. Freeman.

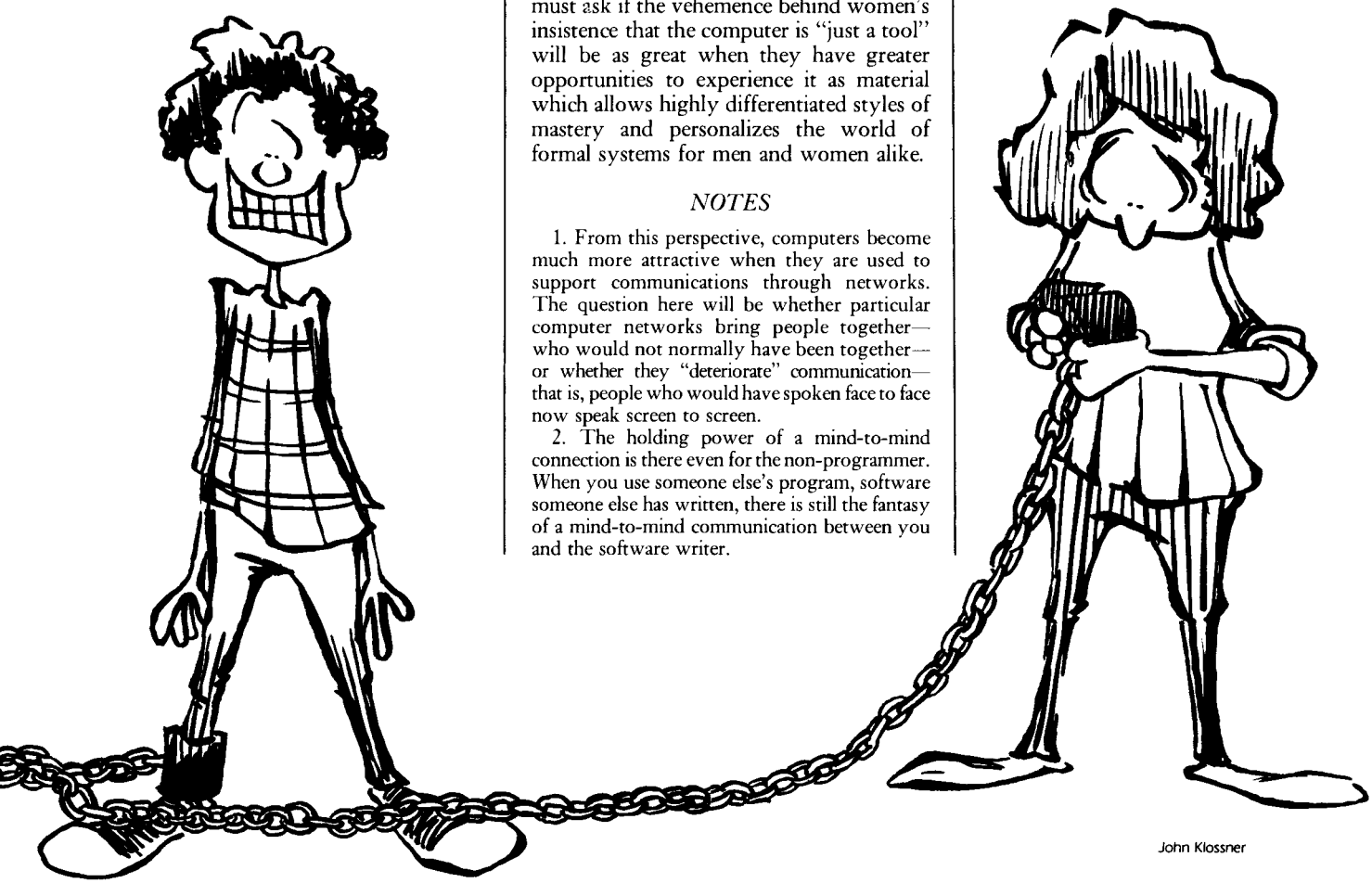
Keller, Evelyn Fox. 1985. *Reflections on Gender and Science.* New Haven, Conn.: Yale University Press.

Kiesler, Sara, Lee Sproull and Jacqueline S. Eccles. 1985. "Poolhalls, chips and war games: women in the culture of computing." *Psychology of Women Quarterly* 9:4, 451-62.

Turkle, Sherry. 1980. "Computer as Rorschach." *Society* 17.

Turkle, Sherry. 1984. *The Second Self: Computers and the Human Spirit.* New York: Simon & Schuster.

Turkle, Sherry. (In press.) "Gender and programming: styles and voices in the computer culture." *Signs.*



John Klossner

Preserving Our Environment

Preventing Hazardous Waste

Suara Welitoff

BY JOEL S. HIRSCHHORN

The subject of hazardous waste never seems to lose steam. Opinion polls repeatedly show that the public is more worried about toxic waste than any other environmental issue. In state elections, almost any referendum calling for action against toxic waste problems succeeds by a large margin.

Recent news about the global environmental consequences of industrial emissions, motor-vehicle fumes, and other uses of fossil fuels through the global-warming greenhouse effect has focused public concern on environmental policies. While the national news media tend to ignore toxic waste issues, except for the scandals, at the local level there is a continuous stream of news stories. Contaminated drinking water, medical wastes and raw sewage washed up on public beaches, leaking landfills, transportation accidents, toxic waste dump discoveries, violations of government regulations, and costly but seemingly ineffective attempts to clean up Superfund sites make headlines in communities across the country.

Much of the public-policy debate on toxic waste concerns siting: attempts to situate, grant permits, and operate hazardous-waste management facilities of any kind, from landfills to incinerators, sea-bound barges, and storage and handling facilities. The public is unwilling to accept almost any environmental risk to their health and well-being. The burden on those who want to locate hazardous-waste management facilities is enormous. No amount of risk assessment, mediation, and economic incentives is likely to erase strong public opposition to siting facilities where they may endanger any community.[1]

The irony is that most people fail to recognize our traditional proclivity to deal with environmental problems *after* we've created them. The history of environmental

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protection policy in the United States has been largely one of reactive crisis management. The environmentalism of the 1960s focused on government regulations to force industry—but not consumers—to deal with pollutants and wastes after they are created. Public policy has used one tool above all others: command and control regulations that deal with "end-of-pipe" pollution. We have been preoccupied with putting pollutants and wastes in "black boxes," somewhere between the point where they are created and the point where humans are exposed to them.

There is a sizable pollution-control industry that has arisen to help industry cope with the increasing numbers of environmental regulations. National spending on the environment has followed regulation: today, the U.S. spends about $10 million annually for every page of federal environmental regulations. And these historic trends seem likely to continue—the more we regulate, the more we'll spend.

FROM DISPOSAL TO REDUCTION

For more than a decade, policy makers from government, industry, and environmental groups have come up with the same hierarchy for dealing with hazardous waste. In a policy statement published in the *Federal Register* in 1976, the Environmental Protection Agency (EPA) agreed that waste reduction—not generating pollutants in the first place—should be the preferred first option for waste management.[2] The treatment or "black-box" approach is in the middle: using technology to convert, destroy, or detoxify waste, so as to reduce risks to health and the environment. At the bottom of the hierarchy lie land disposal and other methods of placing waste directly into the environment, including dumping it in the ocean or enclosing it in salt domes.

The irony is that most wastes have been managed in what policy makers agree to be the worst way: they've been put directly into the environment. But in the last several years there has been an enormous public movement to limit the use of land disposal. This movement has followed, first, the discovery of uncontrolled and often abandoned toxic-waste burial sites that posed threats to health and the environment and had to be cleaned up. Love Canal, the community in New York that had to be evacuated because of severe health problems and deaths attributed to toxic waste, spurred the nation's multibillion-dollar Superfund cleanup program.[3]

Second, contaminated drinking water, discovered in the taps of more and more households and communities every year, has also fueled the opposition to waste burial. These two consequences of land disposal have created a potent public backlash toward all toxic-waste facilities.

With the 1984 amendments to the Resource Conservation and Recovery Act (RCRA), Congress took explicit action to severely constrain land disposal methods, following the lead of several states. But from a public-policy perspective, we have only moved up one rung on the ladder of preferred waste-management options to the treatment or "black-box" approach. We're still avoiding the best option—waste reduction.

