SCIENCE FOR THE PEOPLE

Dear SFTP Reader,

We're back. After a three-and-one-half month delay, SCIENCE FOR THE PEOPLE is publishing again. Financial difficulties made it necessary for us to skip our May/June issue; all subscribers who would have received that issue will get the current July/August issue in compensation, and renewal dates will be extended two months.

Although we are back, serious challenges lie ahead. Science for the People is no longer the volunteer organization it was during the first decade of its existence, from 1969 to 1978. While interest in our magazine and organization continues to grow, the costs of administering an expanding program have grown as well. We rely more on professional freelance designers and writers. Our rent has doubled since 1984. And the Post Office no longer mails out the magazine for 3.5 cents per copy.

We are seeking new sources of funding for our work, and we are evaluating where to cut costs in an operation that is already streamlined. But in order to survive in a meaningful way, and to have reason to celebrate our twentieth anniversary next year, we must continue to appeal to those who best know and value the work of Science for the People: our readers.

About one in four of you consistently donates money to keep SFTP going. Your donations have helped us produce some great issues of the magazine, such as the recent report on science and the military. But you have also helped us serve as an active resource to others. Our Science for Nicaragua Program continues to send much-needed expertise and material aid to Managua. We hope to extend our efforts in the coming year to include sponsoring Nicaraguan students to visit U.S. schools and developing Spanish-language teaching aids for our program teachers. SFTP's Genetic Screening Study Group is planning a major conference for science writers to explore the implications of new genetic technologies. We have committees of activists in Berkeley, CA and San Juan, PR supporting our work, and a group of Nicaraguan scientists wishes to form an affiliated chapter in Managua.

It is particularly frustrating that at a time of such vital activity we should be held back because of money. We have plans to increase our budget over the next twelve months in order to meet our obligations and our ambitions. Special fundraising campaigns are scheduled for the summer and fall, which will help us find new sources of support among scientists and activists who are not yet familiar with our work. But while we implement these strategies, we need immediate support from our friends to sustain our work.

To those of you who have already given, we thank you. If you are not able to help out now, we hope you will remember us at a future date.

As for the other three out of four readers, please give serious thought to making a donation now, when it can do so much to keep Science for the People a vital, activist force in the science community. There are a number of ways you can help:

1) Become a donor. Your tax-deductible donation will keep us a determined voice for social responsibility in all the sciences.

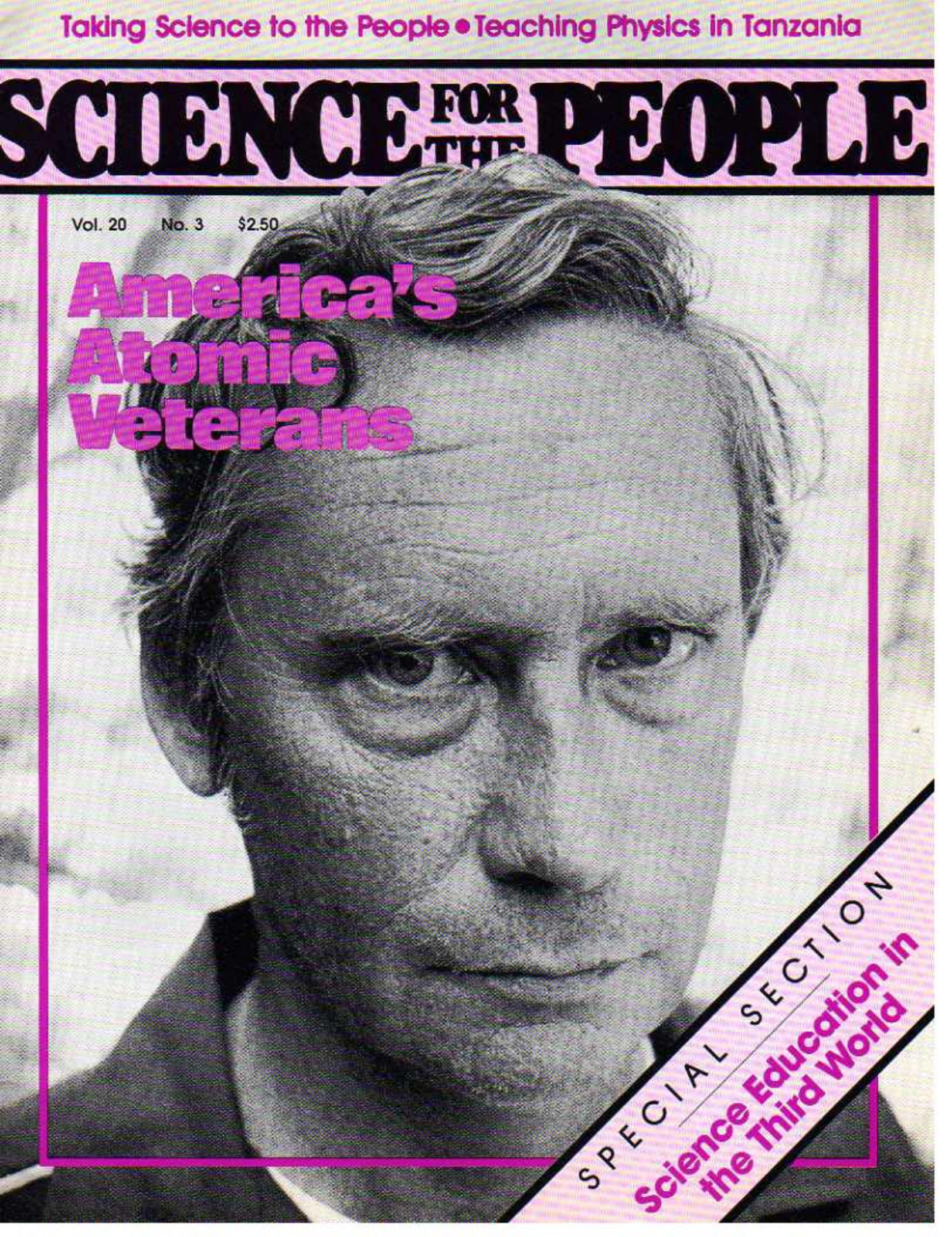
(continued on back cover)

Taking Science to the People • Teaching Physics in Tanzania

SCIENCE FOR THE PEOPLE

Vol. 20 No. 3 $2.50

America's Atomic Veterans



SPECIAL SECTION

Science Education in the Third World

Letters

Science and Freedom

Dear SftP:

I really enjoyed the "Science and Freedom" issue (March/April 1988) because it dealt with the overtly political topic of popular dissent over science and technology issues and the efforts of governments to repress that dissent. I had a problem with Gena Corea's article, "Reproductive Repression: West German Police Raid Activists," however: the terms "reproductive and genetic engineering" and "reproductive and genetic technology" kept coming up, with very little explanation.

These terms could mean anything. Was the movement in West Germany to which Corea was referring opposed only to such practices as surrogacy? Or was it opposed to *in vitro* fertilization or harvesting of ova and sperm? Or to any and all manipulation of genetic material, for research or clinical purposes? The repeated lack of definition of these terms detracted from the article and left me wishing for clarification, of both the terms and the specific nature of the activists' opposition. Thus a potentially controversial and politically charged article became a simple "goodies vs. baddies" story, with no real analysis.

—Roger Felix
Valhalla, New York

AIDS and African Women

Dear SftP:

As I stated clearly in the article "AIDS & Sexual Mutilation" (Nov/Dec 1987), female genital mutilation is only *one* factor that contributes to the transmission of AIDS to women in Africa, and I cited a number of others. Of course, sexually transmitted diseases (STDs) are a major factor everywhere, and gonorrhea is rampant in most African countries, as World Health Organization (WHO) statistics confirm. But STDs are also widespread in the rest of the world.

It is a fact that only in Africa are women infected by AIDS in as large numbers as men—or even larger—in the few hospitals where tests have been made, compared to the rest of the world and not only to the USA (see WHO world statistics on AIDS), as Nancy Krieger and Lisa Dorothy Moore falsely claim (see their letter to SftP in the March/April 1988 issue).

To be sure, what few statistics are available from Africa are from very few city hospitals (e.g., Rwanda and Zaire) or from the examination of prostitutes in Kenya. In most African countries, the military or other dictatorships in power simply do not allow any competent health teams to carry out tests or even talk to people about this. ("It would be bad for the tourist traffic," some claim.)

It is unfortunate that people like Nancy Krieger and Lisa Dorothy Moore are "disturbed" if they hear the truth—especially if they, as "health specialists," have failed for years to speak about the terrible suffering and health problems and human rights violations to which millions of African female children and women are routinely subjected because of "tradition." The real racists among us are those who fail to speak about these terrible mutilations, especially the silent collaborators in the health sector who must be held responsible for the fact that these mutilations not only continue today, but are now practiced in many African hospitals by health personnel trained in Western medicine. All this I have pointed out in congressional testimony as U.S. AID money (our taxes) is used for the training of African health personnel.

Obviously the letter writers, though in the health sector, are not familiar with WHO statistics: in most African countries, fewer than ten percent of the population have any contact with Western—that is, imported—health services (as opposed to indigenous traditional ones). What is more, Southeast Asia has no more modern health services in relation to its population numbers than most of sub-Saharan Africa, yet they do not have an AIDS epidemic. Since Krieger and Moore claim that the lack of health services is responsible for the spread of AIDS in Africa, why is there no AIDS epidemic in Southeast Asia?

Massive urbanization and inadequate health services are not limited to Africa. On the contrary, urbanization in Latin America and Asia is far more advanced, while in most sub-Saharan African countries more than 70 percent of the population still lives in rural areas. No published reports on AIDS exist for rural areas in Africa. Given these conditions, all statistics published on AIDS in Africa are educated guesses—especially since most African

CONTINUED ON PAGE 2

SCIENCE FOR THE PEOPLE

Editor
Leslie Fraser

Publisher
Gary Keenan

Designer
David Gerratt

Illustrator
John Klossner

Art & Photos
Barbara Goldoftas, Bob Lange, Jim Lerager
Paul Valerry, John Vandermeer

Editorial Committee
Tracey Cohen, Rich Cowan, Michael Filisky
Leslie Fraser, Stephanie Pollack
Joseph Regna, Seth Shulman, Ellen Weinstock

Magazine Planning
Joseph Alper, Jon Beckwith, Marilyn Frankenstein
David Himmelstein, Bob Lange, Richard Lewontin
Diane Paul, Steffie Woolhandler, Katherine Yih

Material Requests
Jim Barton

Distribution
Richard Aichelmann

Editorial Advisory Board
Joseph Alper, Rita Arditti, Jon Beckwith,
Philip L. Bereano, Edith Brickman,
Stephen Chorover, Fran Conrad,
Eric Entemann, Roslyn Feldberg, Ross Feldberg,
Marilyn Frankenstein, Douglas Futyama,
Ted Goldfarb, Rae Goodell,
Stephen Jay Gould, David Himmelstein,
Eric Holtzman, Ruth Hubbard, David Kahn,
Charles Koplik, Richard Levins, Richard Lewontin,
Karen Messing, Frank Mirer, David Noble,
Richard Novick, Connie Phillips,
Alvin F. Poussaint, Stephen Risch, Richard Rosen,
Virginia Schaefer, Scott Schneider, Miriam Struck,
Sue Tafler, Michael Tanzer, Scott Thacher,
John Vandermeer, Gerry Waneck,
Joseph Weizenbaum, Sandy Wiper,
Steffie Woolhandler