In the RCRA amendments, Congress directed the Environmental Protection Agency to consider the availability of treatment capacity in its decisions to ban land disposal. EPA was not directed to consider the ability of waste generators to reduce their waste with currently available knowledge and technology, and it hasn't taken the initiative to do so.

When it comes to waste reduction, the term used in the RCRA amendments is "waste minimization," and this term encompasses both waste reduction and waste treatment. The amendments make it clear that waste reduction is preferred. Moreover, the legislative record explicitly directed EPA not to intrude into private sector production decisions with regulations prescribing waste minimization.

END-OF-PIPE POLICIES

There is a pivotal difference between waste reduction and both of the other two generic options—treatment and land disposal. The latter remain faithful to the end-of-pipe concept on which our entire environmental protection system was founded. Waste reduction, which everyone agrees in principle to be the best option, is fundamentally different because it prevents pollution, rather than just controlling it. Waste reduction is not simply another attempt at regulatory reform within the pollution-control framework.

Therefore, public opposition to "better" or "high-tech" waste management options, even when they're termed "waste minimization," should come as no surprise. For example, opposition to incineration of wastes increasingly resembles the public's rejection of land disposal. Toxic pollution from incinerators still ends up in the environment.

Although treatment differs from land disposal, and in most cases is probably better environmentally, it is also similar to land disposal in several important ways:

Both treatment and land disposal require effective government regulation, but the history of the effectiveness of the regulatory system is not very satisfying to the public. Two points illustrate this: extremely high levels of noncompliance[4] and large loopholes in which substances or practices viewed as threatening remain unregulated altogether.[5] A good example is toxic air emissions from incinerators, which under the Clean Air Act program remain largely unregulated. (See "Environmental Mismanagement: Frittering Away Air Pollution Controls" by Siddarth Dube in the January/February 1987 issue of *SftP.*)

Both treatment and disposal are vulnerable to the failure of technology, people, and institutions. About ten percent of current Superfund sites were waste treatment or recycling facilities. Moreover, the public has become more aware of the limits and failures of even the most sophisticated technology through spectacular failures, ranging from the NASA space shuttle disaster to the chemical plant accident in Bhopal, India and the Chernobyl nuclear reactor catastrophe. Optimism and fascination about technology may be fading, or at least becoming balanced with skepticism.

Furthermore, both treatment and disposal hold the risk of releases of hazardous substances, with uncertain effects on health and the environment. Although there is a continuing attempt by environmental policy makers to use risk assessment to educate and convince the public that specific risks may be acceptably low, there is little reliable data to plug into risk assessments.

Data inadequacies create a dependence on theoretical models that are complex enough to be incomprehensible to the public, but also so simple that they are inaccurate. The public must depend on the experts to find out what risk assessments mean, but the public increasingly distrusts experts and knows that "expert" judgments influence the results of health risk assessments. (See "Risk: Another Name for Danger" by Langdon Winner, and "Assessing Risk: Making Toxics Acceptable" by Joseph Regna in the May/June 1986 issue of *SftP.*)

Therefore, we come to an interesting and uncomfortable point in hazardous-waste public policy. It is based on rejecting the worst option and moving to the middle ground of waste treatment. But as we have seen, waste treatment suffers from some of the same basic flaws of land disposal.

Should we be looking for suitable backyards for waste treatment facilities? Shouldn't we focus on waste reduction and pollution prevention in industrial plants and even in the households where the problem begins? Would investments in waste reduction yield greater environmental and economic benefits than investments in waste treatment? Is it enough to talk about controlled and acceptable risks? Or must the environmental protection system move, just as the health care system has done, to relying more on prevention and less on reaction to environmental hazards?

PUBLIC POLICY CHOICES

Environmental pollution naturally resulted in attempts to use technology to

keep hazardous substances from entering the environment. Traditionally, engineers had assumed that the environment could accept and tolerate wastes generated during industrial production. They made blueprints for industrial plants with arrows showing the wastes going into the air, water, or land.

After society discovered pollution in the air and water and turned to technology to control and collect hazardous or unwanted substances before they entered the environment, the land became the place to dispose of pollutants. Not until 1976 did federal public policy recognize hazardous waste to be a subset of solid waste and establish new regulations to deal with facilities that managed a broad and ill-defined range of wastes. But the RCRA program did not attempt to regulate or limit the generation of hazardous waste.

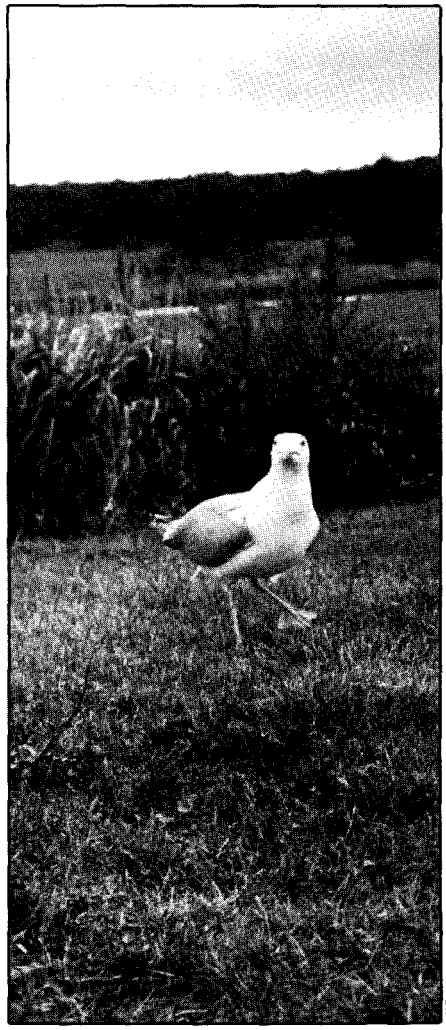
Within the primary environmental statutes—the Clean Air Act, Clean Water Act, Toxic Substances Control Act, and Resource Conservation and Recovery Act—opportunities did exist to pursue waste reduction and pollution-prevention policies. But neither the government, industry, nor organized environmental groups took waste reduction very seriously.[6] Instead, nearly everyone concerned with environmental protection grasped the same choice: end-of-pipe regulations dealing with pollution control.

Industry acquiescence to pollution control rather than prevention proved to be the implicit justification for this choice. Industry sought to keep the government out of its operations as much as possible. As burdensome and unnecessary as pollution-control regulations might have appeared to those in industry, they were preferable to the government dictating what could or could not be done in production or regulating the composition of products.

Environmentalists wanted immediate action: in spite of the difficulties associated with pollution control, it appeared harder to move upstream to regulate the generation of pollutants and wastes. As for the government, examination of statutes and EPA studies shows that the EPA was more interested in prevention than were other environmental policy makers. But the EPA's early interest did not find a constituency.

Only within the past few years has there been an explicit examination of prevention as a fundamentally different public-policy strategy. A series of studies, conferences, and reports have come forth on this subject from organizations including the National Academy of Sciences, Office of Technology Assessment, the research association INFORM, League of Women Voters, Environmental Defense Fund, and the EPA.[7]

Nevertheless, although these reports are optimistic about waste reduction and detail



Suara Welitoff

ways to implement a pollution-prevention strategy, there has been no concentration of political activities, significant news coverage, or crystallization of the issue. There has not been a clear national movement to identify, define, and implement a new public policy choice. Is this situation changing?

THE CHANGING ENVIRONMENT FOR NEW POLICIES

There are several factors that could cause a major redirection of environmental public policy:

• *REGULATORY INEFFECTIVENESS.* There is increased recognition that the current regulatory system is not effective in protecting health and the environment. The result is a widespread loss of public confidence in government agencies charged with environmental protection. Increasingly, environmental problems that might have been prevented or responded to before public health was threatened now invade people's lives. These include asbestos exposures, radon in houses, toxics in drinking water from waste sites and leaking underground storage tanks, lead in products and water, and chemical plant, industrial, and transportation accidents. There seems to be a steady creation of an environmental deficit that is bound to come due.[8] The public is also better informed today about regulatory noncompliance and loopholes, and more quickly notified about threats to their health. Like a wound that has not healed properly, the public is hypersensitive to chemical threats.

• *ECONOMIC INEFFICIENCY.* The precarious national economy and distressed industrial base focus attention on the economic efficiency of the current system. More environmental regulations will cost society more money. The cost-benefit issue becomes more important in decision making. More people are asking questions like: Are we getting our money's worth? Are we paying too high a price for uncertain environmental protection in industrial unemployment, plant closings, and relocations to other nations?

• *INSTITUTIONAL PROBLEMS.* The current regulatory system is increasingly complex and difficult to administer. More and more regulations require more and more information, producing studies that still don't meet public needs. For example, more than ten years after the passage of RCRA, there is still no reliable national data base on hazardous-waste generation and management. Problems in the EPA mean that the legislative and judicial branches are increasingly doing the job of the regulatory agency. More litigation adds to delays. Actions of one part of government often negate those of another.

The current regulatory system is constantly added to as existing regulations appear ineffective or incomplete—but like a soup that started out with the wrong ingredients, it never tastes quite right, no matter how many cooks try to fix it. Moreover, the ever-expanding environmental policy system grows without a strategy or enough information and resources. The federal government shifts responsibility to the states, but most states don't have the resources for implementation. Bureaucratic and institutional gridlock tightens as policy makers respond to the public's demands with more regulations.

• *LIABILITIES.* The private sector faces costly and uncertain long-term environmental liabilities. These cover a wide spectrum: Superfund cleanup costs, civil litigation over injury and damage claims, criminal prosecutions of corporate officials, constraints on future sale of property because of possible toxic contamination, and uninsurable costs of accidents. Small and large companies face increasingly large, unforseen, and debilitating liabilities, threatening the industrial strength of the national economy.

• *ENVIRONMENTAL ACTIVISM.*

Power is shifting away from national organized environmental groups that focus on federal legislation to community and grassroots activism that focuses on influencing local actions and state and local legislation.[9] Current public policies are rejected and community fears and frustration often lead to "negative" solutions—such as blocking the siting of incinerators and other waste-management facilities. Industry asks local citizens, "What is acceptable?" And citizen activists typically answer, "That's your problem!"

Environmental activists seem disillusioned with federal policies and are more inclined to seek political solutions at the community or state level, and they have often been successful in this strategy. However, the solutions they seek are often difficult, if not impossible, to implement when they are contingent upon zero emissions or zero risk. Those solutions seem impossible to industry managers and inconsistent with the products and lifestyles of modern industrial society.

• *TECHNOLOGICAL PESSIMISM.* The public is growing more apprehensive about technology and the human and institutional systems that control it; technological failures get a lot of attention. Technical fixes are increasingly viewed with anxiety and suspicion; this is especially true for hazardous waste technologies.[10] And scientists and engineers are participating in grassroots environmental activities more than ever; communities are demanding government funding to hire independent technical consultants. Indeed, the Superfund law provides such funding.

The public is asking more sophisticated questions about the nature, limitations, and implementation of technological solutions to environmental problems. These questions contribute to delays in reaching agreement on technical solutions, which are evident in the Superfund program and in siting hazardous-waste facilities. Thus, existing problems never seem to get solved and new problems spring up. The market for new and innovative technology grows, and improved technologies are being developed to reduce hazardous-waste production in certain industrial procedures, such as electroplating and degreasing. But demands for even better technology to reach acceptable or zero risk often escalate costs and exacerbate the economic problems discussed above.

FROM CONTROL TO PREVENTION

There appears to be one fundamental shift in environmental public policy that satisfies a number of needs. That is the choice to climb the ladder of environmental protection policies to the highest and best option: pollution prevention.

No one disputes that prevention is the most certain way to reduce (and often remove) threats to health and the environment. Although it is clearly nonsense to suggest that all environmental pollutants and wastes can be avoided, there is convincing evidence that a significant fraction can be cut through waste-reduction measures that are technically and economically feasible now. Moreover, a waste-reduction effort that included all pollutants and wastes, irregardless of how they are regulated now, would provide the comprehensive coverage that has eluded the current system which was built up by addressing one environmental impact at a time.

The economics of pollution prevention are very attractive today because the current regulatory system and multiple liabilities create a stream of increasing costs that can be cut. More fundamentally, industrial spending on waste reduction increases industrial efficiency, profitability, and competitiveness. Data from the 3M company shows a savings of about $300 million from 1975 to 1985 from pollution-prevention techniques that reduced waste generation by 50 percent. The savings amounted to about a five-percent increase in 3M's net income over that period. So pollution prevention is a way for companies to cut their environmental spending even as regulations increase: 3M continues to work at reducing waste.

The institutional problems discussed above clearly would benefit from a shift to pollution prevention. Government regulatory agencies would have less to regulate. It is difficult to imagine any other action that would lighten the demands of government institutions so much, even if there are more regulations created to cover more substances and situations.

The environmental activism of today has not yet fully embraced pollution prevention as a principal strategy, in part because the media and public education have not paid much attention to this alternative. Environmentalists have been busy cleaning up and opposing immediate threats, and it has been easy to put off thinking about a new preventive strategy that can't do anything about the hazards we've already inherited.


Suara Weltroff

But there is also fear that a focus on pollution prevention might weaken the current regulatory system or sap resources for its implementation and enforcement. Even though current regulations may be less effective than many of us would like, some environmentalists are apprehensive about waste reduction, especially if it is a *voluntary* industrial effort. And almost every study of waste reduction has pointed out how impractical it would be to use a traditional regulatory approach.

Nevertheless, there is evidence that environmental activists increasingly see pollution prevention as a way to improve protection as long as the pollution-control regulatory system remains intact. The challenge for public policy is to maintain the strength of the pollution-control system, while recognizing how current regulations pose obstacles and disincentives to industrial waste reduction. For example, the current system has the force of law to channel industrial resources into end-of-pipe measures rather than to change production systems to reduce waste.

Finally, pollution prevention addresses underlying social concerns about technology. Waste reduction could help resolve siting problems by demonstrating real need for safer and fewer waste-management facilities. Waste reduction simplifies the situation by cutting down on end-of-pipe devices and by calling for a reexamination and redesign of production facilities, technologies, systems, materials, and equipment.

Some industrial experiences in waste reduction have been impressive. Du Pont claims that from 1984 to 1985 it reduced hazardous-waste production from 35 to 50 percent in some divisions. In terms of waste output relative to unit production output, Exxon Chemical Americas and Rohm and Haas both reported a 10 percent reduction from 1984 to 1985. Monsanto claimed a 20-percent reduction in waste production from 1982 to 1984, and Olin Corporation reported a 34-percent drop from 1981 to 1985.

Yet very few U.S. companies have undertaken waste reduction. An Illinois study of 275 companies found that more than 50 percent of hazardous-waste producers had not begun serious waste reduction in 1985. A New Jersey study of 22 companies found that 41 percent claimed to have implemented waste reduction between 1981 and 1985, and 36 percent said that they had plans for waste reduction in the future. A study of more than 100 small metal plate manufacturers

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Katherine Berney

BY LEW GURMAN

In 1963, a 24-year-old Oregon State Prison inmate named John Atkinson was told that his participation in a medical experiment would further our knowledge of human radiation exposure. Induced to aid medical science and to earn $15 a month for his services, the prisoner signed a consent form allowing researchers to bombard his testicles with massive doses of X rays.

The laboratory where Atkinson served as an experimental subject was a drab, sparsely furnished penitentiary room unlike any medical lab he had ever seen. On arrival, he was told to strip. A blue-uniformed inmate led him to a table flanking a makeshift-looking radiation machine. He was told to lie face down on the table and to put his testicles into a water-filled receptacle in the center. He complied. Then two untrained inmates serving as X-ray technicians stepped outside the room and switched on the radiation machine.

For about a minute, 200 rads of X-radiation, equivalent to 20,000 times the amount of radiation in a normal X ray, surged into the prisoner's sex organs. The rest of his body was unshielded from the rays. Atkinson felt a momentary sting. Five minutes later, the technicians returned. He wondered why they had taken so long. They couldn't come back into the room, they told him, because they didn't want to be exposed to the radiation.

Subsequently, researchers performed seven testicular biopsies on Atkinson, which left his testicles burned raw and swollen. When he complained of pain, they gave him asprin. But when he told them that he wanted to quit the program, they said that he would not be released unless he submitted to a vasectomy. It was essential, they said, so that he would never produce a deformed child. He had the vasectomy.