Printing
Common Wealth Printing Company
47 East St., Hadley, MA 01035
(413) 584-2536

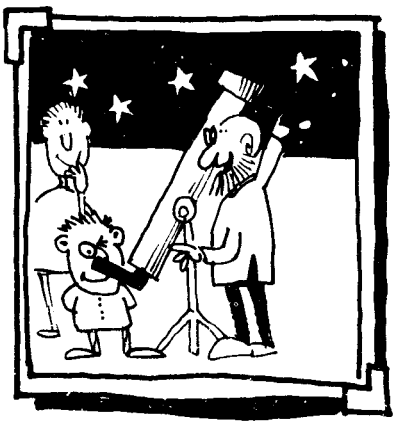
SUBSCRIPTIONS: U.S. one year/six issues: $15. Foreign rate: $21. U.S. libraries/institutions: $24. Foreign libraries: $30. Member subscriptions (includes the magazine, our newsletter and other communications): $30. Foreign subscribers must remit in U.S. currency, with either an International Money Order or a check drawn on a U.S. bank.

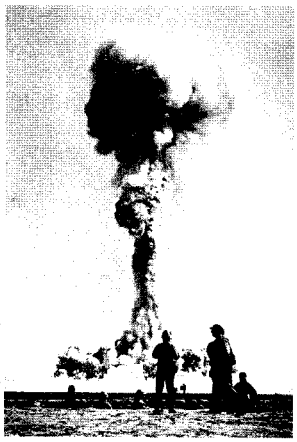
SCIENCE FOR THE PEOPLE is available to bookstores on consignment from the publisher or through Carrier Pigeon Distributors, Box 2783, Boston, MA 02208. The magazine is available in microform from University Microfilms, 300 N. Zeeb Rd., Ann Arbor, MI 48106. Science for the People is indexed in Alternative Press Index, Box 7229, Baltimore, MD 21218.

SCIENCE FOR THE PEOPLE (ISSN 0048-9662) is published bimonthly by the Science Resource Center, Inc., a nonprofit corporation at 897 Main St., Cambridge, MA 02139, telephone 617/547-0370. Edited and produced by the national organization of Science for the People. We offer a progressive view of science and technology. Articles, letters, reviews, newsnotes, photos, and art work are welcome. Please send double-spaced, typed manuscripts, on Wordstar IBM-compatible disks if possible.

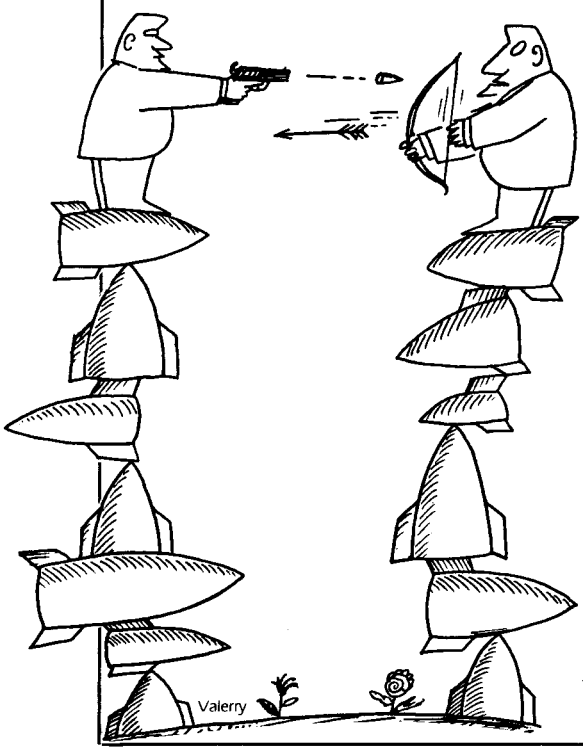
SCIENCE FOR THE PEOPLE

July/August 1988
Volume 20, Number 3





Courtesy of Larry Prey



CONTENTS

Letters

CONTINUED FROM INSIDE COVER

dictatorships still prevent information gathering.

For instance, Nigeria, a country with more than 100 million people, officially claimed until quite recently that AIDS did not exist there. Recently they admitted that they had found nine cases of AIDS! Yet Nigeria has many modern hospitals and trained specialists, according to WHO statistics on AIDS. In Eket, Nigeria, the Women's Center is presently conducting a campaign against genital mutilation and AIDS, linking the two. In a recent issue of *Women's International Network (WIN) News*, which I publish and edit, we ran an appeal from the center for help with their work.

An inter-African committee with affiliates in more than 14 countries and headquarters in Addis Aababa and Geneva has been at work since 1984 fighting to stop genital mutilation and other damaging traditional practices that affect women in Africa.

To repeat the facts about AIDS: in the vast majority of cases, AIDS is transmitted by sexual intercourse. Therefore it is logical to look at what kinds of sexual practices need to be changed—under pain of death. This is what I have said in the article and I confirm it here: prevention is at present the only remedy for AIDS, and that requires dramatic changes in the traditional sexual practices in Africa—whose innocent victims are young girls and women who have no control over their bodies and lives.

Unfortunately, this magazine limited the space they "allowed" me so that I was unable to state the facts before. In addition, the editors of *Science for the People* botched my explanation of the genital operations and they also failed to print the map which I supplied, showing the affected regions in Africa. To set the record straight, it is excision that is practiced in most of Africa, while infibulation—the most drastic operation—predominates in the Sudan, Somalia, large parts of Ethiopia, southern Egypt, northern Kenya, and in some areas of West Africa, notably Mali and beyond.