PRISONERS OF PAIN

Dale Allred was another Oregon State Prison inmate during the 1960s who volunteered to participate in the experiments. A document signed by head researcher Dr. Carl G. Heller in 1971 and later used as testimony in a lawsuit against him in 1976 showed that prior to Allred's six years of testicular radiation and biopsies, Heller failed to inform him that the treatments could produce burns, swelling, pain, infection, tumors, and sexual impotence.

For five years, beginning in 1962, inmate Canyon Easton also took part in the program. Throughout his period of participation and for weeks after treatment, he suffered sharp pains in his groin. He was told that his reaction was a normal part of the healing process. Eventually, Easton

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Lew Gurman writes on defense and the environment.

became so depressed by the way he was treated that he tried to castrate himself to escape from the program. In 1975, eight years after his prison release and a year after his second marriage failed, his repeated castration attempt succeeded.

Thus ended a decade of one of the most cruel experiments in American medical history. From 1963 to 1973, 131 men serving life sentences at the Oregon and Washington State Prisons participated in these radiation experiments. They were paid $5 to $15 a month for their services. Funded by the U.S. Atomic Energy Commission (AEC), the studies sought to discover whether exposure to radiation from a nuclear accident or attack would make men sterile.

The Oregon program, however, had a second objective. By examining irradiated tissue, taking sperm counts, and evaluating urinary and blood hormones, Dr. Heller—one of the three endocrinologists who helped develop the female contraceptive pill—hoped to develop a similar pill for men. Although the experiments resulted in the publication of several scientific papers, the male pill never materialized.

UNETHICAL EXPERIMENTS EXPOSED

Research at Seattle's Pacific Northwest Research Institute came to a halt in January 1973, discontinued by state officials a few weeks after the first incomplete accounts of the radiation experiments began to appear in Oregon newspapers. In the ensuing controversy, a dozen inmates filed lawsuits against researchers and government officials, claiming that they were not adequately warned of possible health risks and seeking millions of dollars in damages. Eventually, the cases were settled out of court for sums ranging from $1500 to $5000.

Although early AEC internal documents acknowledged that radiation could cause cancer and that the experiments were unethical, most consent forms warned only of sterility and skin burns. Some prisoners were given no consent forms. Others were told that no harm would result from their X-ray exposures.

On October 21, 1975, an article appeared in the *National Enquirer* under the headline "67 EX-CONVICTS WHO VOLUNTEERED FOR USELESS RADIATION EXPERIMENTS COULD BE UNKNOWING CANCER VICTIMS." Cited in the story were doctors who branded the experiments "barbaric and inhumane." A British physician said that the tests were "as unethical and indefensible as the Nazis' sterilization experiments."

Marshall Parrott, then the manager of radiation control for the Oregon State Health Division, said in the February 16, 1976 edition of the *Willamette Weekly,* "I never felt such experiments should be conducted on humans. Almost all of the work in this field has been with animals. Of the 67 men who participated in the experiment, 15 received 600 rads and 17 received 200 rads or more. If you receive 600 rads in your whole body, you would probably die." In the same article, Mavis Rowley, Heller's chief assistant in the experiment who was untrained in radiation biology, told the newspaper that there was no danger of the prisoners getting cancer.

Subsequently, Meta Heller, wife of the research director, also defended her deceased husband's experiments. In a 1986 letter addressed to the U.S. House of Representatives Energy and Commerce Subcommittee on Energy, Conservation and Power, she wrote, "None of his subjects were ever harmed by the X-rays they received. In fact, those subjects who were irradiated at the highest dose were showing signs of recovery of sperm production when the project ceased."

VIOLATING THE NUREMBURG CODE

Nonetheless, scientists and government officials who learned of the human radiation experiments in the late 1970s and early 1980s charged that they had violated the Nuremburg Code on human experimentation established in 1946. Later known as the Helsinki Declaration, the code stated that risks to experimental subjects must be minimal, clearly understood by the subjects, and taken only if the subjects would benefit from them.

The most widely publicized expression of outrage, however, occurred on October 26, 1986, when Congress released a report entitled "American Nuclear Guinea Pigs," detailing over 30 years of government-sponsored human radiation studies, including the Heller experiments. Prepared by the U.S. House of Representatives Subcommittee on Energy, Conservation and Power under Congressman Edward J. Markey (D-Mass.), the report decried the use of human subjects in dozens of radiation experiments financed by the Manhattan Project, the AEC, the Energy, Research and Development Administration, and the Department of Energy from the 1940s to the 1970s.

The report stated that, of the nearly 700 experimental subjects, hundreds were exposed to radiation in experiments which provided little or no medical benefit. In many experiments, subjects received doses that exceeded the current recognized limits for occupational radiation exposure. Some doses were 99 times the recommended doses for the substances involved, as specified by safety standards of the time.

Subcommittee researcher Dr. John Abbots wrote in a memo to Congressman Markey, "The purpose of several of these experiments was actually to cause injury to the subjects. Others sought to measure the effects of radiation on humans. Too many of these experiments used human subjects that were captive populations that some experimenters might have considered 'expendable': the elderly, prisoners, hospital patients suffering from terminal diseases who might not have retained their full faculties for informed consent. The experiments represent an historical, institutional failure."

Although international medical societies, for decades, tried to prohibit the use of prisoners as subjects, their efforts largely failed. In prison, doctors could conduct experiments on inmates that would not be sanctioned for student subjects because of the risks and pain involved. If a volunteer became seriously ill or died as a result of the experimental procedures used in prison, the repercussions were less severe.

Prison medical records mysteriously disappeared. Few prison subjects dared to bring lawsuits against researchers. Furthermore, prisoners who were paid even moderately well for their services felt obligated not to report questionable medical practices and not to withdraw from an experiment.

CHALLENGING ETHICAL STANDARDS

It was not until 1966 that Dr. Charles L. Dunham, director of the AEC's Division of Biology and Medicine, ordered laboratory directors to consider revising their procedures to comply with a new code of ethics instituted by the U.S. Surgeon General. And it was not until three years later that his successor, Dr. John R. Totter, notified the laboratories that the AEC had officially adopted the National Institute of Health's procedures to protect human subjects from unethical practices.

Many of the 31 experiments described in the Markey subcommittee report, however, had not fallen under these guidelines. Some were as extraordinary as the Heller experiments. From 1945 to 1947, for example, the Manhattan Engineering District, predecessor to the AEC and the agency which built the atomic bomb, conducted a study at several U.S. research centers to learn how much plutonium the human body could retain.

As much as 98 times the permissible occupational limit of this toxic element was injected into eighteen patients without their informed consent. Nine of the 18, all of whom had maximum life expectancies under ten years, died within three years. Six patients, according to a medical study published in 1976, received plutonium doses high enough to cause cancer. None benefited medically from the plutonium injections. (See the accompanying sidebar.)

A 1972 memorandum from the Argonne National Laboratory's Human Radiobiology Center, one of the institutions which had conducted the experiments, warned that studies on surviving patients "should never

Katherine Berney

use the word 'plutonium' in regard to these cases." Consequently, patients still alive in 1973 were not informed that they had been injected with plutonium in the 1940s.

In another unusual experiment underwritten by the Manhattan Project in the 1940s, investigators injected uranium salts into patients with good kidneys to see what dose would produce kidney damage.

RADIATION TREATMENTS

During the post-World War II decade, while some American researchers under contract to the Manhattan Engineering District and the Atomic Energy Commission were carrying out questionable human radiation experiments, other researchers for those agencies were trying to use newly discovered radioisotopes to save lives. Popular magazines of the era such as *The Saturday Evening Post* hailed the innovative application of radio-iodine to treat hyperthyroidism and thyroid cancer. Radiation specialists at the Oak Ridge, Tennessee, Argonne, Illinois, and Brookhaven, Long Island National Laboratories had begun to combat various malignancies using radio-iodine and other radioactive isotopes.

The July 8, 1950 issue of the *Post* told of surgeons at Boston's Massachusetts General Hospital introducing "tagged atoms" of radio-phosphorus into the bloodstream of a patient to pinpoint the location of a brain tumor. Removal of the cancer saved the man's life. The magazine reported, "As a means of extending man's perception, isotopes have been called the greatest advance since the invention of the microscope. More than a hundred brain tumors have been verified at Mass. General by the radioactive phosphorus method."

Comparable strides in fighting disease were also being made through the use of teletherapy, by exposing patients to nuclear particle beams generated by cyclotrons and other atom-smashing machines. Increasingly, when conventional modes of treatment failed to produce results, doctors would use this innovation.

Twenty healthy men and women aged 63 to 83 permitted themselves to be injected with radium and thorium by researchers from MIT, but the experiment served no medical purpose.

Using teletherapy, medical researchers at the University of California's Lawrence Radiation Laboratory successfully treated mammary and pituitary cancer. Meanwhile, scientists at the Oak Ridge and Argonne laboratories employed cobalt and cesium teletherapy to fight other forms of the disease. Massachusetts Institute of Technology radiation expert, Dr. Robley Evans, proclaimed in the January 1946 issue of the *Atlantic Monthly,* "Through medical advances alone, atomic energy has already saved more lives than were snuffed out at Hiroshima and Nagasaki."

AEC-SPONSORED RADIATION EXPOSURES

Despite such supposedly enlightened uses of radiation, bizarre experiments financed by the AEC continued in the 1960s. At the University of Chicago and nearby Argonne lab, radioactive fallout gathered from nuclear tests in Nevada was fed to 102 human volunteers to discover how much radiation they could absorb. During the same decade, the AEC's National Reactor Testing Station in Idaho ran an experiment to measure the passage of iodine through the food chain into the human thyroid by requiring subjects to drink milk contaminated by the radioactive isotope.

From 1963 to 1965, radioactive iodine was intentionally released into the air on seven occasions at the Idaho site. Researchers hoped to find new information about the transportation of radio-iodine

produced by nuclear reactors and nuclear bomb tests. AEC officials considered such data important in planning for emergency action after a radiation accident.

Two decades earlier, the huge nuclear reservation in Hanford, Washington, which produced plutonium for the bombs that the U.S. dropped on Japan at the end of World War II, routinely discharged its radioactive iodine wastes over the surrounding countryside. The U.S. Environmental Protection Agency later found that the plant had released an estimated 500,000 curies of radiation between the years 1944 and 1946. A woman who had been a student at nearby Whitman College in Walla Walla at the time of a planned release in December 1949 returned home that year with severe hyperthyroidism and hair loss.

At Los Alamos Scientific Laboratory in New Mexico, the birthplace of atomic bomb research during World War II, five dozen normal adults were fed tiny spheres of radioactive uranium-235 to determine how long the uranium would take to pass through the gastrointestinal tract. The purpose of the investigation was to assess the potential hazards of rockets propelled by nuclear reactors from atmospheric reentry and burnup. Researchers believed that such burnup could produce particles small enough to be inhaled or ingested.

Although the Markey report suggested that the experiment was harmful, Chester Richmond, a scientist at the lab in the 1960s, discounted the possibility that the uranium-235 experiment could have injured its human subjects. "The radiation experiments we did at Los Alamos," he said in a 1986 news story, "were the most benign that I know about. They were nothing if not ethical. We were sure the materials were insoluble and our dose was much smaller than the allowable dose."

RADIUM AND THORIUM INJECTIONS

Meanwhile, the decade witnessed still another questionable radiation experiment funded by the AEC. Twenty healthy men and women aged 63 to 83 from the New England Age Center permitted themselves to be injected with radium and thorium by researchers from the Massachusetts Institute of Technology. The experiment was supposed to examine the effects of these radioactive elements on metabolism. Subsequent medical review, however, concluded that the experiment served no medical purpose.

Despite a government study published in the 1930s blaming radium for a "trail of death" among industrial workers, the potentially damaging effects of radium prior to World War II were widely and sometimes tragically misunderstood. Little was known about the behavior of radioactive materials taken internally. Such substances, it was thought, were completely eliminated. No one knew that radium could remain in the body for years, still radioactive and lodged in the bone, which it gradually deformed or destroyed. Nor did anybody realize that radioactive substances could affect the formation of blood in the bone marrow, causing leukemia and anemia.

As a result, young women were allowed to apply radium paint to the figures on watch dials, licking their paintbrushes to a fine point as they worked. And sufferers of arthritis, gout, and similar ailments received radium injections, inhaled emanations from radium solutions, or swallowed medicines containing radium for their alleged therapeutic effects. In the early 1930s, many Americans were even drinking a radioactive patent tonic called Radithor, which its manufacturer described as a therapeutic agent for gout, neuritis, high blood pressure, and declining sexual powers.

SPACE PROGRAM EXPERIMENTS

One of the more controversial human

THE PLUTONIUM INJECTIONS OF 1945

BY ROBERT ALVAREZ

The first known experiments with ionizing radiation and human subjects for nuclear weapons research occurred during the closing days of World War II. Massive quantities (the equivalent of an estimated 28,000 person/rems) of plutonium-239 were injected into the veins of 18 men, women, and children ranging from age 4 to 69 years. These experiments were performed through the auspices of the Manhattan Project in Rochester, New York City, and San Francisco, under conditions so secret that the plutonium was referred to only as "The Product."

According to published reports, the patients were never told about the implications of these experiments. They received no special surveillance treatment or care. The purpose of the experiments was to develop information on how plutonium behaves inside the body. From these experiments came a metabolism formula for plutonium-239 known as the "Langham Equations," named after Dr. Wright Langham, formerly of Los Alamos Labs.

Although the patients injected with plutonium were considered to have terminal diseases, they did not die when predicted. In 1975, the Energy Research and Development Administration (ERDA) issued a report prepared by the Argonne and Lawrence Livermore laboratories which identified 17 out of the 18 participants. Eight patients survived for at least eight years following the injections.

Interestingly enough, this study was released during a period when plutonium exposure standards were under severe criticism, and when authorization for the Clinch River Breeder Reactor was subject to its first attack in the U.S. Congress.

Proponents of plutonium fuels have used this plutonium study to fend off criticisms of exposure standards. British physicist and breeder reactor proponent J.H. Fremlin notes that the plutonium injections "could hardly have done much harm." Fremlin, on the basis of this study, contends that present plutonium exposure limits are adequate. And the ERDA study states: "It appears that plutonium cannot be considered to be a contributing cause of these deaths."

But Dr. Karl Z. Morgan, former director of the Health Physics Labs at Oak Ridge and world-renowned expert on the effects of ionizing radiation, notes: "It would seem that all these mistreated persons received very high doses. As you know, at such high doses, incidence is greatly reduced because of damage to the reticuloendothelial [immune] system. The person dies before they can develop cancer.... It would be those most likely to die of cancer that would be killed early by damage to their immune system. Thus the two survivors are persons who have a low-probability of death from radiation-induced cancer."

There were no therapeutic benefits from the plutonium injections. The Department of Energy admits to this.

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SOURCES

J.H. Fremlin, letter to Karl Z. Morgan, February 5, 1980.

Science Trends, Vol. XXXV, No. 22. Trends Publishing Company, Washington, D.C., February 1976.

W.H. Langham, S.H. Bassett et. al., *Distribution and Excretion of Plutonium Administered in Man.* Los Alamos Scientific Laboratory Report LA-1151.

Karl Z. Morgan, letter to J.H. Fremlin, February 14, 1980.

radiation experiments carried out by the Atomic Energy Commission, financed in part by the National Aeronautics and Space Administration, came to light in October 1981, when the U.S. Congress investigated charges that cancer patients at the Oak Ridge Institute of Nuclear Studies (INS) in Tennessee had been given nontherapeutic doses of radiation to produce data for the space program.

Much of the testimony centered on the case of Dwayne Sexton, a young child with acute leukemia who was treated at INS from 1966 to 1969. The child's mother claimed that she and her son had not been fully informed of the risks involved in the treatment, and that he might have lived if he had been given only standard chemotherapy. But the investigation showed that Dwayne's mother had volunteered to have her son treated with an untried form of radiotherapy and that the boy, as well as other cancer patients at INS, had not been harmed by the experiment.

House of Representatives Science and Technology Oversight Committee chairman Albert Gore, Jr. did discover, however, that the INS medical director had refused to participate in unethical experiments using California prisoners that were proposed by a NASA official.