—Fran P. Hosken
editor and publisher of WIN News
187 Grant St., Lexington, MA 02173

Women out of Science

Dear SftP:

Recently I began again to gather statistics on male and female academic scientists. One excellent source which I used five years ago for an article in *Atlantis* published in 1985 was the annual *Commonwealth Universities Yearbook* (1982), available at most university libraries. It lists by name the faculty of all commonwealth universities around the world. A note in the front of the three volumes states that the male teachers have their initials after their surname, while the female teachers have a given name. It was easy for me to work out the percentage of women in any department of any university, information often unavailable in the universities' own calendars, where initials only for both men and women were the rule.

When I began to work out similar percentages from the 1987 *Yearbook* to determine what gains women had made in five years, I was amazed to find that in some departments there were apparently now no women at all. A closer investigation showed that in this edition, various universities had often not followed the guidelines set out by the yearbook, but instead listed all faculty members only by their initials.

"We feel a professor is a professor, and there is no reason to list anyone's sex," one professor told me when I asked him about this. "We believe in equality."

True enough, but now it is very difficult to check if such rhetoric has any basis in fact.

Similar obscuring methods of presenting statistics are used by Statistics Canada and other institutions. Sometimes they pool "Arts" and "Science" students together, so that the small number of women in science compared to women arts students goes unnoticed. Commonly, "Agricultural and Biological Sciences" is used as an entry, even though its large number of "Household Science" students (who are usually all women) masks the much smaller number of agriculture and biology students who are women.

Similarly, pooling all teachers in the "Health Professions and Occupations" does not allow one to appreciate the few women doctors on faculty, compared to the large number of women nurses. As another example, in any one category, the number of "teachers" is often given, which hides the fact that the prestigious top professors are virtually all men, while most low-ranking demonstrators and instructors are usually women.

Without statistics we would be unaware of many of the trends that are now taking place in society. Perhaps recognizing this, many institutions supplying information now seem to be presenting it so that some trends are hidden.

—Anne Innis Dagg
University of Waterloo, Ontario

Newsnotes

HOW DO YOU SPELL DECEPTION?

What do *Business Week* and your favorite magazine have in common? Even though you may be saying to yourself "nothing at all," there is one thing that the weekly media mouthpiece for capitalism and SftP do share: neither will be promoting nuclear energy through ads paid for by the U.S. Council for Energy Awareness (USCEA) this year.

The pronuclear USCEA is attempting to foist its own brand of awareness on the public. A confidential document obtained by the San Francisco-based environmental group Earth Island Institute revealed that USCEA will spend $340 million on its 1988 Media Plan. The goal of the plan is to "emphasize good news about nuclear energy" and "to maximize awareness and recognition throughout the year of the critical link between the use of coal and nuclear energy in achieving America's goal of energy independence."

USCEA's 1988 advertising targets "adults from 25-64 with household incomes of $30,000 plus," particularly people "who regularly express their opinion by writing to the media or elected officials, or, in their positions as members of local church or school boards, business organizations and local governing bodies." The pronuke group plans to reach nearly 40 percent of adult TV viewers through ads and nearly half of all adults through the print media. For example, USCEA has placed its 1988 propaganda on the TV airwaves during the miniseries "War and Remembrance" in May and throughout the 1988 World Series.

In the pages of the print media, USCEA plans to cheerlead nuclear power in the *Wall Street Journal, Forbes, Time, Newsweek, U.S. News and World Report, National Geographic, Reader's Digest, Natural History, Psychology Today, Sports Illustrated, Smithsonian,* and *Scientific American.* Also of interest to USCEA's misinformation peddlers are periodicals marketed to women. "The environment of women's magazines is not inappropriate for USCEA advertising," their document explains.

Six publications which accepted pronuclear advertising in 1987 did not make USCEA's final cut for 1988. *Business Week* fell into this group. Also excluded were *Omni, Atlantic Monthly, The New Yorker, Harper's,* and *Discover.*

While USCEA can't count on readers of alternative periodicals to forget Three Mile Island or Chernobyl, it is banking on such amnesia and denial from the readers and viewers of mass media. Let's hope that the public surprises them by writing letters of protest to the editors and owners who publish the pronuke propaganda.

—Joseph Regna

John Klossner

SLAVES TO THEIR GENES?

Why blacks tend to have higher blood pressure than whites has always intrigued sociobiologists, much like the race and I.Q. controversy. Clarence Grim of the Charles R. Drew University of Medicine and Science in Los Angeles, in an address to the American Heart Association's fifteenth Science Writers Forum earlier this year, hypothesized that this difference came about due to conditions on 16th to 19th century slave ships crossing the Atlantic Ocean from Africa.

Grim believes that because of the lack of food and water on slave ships, "survival of the fittest" resulted in "selecting" blacks who could retain salt to better endure the ordeal of seasickness, dehydration, diarrhea, and hunger. Their descendants, eating salt-rich diets, are now suffering the consequences by becoming hypertensive, claims Grim.

Grim believes that twin studies present "very powerful evidence that your blood pressure is set by something other than your environment." His studies on blacks in Indiana allegedly show that blood pressure levels and sodium excretion ability are "strongly inherited." He has also been studying black twins in Los Angeles and concludes that 60 to 80 percent of blood pressure variability is related to heritable factors.

Grim plans to do case control studies with blacks still in Africa matched with U.S. blacks, as well as studies of blood pressure patterns among U.S. blacks whose ancestors arrived after the abolition of slavery. The "benefits" of this research, according to Grim, will be the eventual identification of a genetic marker that could alert physicians to the predisposition for high blood pressure and lead to earlier changes in diet to prevent hypertension. But haven't nutritionists been telling people to eat low-salt diets for years? And what about higher stress factors for blacks—including inadequate housing, employment, medical and child care—contributing to hypertension? Sounds like another Grim fairy tale.