Though largely unpublicized in press accounts of the Markey report, similarly positive findings appeared in the document. Favorably cited were a number of medically beneficial experiments used to treat cancer, as well as studies in which subjects were given long-term follow-ups. One such study is the Fermi National Accelerator Laboratory project to treat cancer patients through neutron beam irradiation. Begun in 1975 and continuing today, the project subscribes to a rigorous procedure of long-term follow-up examinations and laboratory tests for every patient in the program.

DOE DEFENDS HUMAN EXPERIMENTATION

In the two years since the release of the Markey report, high-ranking Department of Energy officials have defended the radiation experiments. On October 24, 1986, Dr. J.W. Thiessen, director of DOE's Office of Health and Environmental Research, said, "Most of the tests involved harmless levels of radiation and were intended to provide immediate and long-term health benefits. They used humans only because there was an urgency to find out if radiation safety standards were adequate. Actual radiation exposure to those people was extremely low."

On February 10, 1987, DOE secretary John Herrington said in a letter to Congressman Markey that the Department had found no scientific reason to expect that any of the subjects not already being monitored would suffer harmful effects from the radiation. He concluded, therefore, that DOE planned neither to pursue follow-ups nor to propose legislation which would compensate victims.

Nearly four decades after doctors like Yale's William Salter first daringly injected a thyroid cancer patient with radioactive iodine to identify tumors and then probed her neck with a needle-thin Geiger counter to locate the cancerous tissue, medical scientists have used humans in nuclear radiation experiments. Many of them have been successfully diagnosed and treated. Others, like the Oregon State Prison inmates, were treated with indifference or deliberately misled. Some, like John Atkinson, still suffer a legacy of trauma, disease, and disfigurement from the experiments.

PERIODICAL SOURCES

Ronald A. Buel, "Prison Tests May Cause Cancer," *Willamette Week,* Feb. 16, 1976, page 1.

Robley D. Evans, "The Medical Uses of Atomic Energy," *The Atlantic,* January 1946, pp. 68-70.

"Ex-Cons," *National Enquirer,* Oct. 21, 1975, page 1.

"Lifesaving Role of the Atom," *U.S. News and World Report,* May 7, 1948, pp. 26-27.

Jessica Mitford, "Experiments Behind Bars," *The Atlantic,* February 1973.

"Oak Ridge Studies," *Science,* Oct. 23, 1981, pp. 423-424.

"Radioactive Testing—New Mexico," AP Report, Oct. 29, 1986.

Mavis Rowley, David R. Leach, Glenn A. Warner, and Carl G. Heller, "Effect of Graded Doses of Ionizing Radiation on the Human Testis," *Radiation Research,* 1974, pp. 665-678.

Steven M. Spenser, "The Atom May Save Your Life," *Saturday Evening Post,* July 8, 1950.

Larry Tye, "Radiation Tests Employed People as Guinea Pigs," *Boston Globe,* Oct. 24, 1986.

Matthew Wald, "Northwest Plutonium Plant Had Big Radioactive Emissions in 40s and 50s," *New York Times,* Oct. 24, 1986, page A20.

George Wilson, "Prisoners X-rayed in Sterility Test," *Washington Post,* Feb. 28, 1976, page 1.

GOVERNMENT REPORTS

"American Nuclear Guinea Pigs," Report by U.S. House of Representatives, Energy and Commerce Committee, Subcommittee on Energy Conservation and Power, October 1986.

"Applications of Radioisotopes and Radiation in the Life Sciences," Report by U.S. Congress, Joint Committee on Atomic Energy, Subcommittee on Research, Development and Radiation, March 1961.

"Human Total Body Irradiation Program at Oak Ridge," Report by U.S. House of Representatives, Committee on Science and Technology, Subcommittee on Investigation and Oversight, Sept. 23, 1981.

Summary Factsheets SFS 1 to SFS 12 on human radiation test subjects, Department of Energy (sent by DOE Sec. Donald Paul Hodel to Rep. Richard Ottinger, June 1984).

PEACE CONVOY CARRIES AID

And a Message to Central America

BY ROB WILSON

Bill Ledger clearly understood why he and 45 other volunteers had traveled more than two months and nearly 9,000 miles with the Veterans Peace Convoy (VPC), carrying over ten tons of medicine and food to Nicaragua. Yet it wasn't until he reached the Apanas Military Hospital, north of the town of Esteli, that he finally faced the reason for the humanitarian aid project. There, in the beds and cots of crowded wards, lay the human toll of the U.S.-inspired *contra* war.

"So many were missing something—an arm, a leg, an eye," the 40-year-old U.S. Navy veteran from Boston remembered. "I stopped saluting people when I served in Vietnam, but I told these people that I saluted them with all my heart. It was hard to stand there and realize that U.S. policies had put all those people in those beds. I went outside and cried. We all cried that day."

None of the VPC organizers expected their journey to be easy, in Nicaragua or on the road through Central America. Even the most prescient of planners, however, couldn't have foreseen the bizarre twists and emotional ups and downs in store for them.

The convoy was conceived by Vietnam vet Bob Livesey of Dorchester, Massachusetts, following his visit to a Nicaraguan war zone with a U.S. Veterans' Peace Action Team. Livesey saw the project to help victims of the *contra* conflict as a "pure and simple, people-to-people aid effort," one that illustrated the direction U.S. foreign policy in Central America could—and should—take. Amplifying the project's peace message were those transporting the aid: men and women who were former members of the U.S. armed services, people traditionally seen as the defenders of U.S. power and policy in the Third World.

Thousands of people responded to the convoy's slogan, "Feed the children, not the war," donating over 150 tons of medicine, food, and clothing. Hundreds more gave to the Let Nicaragua Live/Oats for Peace Campaign, a convoy cosponsor that sends food to Nicaraguan children. (See the accompanying sidebar.) And a rainbow of political, church, and veterans groups, including the Quixote Center, Madre, the Nicaraguan Network, Chicanos Against Military Intervention in Latin America (CAMILA), and the Smedley D. Butler Brigade, united behind the project, helping to put it on the road in less than six months.

Fifty-five veterans of the wars in Vietnam and Korea and World War II, along with 41 nonveteran activists, filled out the convoy ranks. After the caravan's May 21 send-off from four U.S. cities, all went smoothly—until the 38 rickety trucks and buses congregated in Laredo, Texas. There, on the eve of a scheduled June 7 border crossing, U.S. agents unexpectedly delivered a Treasury Department order stating that VPC drivers could not donate their vehicles, as planned, to aid groups in Nicaragua. Such action, the government said, would violate the 1985 U.S. trade embargo against Nicaragua. The *"convoyistas"* were given an ultimatum: either pledge to return the trucks in 30 days or stay in the U.S.

With the help of the Center for Constitutional Rights (CCR), convoy lawyers scrambled to prepare and file a preliminary injunction against the order in Federal District Court. The caravan, with its 35 tons of food, medicine, and clothing, sweated through a week of higher than 100-degree days before testing the legal blockade on June 15.

Newspaper reporters watched and TV cameras rolled as four trucks approached the International Bridge and were seized

Bill Ledger

Rob Wilson, who lives in South Deerfield, Massachusetts and works for a computer software firm, traveled with the Veterans Peace Convoy in the U.S. He is a member of Tecnica and serves as a coordinator of the Rural Electrification Support Project, an international program helping to bring electricity to rural Nicaraguan villages.

by border guards. "We didn't pick this fight, but we're not backing down," claimed convoy driver Raoul Valdez, a Vietnam combat vet and member of the Austin chapter of CAMILA, as he prepared for the confrontation. "If they want to stop us, that's fine, but the whole world will watch."

Frustrated about the standoff, most VPC members agreed to try a dramatic new tack: driving the convoy to Washington, DC to protest and meet with government officials responsible for the order. Although the trip to the nation's capital led to more frustration—the city largely ignored the convoy's rally and march around the White House, and State Department officials refused to meet with VPC spokespersons—the publicity showered on the convoy sparked an outpouring of national support.

Activists and celebrities—including Brian Willson, Ron Kovic, Ed Asner, and Paul Newman and Joanne Woodward (who had dispatched a cooler of Newman's Own Lemonade to Laredo)—joined politicians such as Jesse Jackson and Ron Dellums to rally in favor of the convoy's humanitarian aid project. Meanwhile, Texas Democrat Mickey Leland introduced a nonbinding congressional resolution to allow the convoy's passage.

The VPC's message played particularly well in Houston at the Texas Democratic Convention, where keynote speaker Jesse Jackson unexpectedly invited the Washington-bound convoy members, who were demonstrating outside, into the cavernous hall. The convoy drivers were given a sustained standing ovation from the conventioneers, as the presidential candidate praised their aid project and criticized the Reagan administration for "exporting bullets, war and death, not peace" to Central America.

Although many convoy members had to return to families and jobs after a week in the capital, 18 trucks and buses were back in Laredo by July 2, ready to continue attempting their "peace invasion." Eight VPC members were arrested trying to cross the border on July 9 and 10. Local police broke windows on one truck and roughed up three drivers, arresting them for blocking traffic.

"We just wanted to exercise our legal right and drive over the border. They were the ones blocking the traffic," quipped Bob Livesey the day after his arrest and release, his eyes still smarting from police mace. Valdez was also maced and arrested in the incident.

Within 48 hours of the widely publicized showdown, however, border guards started letting the brightly painted and clearly identifiable VPC through. On July 11, 12, and 13, all of the remaining convoy vehicles passed into Mexico, where they were eventually joined by three more trucks. After crossing through Guatemala and Honduras, under armed military escort, the caravan rolled triumphantly into Managua on July 28.

"The children and old people would reach out to touch us," Bill Ledger recalled. Feted by thousands of Nicaraguans, the *convoyistas* had private audiences with President Daniel Ortega and other top officials and delivered their trucks to aid groups in Nicaragua.

The VPC's Washington office, reflecting on the sudden change in attitude at the U.S.-Mexican border in July, saw no mystery in the move. "The government didn't have enough confidence in their own embargo to keep us in Laredo, and we were getting too much publicity at the border," said national VPC coordinator Tom Hansen. "Some local police and border guards even advised us on how to get across. It seems clear that the government wanted to quietly back out of this."

Customs spokeswoman Donna La Torre, however, said that the convoy had passed without the knowledge or approval of the government. She added that the VPC drivers had broken a federal law and faced fines of as much as $50,000 and up to 10 years in jail. Although most drivers had returned to the U.S. by the end of August, no charges related to breaking the embargo had been filed against any VPC participants by that time.

Gerry Condon, a VPC leader from San Francisco, observed that the Reagan administration's action handed the project "media coverage we couldn't have bought," ultimately promoting aid to Nicaragua. "By holding up a bunch of veterans carrying medicine and baby food, the government exposed the true nature of its mean-spirited policies and economic warfare," he added.

Convoy officials said that the amount of aid donated to the VPC had doubled, to over 300 tons, during the delay. Most of the material was shipped to Nicaragua on container ships.

The halting of the VPC, according to Center for Constitutional Rights lawyers, has also generated grounds for the strongest challenge yet to the State Department's practice of using the International Economic Emergency Powers Act (IEEPA) and the trade embargo to block humanitarian aid to Nicaragua. A favorable judge's ruling on the case—which was still being considered at this writing—could also open the gate for humanitarian aid to Vietnam.

"Aid that relieves human suffering is clearly permitted under IEEPA terms, yet this administration has regularly blocked the shipment of such humanitarian goods," explained spokesman David Lerner from CCR's New York headquarters. "Congress never intended humanitarian aid to be politicized."

Aid continues to flow to Nicaragua through VPC efforts. Six hastily organized "Convoy 2" trucks from around the U.S. headed for the border at Laredo in mid-August, planning to reach Managua in September. One of the trucks was donated by the family of Benjamin Linder, the first U.S. technical aid worker killed by the *contras*, through the Linder Memorial Fund. Another was given by New York veterans groups. Its cargo—wheel chairs, crutches, and hospital beds—was bound for *contra* war victims like those Bill Ledger met in northern Nicaragua.

The VPC needs help for its aid project. Tax-deductible donations may be made out to the Veterans Peace Convoy, Inc. and mailed to VPC, 2025 I Street, Room 313, Washington, DC 20006.

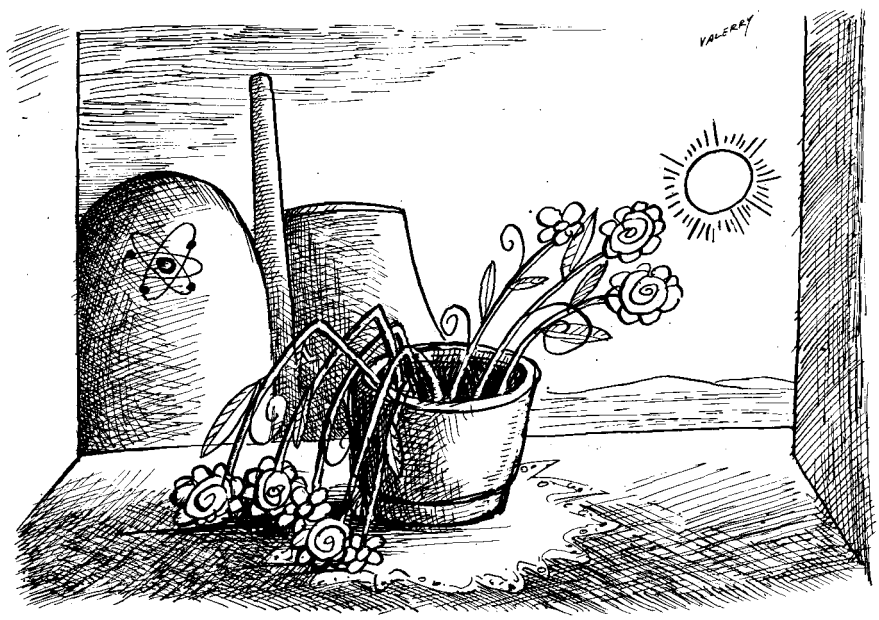
OATS FOR PEACE

The Veterans Peace Convoy carried the first shipment of the Let Nicaragua Live/Oats for Peace campaign to Nicaragua, an effort on the part of activists throughout the U.S. to help meet the nutritional needs of Nicaragua's children. Due to the devastation of the war and a severe drought, food shortages are projected for the coming year. In response to a request from Nicaraguan agencies, the Oats for Peace campaign has committed itself to raising the funds for over 400 tons of raw oats, which will be processed into cereal inside Nicaragua and distributed to the many children orphaned or displaced from their homes by the *contra* war.

You can help the Oats for Peace campaign as an organizer, monthly sustainer, or one-time donor. Contact them at the Central America Solidarity Association, 1151 Massachusetts Ave., Cambridge, MA 02138, telephone (617) 492-8699. Please make checks payable to Let Nicaragua Live.

THE GREENHOUSE EFFECT

And the Second Coming of Nuclear Power



BY RICHARD RUDOLPH

The threat of global climatic warming due to the atmospheric greenhouse effect has provided new arguments for promoting a "second coming" of nuclear power. During the past few years, utility executives have warned of impending brownouts, blackouts, and power rationing unless new coal and nuclear plants are built. Simultaneously, they have mounted efforts to discourage independent power production by limiting transmission access and offering special rate reductions to retain industrial customers who indicate an interest in generating their own power. Now they are exploiting the emerging public concern over global warming to facilitate the accelerated licensing and construction of a new generation of nuclear reactors.

Plans for the second coming of nuclear power were temporarily put on hold following the partial meltdown at the Chernobyl nuclear reactor in 1986. They are now being put in place. Legislation currently before Congress would sweep away institutional barriers to nuclear power. Reactor licensing would be streamlined into a one-step process, limiting public participation in hearing rooms. Reactor design would be standardized and given advance approval. Sites for new reactors would also receive prior approval.

Other legislative proposals call for replacing the Nuclear Regulatory Commission with a nuclear safety agency headed by a single administrator. This move, sponsors say, would increase nuclear oversight accountability. Financing of plants would become more automatic, with bills for construction passed immediately to consumers during the building of the plant. This would eliminate major rate increases when plants come on line and guarantee a profit to investors. And new consortiums which could include insurance companies, banks, oil companies, and other major corporations would be allowed to form and build new plants.