—Scott Schneider

MATH SOCIETY VETOES SDI

By a significant margin, members of the American Mathematical Society (AMS) voiced their opposition to the Reagan administration's Strategic Defense Initiative (SDI) program and to the extent of military funding in their field. This opposition came in the form of a referendum vote, the results of which were released on March 25, 1988. The mail ballot drew over 7,000 responses from the society's approximately 20,000 members—nearly twice the number that votes in elections for AMS officers.

The referendum's first resolution, adopted by a 57 percent majority, expresses the society's refusal to lend "a spurious scientific legitimacy" to the SDI program by endorsing or supporting it in any way. The measure states that the AMS "will lend no support to the Star Wars program" and that "persons representing the AMS shall make no efforts to obtain funding for Star Wars research or to mediate between agencies granting Star Wars funds and people seeking these funds."

G.D. Mostow, AMS president and professor of mathematics at Yale University, notes that the passage of this motion "reflects widespread skepticism in the mathematical community about the ability of the SDI program to achieve its stated objectives. It also reflects concern about SDI's incalculable cost and the

CONTINUED ON PAGE 6

2,810 NUKE ACCIDENTS

According to an annual report issued by the Critical Mass Energy Project in March, there were 2,810 accidents reported at the 105 operating commercial nuclear reactors in the United States during 1987. "The findings of this report indicate that the lesson of Three Mile Island has been forgotten by the nuclear industry and its friendly watchdog," claimed Kenneth Boley, one of the report's authors, referring to the Nuclear Regulatory Commission.

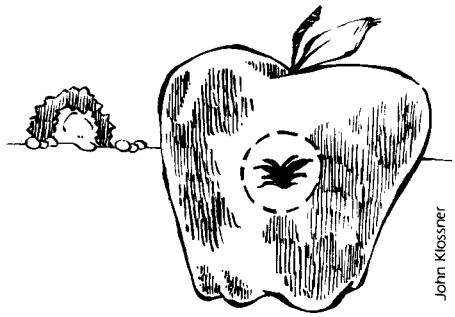
The NRC fined utility companies in only 46 cases, compared to 50 fines issued in 1986. The reprimands included the closing of the Philadelphia Electric Company's Peach Bottom reactor because operators were found to be sleeping on the job on a regular basis. At the Jersey Central Power & Light Company's Oyster Creek plant, the NRC proposed an $80,000 fine because a supervisor instructed operators to tie two valves open in violation of regulations. Five workers were fired from the Detroit Edison Company's plant after a trainee operator failed to notify his supervisor for two hours when reactor water temperature rose to dangerous levels.

NIH CLEARS ROGUE BIOLOGIST

Readers following the assorted manuevers in the biotechnology business might recall a brouhaha last August when biologist Gary Strobel, of Montana State University, released genetically altered bacteria into the environment without prior regulatory approval. Strobel's errant behavior earned him a slap on the wrist for violating Environmental Protection Agency guidelines on the release of engineered organisms.

Now the National Institutes of Health has seen fit to clear Strobel—who has been compared favorably by some observers with rough-'n-ready Oliver North—of any wrongdoing. The NIH Recombinant DNA Advisory Committee, which oversees university research involving gene manipulation, found that Strobel had not violated its rules since no recombinant DNA work was involved. The operative word, of course, is *recombinant*. Strobel's organisms were not created using the standard biochemical cut-and-paste technique. As far as the NIH is concerned, it's the means, not the ends, that count.

—*Tracey Cohen*



John Klossner

IRRATIONAL IRRADIATION

If you eat processed spiced foods, you've probably consumed some irradiated food already. But irradiated food that requires a label won't be on the shelf for quite some time—if ever—due to the controversy concerning its safety. Public concerns over toxicity may put an economic brake on food irradiation.

For many fruits and vegetables, foods that irradiation proponents claim will be preserved longer and through less treatment with fumigants and pesticides, irradiation promotes the production of carcinogenic and mutagenic substances such as formaldehyde, benzene and malondialdehyde, reduces the ability to heal cuts or bruises caused in harvesting, and increases the instances of softening, rot, and sensitivity to cold. Consumers, grocers, and food processors are wary of buying or selling food damaged by irradiation.

According to a 1987 survey by Opinion Research Corporation, 43 percent of those surveyed believed that irradiated food would or might pose a serious health hazard. Twenty-nine percent thought that irradiated food might be something of a hazard, and only eight percent thought there would be no hazard; the rest of those surveyed weren't sure.

Other public concerns with food irradiation include the long-term health effects of eating irradiated foods and the decreased nutritional value caused by irradiation. There are also well-founded fears about the environmental and occupational safety in the irradiation process, which uses radioactive cesium-137 or cobalt-60. Federal agencies including the Food and Drug Administration, the Department of Energy, and the Environmental Protection Agency are promoting irradiation as a means of reprocessing radioactive waste from nuclear weapons production.

Radiation Technology Inc. (RTI), an irradiation company with plants in Rockaway and Salem, New Jersey, Haw River, North Carolina, and West Memphis, Arkansas, is in deeper trouble with another federal agency, the Nuclear Regulatory Commission. RTI irradiates spices and medical equipment. The company's president and co-founder, Martin A. Welt, was indicted on March 19 by a federal grand jury on charges of conspiracy, obstruction of justice, and violations of the Atomic Energy Act.

The indictment charges Welt with submitting falsified documents to the NRC about company directives to bypass safety interlock devices that are required by law. The interlocks are designed to prevent workers from being inadvertently exposed to radiation from cobalt-60. Welt was also accused of covering up the safety deficiencies, calling a meeting of employees to urge them to lie to investigators about safety violations, and threatening to fire any employees who refused to participate in the cover-up.

Welt and William Jouris, the operations manager and nuclear engineer at the Rockaway plant, were the top RTI officials indicted by the grand jury. Welt faces up to $1.5 million in fines and 37 years in prison, while Jouris could be fined up to $1 million and jailed for up to 22 years if convicted.

On March 16, RTI's current president, Allan K. Booth, pleaded guilty on the company's behalf to two felony charges involving safety violations, including a charge that RTI submitted falsified memos to the NRC. He also admitted that company officials had lied to federal investigators and radiation specialists about the length of time RTI had operated without radiation safety monitoring equipment. The company faces fines of up to a million dollars. In spite of these charges and admissions of guilt, RTI continues to operate under a provisional license.

As far as many food sellers are concerned, the hazards and public concerns don't warrant the economic risk of carrying irradiated food on their supermarket shelves. "We wouldn't even touch that garbage," says William Allen,

owner of Chicago's Treasure Island supermarket chain. "Until such time as we believe it is satisfactorily received in other markets, with little or no opposition, we're going to follow the careful road," says Larry Nauman, the vice president of advertising and public relations at another Chicago-area chain. "I think the produce division has sent out a letter to our suppliers making sure they do not send us any irradiated foods."

—Leslie Fraser

WHISTLING AWAY

New Hampshire Yankee, operator of the still-stalled nuclear power plant in Seabrook, New Hampshire, issued an ethics policy in April designed to prevent workers from talking to the press about safety or health violations. The policy states that "employees shall not raise concerns by providing information to news media or other nonregulatory external organizations without proper authorizations."

In a cover letter to Yankee employees, company president Edward A. Brown stated, "I expect that everyone will adhere to the letter and spirit of the new policy. Failure to do so simply cannot be tolerated." All of Yankee's 700 employees and 600 contract workers are required to sign the policy. They are allowed to contact only the company's complaint board or the Nuclear Regulatory Commission with their concerns.

Advocates for whistleblowers and opponents of the Seabrook nuke claim that the NRC and Yankee officials have not dealt with allegations of health and safety violations in the past. Safety problems and drug and alcohol abuse among construction workers at the plant were only addressed by the company and the regulatory agency after reports were made to the media and environmental groups.

The new policy at the Seabrook plant points to the need for protection for workers who report health and safety violations. On February 23, 1988, Senator Howard Metzenbaum introduced the Uniform Health and Safety Whistleblower's Protection Act to the U.S. Senate, while Congressman Augustus Hawkins brought the bill to the House of Representatives on March 31. The bill would protect workers in the private sector by increasing the statute of limitations for complaints from 30 days to 180 days, allowing for immediate employee reinstatement, and requiring industries to post notices of employee rights and protections under the law.

In addition, the bill would close loopholes which have excluded employees in some industries, such as aviation and food and drug production, from protection. It would also prohibit courts from preempting employees who use state statutes to obtain damages and strengthen some OSHA protection provisions. The bill has been introduced into the Senate as S. 2095, and the House version is H.R. 4305. Contact the Government Accountability Project at 25 E St., NW, Suite 700, Washington, DC 20001 for copies of the bill and more information. And contact your senators and congressional representatives urging them to support this legislation.

John Klossner

HARVARD & DU PONT PATENT A MOUSE

You heard our warnings in the July/August 1987 Newsnotes in *Science for the People.* Following a Supreme Court ruling in 1980 that permitted the patenting of microorganisms and a 1985 U.S. Patent Office ruling covering the patenting of plants, the patent office approved animal patenting last year. In April, the first animal patent was issued to Harvard University for genetically engineered mice. But exclusive rights to the technology reside with the Du Pont company, major funder for the biotechnology research which created the mouse.

Twenty other patent applications for genetically altered animals are now being considered. Opposition to animal patenting—conferring exclusive rights and ownership of animals altered by genetic engineering techniques—is strong inside the science community as well as in public interest organizations. Two bills have been introduced to the U.S. Senate and House of Representatives banning animal patents.

The patented mice contain cancer genes that make them susceptible to breast cancer. They can be used to test the carcinogenic properties of small amounts of substances which they are exposed to, as well as aid in cancer therapy research.

But is it ethical to create cancer-prone animals—and then give private corporations the exclusive rights to those animals?

Newsnotes

CONTINUED FROM PAGE 3

waste incurred by premature deployment."

By a 74 percent majority, AMS members also passed a broad resolution asserting the society's concern over the extent of military funding in the field, which tends to support narrowly focussed programs and circumvents peer review procedures. "This situation may skew and ultimately injure mathematics in the United States," claims the motion. The resolution urges AMS members to direct their efforts towards increasing the fraction of non-military funding for mathematics.

Three other resolutions were passed by 88 to 90 percent majorities. These affirmed the respective goals of urging special support for individual investigator grants in the field, basic research efforts, and diversified peer review—all attributes which are notably missing from most Department of Defense grants in mathematics.

William Thurston, mathematics professor at Princeton University and one of the originators of the referendum motions, says that he is pleased not only with the strong passage of the resolutions, but also with the high turnout and what he calls "the vigorous debate" within the organization prior to the vote.