In addition to removing institutional barriers, the second-coming plan calls for the development of "safe reactors." These would cost half as much, require six years to build, have a capacity factor of 80 percent, and a lifetime of 60 years. The U.S. government also supports the creation of a new light-metal breeder reactor. It plans to ship uranium-233 and plutonium, highly enriched uranium, and irradiated nuclear material to Japan in order to promote research and development of a prototype scheduled to come on line in 1992.

There is little logic behind the industry's assertion that nuclear power could abate global warming. Essentially, the greenhouse effect is a problem caused by the release of carbon dioxide and other gases into the atmosphere. U.S. fossil-fuel electric generating plants are responsible for only four percent of the worldwide emissions contributing to global warming. Motor-vehicle fumes, deforestation, methane produced by agriculture and farm animals, other uses of fossil fuels, and industrial emissions account for the bulk of the problem.

A study recently completed by Dr. Bill Keepin and Gregory Kats for the Rocky Mountain Institute shows that nuclear power generation is a slow, expensive, and above all, highly ineffective way to

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NUCLEAR REFERENDUM IN MASSACHUSETTS

This November, Massachusetts voters will have the chance to support an initiative that would "prohibit the generation of electric power by commercial nuclear power plants in the Commonwealth by means which result in the production of nuclear waste." If Question 4 passes, the nation's oldest operating commercial nuclear reactor, Yankee Rowe, and its worst-managed reactor, Boston Edison's Pilgrim nuclear plant, will close. The Pilgrim plant has been shut down since April 1986 due to poor radiation controls, mismanagement, and failure to meet Nuclear Regulatory Commission safety and operating standards.

The nuclear referendum is being sponsored by Massachusetts Citizens for Safe Energy, a coalition of environmental and public interest groups and supporters throughout the state. For information or to lend a hand in the campaign, contact them at 37 Temple Place, Boston, MA 02111, telephone (617) 426-5556.

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address the global-warming problem. A worldwide transition from coal to nuclear power would require building one large nuclear plant every one-to-four days for the next 40 years, at a cost of between $200-$787 billion per year. Such massive investments would be infeasible in the Third World and would have a severe economic impact on developed countries.

An increase in the number of nuclear plants (assuming that the managerial capacity was available) would do little to mitigate the warming of the earth. Carbon-dioxide emissions from other sources will continue to grow by 65 percent during this same period.

A massive switch to nuclear power makes little sense given the enormous risks: costs, radioactive wastes, meltdowns, vulnerability to terrorism, sabotage, and diversion of nuclear fuel to weapons use. Mining energy that is presently wasted is the most environmentally benign and cost-effective way to reduce carbon-dioxide emissions. It provides a number of opportunities which cannot be tapped by increasing the number of nuclear plants.

Doubling U.S. vehicle mileage standards from the present 18 miles per gallon to 36 mpg could cut carbon emissions in half. Moreover, if all new office buildings were constructed in the most energy-efficient method, they would save the equivalent of 85 power plants and two Alaskan pipelines without additional cost. Replacing all of the light bulbs currently used in the U.S. with the most efficient bulbs available could shut down an additional 40 large coal-fired plants and save the nation $10 billion.

A single 18-watt compact fluorescent light bulb produces as much light as a 75-watt incandescent bulb. Yet over its lifetime, the fluorescent bulb prevents the burning of 400 pounds of coal, forestalls the release of 12 pounds of sulphur dioxide into the atmosphere (which produces acid rain), and saves the U.S. economy $15.

Overall, a major commitment to energy efficiency could cut per-capita energy use in half while maintaining gross-national-product growth rates of one to two percent per year. The rapid introduction of cost-effective renewable energy technologies and reforestation of the earth would further reduce the greenhouse problem.

For those of us without a stake in the nuclear industry, energy efficiency is a more rational way to ameliorate the greenhouse effect, for it provides the quickest, least-expensive and most-effective approach to curtailing carbon-dioxide emissions. There is no reason to repeat the nuclear mistake and trade one environmental and economic disaster for another.

PRESERVING OUR ENVIRONMENT

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by a California public interest group found that 75 percent were not implementing waste reduction procedures in 1986.

Although few companies practice serious waste reduction, neither technology nor economics appear to be the limiting factors. Instead, there is a host of human, organizational, and institutional obstacles in the private and public sectors. There has always been some waste reduction. The challenge for public policy is to find ways to increase its pace and comprehensiveness.

A WASTE-REDUCTION ETHIC

The shift in paradigm from pollution control to pollution prevention has intellectual roots in the 1970s, but it is still on the sidelines in the public-policy arena. That's because we live in a pollution-control culture: less than one percent of the U.S. government's environmental spending goes for pollution prevention. We need institutional champions for waste reduction and we need to change consumer tastes, practices, and products to reduce household generation of hazardous waste.

Creating a waste-reduction ethic remains a goal. For industry, that means engendering strong support, from senior management to rank-and-file employees. Waste reduction needs to become a priority of corporate culture, just as energy conservation has become a goal for many industries. Staff and management should be motivated to meet company waste-reduction goals and timetables, which can be set through waste-reduction audits. The economic motivation for preventing hazardous waste should be transferred to manufacturing and production divisions, including responsibility for future liabilities and cleanup.

Employees should be trained in waste-reduction techniques and information should be disseminated throughout companies and industries. Technical assistance can come from state and federal agencies, private consultants, company production personnel, and environmental engineers. For example, an on-line waste-reduction database is being developed by the EPA, and "expert system" computer programs to assist engineers in implementing waste reduction are being created by the EPA and state agencies in Illinois and Maryland.[11]

As threats to health and the environment continue, such as more drinking water supplies found to be contaminated beyond use, an atmosphere conducive to environmental policy changes will result. Society may be driven to pollution prevention out of desperation rather than attracted to prevention because of its intrinsic benefits. If that happens, policy makers will respond with initiatives that they think have a chance of succeeding through broad public support.

Detailed policy options to implement a strong federal waste-reduction initiative have been presented for congressional consideration. In fiscal 1988, Congress allocated the EPA with funds for its own waste-reduction program and $4 million for grants to state waste-reduction programs. Legislation is also being considered that would spell out the primacy of waste reduction, define it carefully, and perhaps establish a national voluntary goal of ten-percent waste reduction per year for five years.[12]

For the evolution of public policy, it is important to remember that the scope of current unfulfilled needs determines the shape of things to come. The longer we wait for public policy to embrace and tangibly support pollution prevention, however, the longer we wait for the environmental and economic benefits that it offers.

NOTES

1. Joel S. Hirschhorn, "Siting Hazardous Waste Facilities," *Hazardous Waste,* Vol. 1 No. 4, 1984, pp. 423-429.

2. *Federal Register* 41FR 35050, August 18, 1976. Also see Office of Technology Assessment, *Technologies and Management Strategies for Hazardous Waste Control,* Washington, D.C., 1983.

3. See, for example, Office of Technology Assessment, *Superfund Strategy,* Washington, D.C., 1985.

4. See, for example, Clifford S. Russell et al., *Enforcing Pollution Control Laws.* Washington, D.C.: Resources for the Future, 1986.

5. See 1983 OTA report, op. cit.

6. See Office of Technology Assessment, *Serious Reduction of Hazardous Waste: For Pollution Prevention and Industrial Efficiency,* Washington, D.C., September 1986.

7. See the 1986 OTA report for citations for these and many other references on waste reduction and pollution prevention.

8. Joel S. Hirschhorn, "Toxic Waste and the Environmental Deficit: Whose Future Are We Discounting?" *Futures Research Quarterly,* Winter 1985, pp. 7-14.

9. Ken Geiser, "Toxic Times and Class Politics," *Radical America,* Vol. 17 Nos. 2&3, 1983, pp. 38-50.

10. Richard Barke, *Science, Technology, and Public Policy.* Washington, D.C.: Congressional Quarterly Press, 1986, pp. 155-180.

11. See Office of Technology Assessment, *From Pollution to Prevention: A Progress Report on Waste Reduction,* Washington, D.C., June 1987. Also see Joel S. Hirschhorn, "Cutting Production of Hazardous Waste," *Technology Review,* Vol. 91 No. 3, April 1988, pp. 52-61.

12. See 1986 OTA report, op. cit.

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