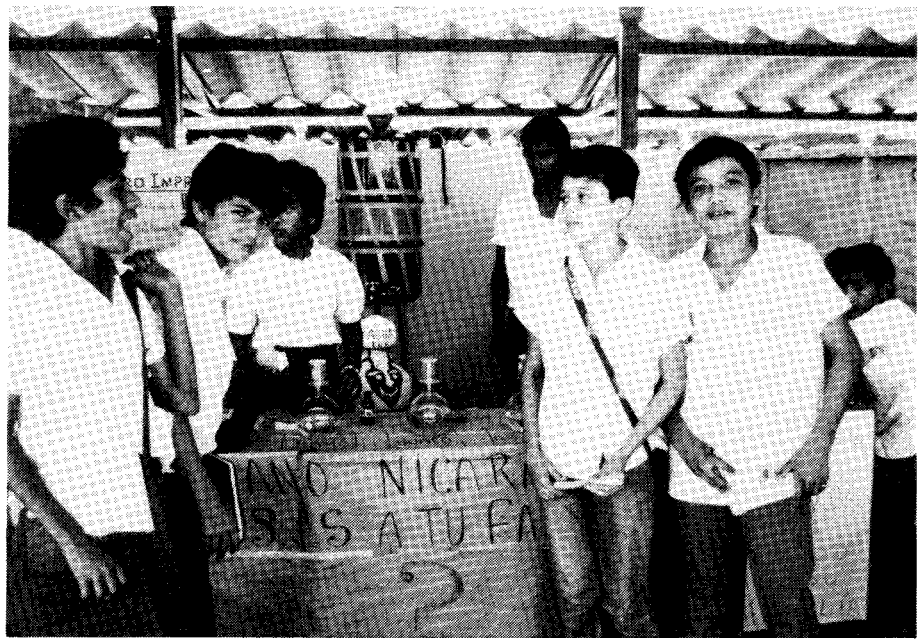
Thurston and a group of colleagues initially introduced the motions in the fall of 1986, in part as a response to a $10 million program in mathematics begun by the Defense Advanced Research Projects Agency (DARPA). In a January 1987 issue of the *Notices of the AMS* Thurston wrote, "Academia should be separated from the military. Military funding of research in universities, and of mathematics in particular, is bad for our society, bad for the universities, and bad for mathematics.

"The military pattern of funding has a large negative impact, since it attaches strong strings from the military to academia. Even in normal times, this channels the short supply of mathematicians into an intellectually limited range of topics, and distorts the debates on societal issues. In troubled times, the strings can be exercised to disastrous effect," Thurston concluded.

However, the issue of military funding of mathematics has stirred much controversy among AMS members in the past year, the tenor of which has been evident in a series of strongly worded letters in the society's newsletter from supporters and opponents of the referendum. For instance, John Polking, math professor at Rice University and former director of the mathematical sciences division of the National Science Foundation (NSF), strongly opposed the referendum, calling the motions "misguided" and "disruptive," and stating that funding decisions should be made by Congress, not by the AMS.

Thurston, who has called the referendum motions "a declaration of neutrality" for the field, says that the AMS vote illustrates that "there is a feeling in the mathematics community that we have been heading in the wrong direction." While he doubts that the vote will directly influence military funding levels, Thurston says he anticipates that "there could be many effects" from the AMS resolutions, including the possibility that other professional societies will be encouraged by the outcome to bring these issues to votes among their constituencies. —*Seth Shulman*

BY EMILIO PEREZ C.
NESTOR BONILLA B.
MAURICIO RODRIGUEZ R.
ALBERTO SEDILES J.
WILLIAM GAMBOA M.



Nicaraguan students display their filter for water purification and microscope setup at the national science fair in Managua in November 1984. Photo/Barbara Goldoftas

CREATING A CULTURE OF SCIENCE
THIRD WORLD REVOLUTIONARY SOCIETIES

With the triumph of the Sandinista popular revolution, Nicaragua obtained the most important part of true independence—political independence. This political independence has generated a rediscovery of national identity and an opportunity to gain complete independence. Consequently, Nicaragua is profoundly different from other countries in the region. Countries like Costa Rica or Guatemala, for example, may have more economic resources, but also have had their independence severely compromised in order to maintain such economic advantage.

To gain a truly complete and integral independence, the development of science and technology is fundamental and indispensable. First, a vigorous development of science is generally necessary for the development of an economy that is multiple, dynamic, and independent. Second, there is no such thing as a truly modern society without a vigorous scientific community. Third, the existence of a scientific tradition creates conditions in the society at large for the development of an ideology that is dynamic rather than static, critical rather than dogmatic, and realistic rather than utopian.

THE ROLE OF SCIENCE IN DEVELOPMENT

Any developing independent economy must have a basis in science and technology if it is to avoid stagnation and regression to a state of dependence. Only science and technology will permit the rational and efficient apportionment of natural resources and industrial development to satisfy the growing needs of the population. This is especially important in Nicaragua, a country attempting to forge a path to a new social and economic order, which of necessity includes a struggle against the interests and aggressiveness of the most powerful nation in the world. For this reason, it is necessary to transform, renovate, and reconstruct an economy that is truly independent, which in turn is not possible without a vigorous scientific and technical community. It is only through that community that it will be possible to intensify and diversify our economy, so as to safisfy our national demands and eventually to compete effectively in international markets.

It is apparent that there exists, within Nicaragua, a certain cynicism or skepticism with regard to the role of science in economic development. Perhaps such an attitude is the consequence of a particular political juncture (for example, the war of aggression by the U.S.-supported contras). But any society, all the more so in a revolutionary country, must recognize science as the best mode by which to understand and transform the real world. A society must not see only the arts and letters as the means of its advance, but rather must identify, in the development of science, a vital element to achieve the goals of the population.

At yet another level, science inevitably contributes to the formulation and development of ideology. An independent ideology that is dynamic, critical, illuminating, and realistic can be the most important element in the development of a nation that seeks to be independent in all its dimensions. It is imperative to have an ideology that is capable of transforming the minds of the population so as to differentiate between faith and science, between the real and utopian, and that can put appropriate tools in the hands of the population to enable it to solve its problems.

We can see in Nicaragua the attainment of great levels of organization and efficiency in defense of our national sovereignty. We must exert all necessary force to insure that the revolution also considers as a major priority the development of science and the formation of scientific and technical cadres. For this reason, it is necessary to define a politics of scientific research that is realistic and integral, that provides scientific and social production for the development of the Nicaraguan revolution.

BASIC AND APPLIED SCIENCE

Throughout the history of modern science it is possible to recognize two major tendencies. First is the science that

The five Nicaraguan authors teach at the Instituto Superior de Ciencias Agropecuarias (ISCA), the Advanced Institute of Agricultural Sciences in Managua. John Vandermeer and Ivette Perfecto teach biology at the University of Michigan and are members of the New World Agriculture Group. John Vandermeer translated the original manuscript from Spanish.

has as its foundation the search for the "truth," which is to say an understanding of the world in a form that is systematic, organized, analytical, and objective. In this case, science is similar to art. Its appreciation is in its existence, with no pretense that it should apply to an immediate solution of any particular problem. The other tendency is a science that has its foundation in the search for immediate solutions to concrete problems, also in a form that is systematic, organized, analytical, and objective.

The first category is called pure or basic science, and the second is called applied science. Obviously, this categorization is not easy to define in the majority of cases and should be treated conceptually as a continuum between basic science and applied science.

The importance of applied science is in its search for solutions to problems that present themselves daily to humanity. But in the development of technology, applied science is fed by basic scientific knowledge.

The ultimate goal of basic science is the continual search for the truth, organized and objective. The job of basic science consists of first providing the ultimate material bases for applied science and technology and, second, establishing the fundamental bases, theoretical and philosophical, of the new society.

TOWARDS THE DEVELOPMENT OF A CULTURE OF SCIENCE

In Latin America, from a general historical perspective, the first steps towards higher education were taken for the purpose of developing professionals who could resolve the various problems of the dominant elite. This is apparently the reason that still, today, the number of graduates in the principal specialties (medicine, agronomy, and engineering) do not satisfy the necessities of Latin America.

As a result of the original implantation of political systems and economic structures which were not in the interests of the populations of Latin America, our economies still are founded principally in agricultural and mining activities that do not require anything from our universities, since they are based on technologies generated in the developed countries. Furthermore, the most relevant industries are subsidiaries of external societies which do their research and development in their countries of origin to develop new products and processes.

This arrangement means that the improvement of production technology, the creation of new ideas, and the application of these ideas to production—work which corresponds to that of scientists and technicians who should be trained in universities—is accomplished elsewhere. Thus there has never been a need for the development of independent scientific institutions or modern universities.

It is hardly necessary to elaborate on the role of institutions of science and education. Independent scientific institutions and modern universities give rise to scientists and youth that are conscious of the underdevelopment of their countries. They demand universities that will be truly dynamic and generate research and development activities, with an attendant structure that will attract other researchers.

Modern economic theory now recognizes that technological innovation plays a central role in production. Innovation has specific characteristics: it may satisfy extant demands or generate new ones; it may be the direct or indirect result of research and casual observations and intuitions; it may have as its inducement the requirements of the market, the substitution of imports, or the scarcity of raw materials. Innovation also has specific obstacles of various forms that must be overcome: sociocultural, economic (e.g., monopolies), financial (e.g., lack of investment capital), political (e.g., inadequate legislation), and scientific (e.g., a weak scientific-technical infrastructure).

Ever since the Second World War, technological innovation in any society is coordinated among three primary elements: the government, the scientific-technical infrastructure, and the productive structure of the economy. These three elements can be represented as vertices in a triangle whose sides thus represent the corresponding interactions.

The governmental vertex forms the political framework for the productive structure and the scientific-technical infrastructure. The productive structure vertex is the conjuncture of productive sectors which provide the products and services that society needs. Finally, the scientific-technical infrastructure vertex forms the educational system, the institutional system of scientific centers, the necessary administration of such centers of research and education, and financial resources as

Photo/Barbara Goldoftas

Award-winning project at the 1984 Nicaraguan science fair on control of nematodes through marigold-coffee intercropping.

AGRICULTURAL EDUCATION IN NICARAGUA

BY JOHN VANDERMEER & IVETTE PERFECTO

During the years of Anastasio Somoza's dictatorship, the *Facultad de Ciencias Agropecuarias*, the Agricultural College of the *Universidad Nacional Autonoma de Nicaragua* (National Autonomous University of Nicaragua, UNAN), located just west of the International Airport on the outskirts of Managua, was the training ground for the majority of Nicaragua's agricultural technicians—those not sufficiently wealthy to go to the United States to study. It was the nation's agricultural university, second in quality and prestige to UNAN in Leon, but first in terms of the number of students actually graduated in agricultural sciences. A bulk of the teaching was done by faculty members provided by the United States. It was never famous for its quality of education, and it never even aspired to be a major research institution.

After the Nicaraguan revolution in 1979, the *Facultad* continued to function, but without the substantial input of faculty members from the United States. The number of students increased dramatically, given the revolution's high priority on education. Furthermore, in keeping with traditional global visions of university education, research became a top priority. But at the same time, the number of highly trained professors decreased dramatically, since many had been provided by the United States. And the input of equipment and supplies, much of which had also come from the United States, ground to a virtual halt.

Thus, a contradictory situation was established. On one side were the lofty goals of a new democracy, stimulated by the enthusiasm of the revolution, which increased student enrollment and generated a great deal of rhetoric about the need to develop high-quality agricultural research activities. On the other side were the substantial deficiencies in physical plant, materials, and human resources, conditioned by decades of dependency and underdevelopment.

In 1986 the *Facultad* gained its autonomy from the UNAN and became an independent institution called the *Instituto Superior de Ciencias Agropecuarias* (ISCA), the Advanced Institute of Agricultural Sciences. The ISCA now offers a full five-year program leading to a bachelor's degree in agricultural sciences, with a specialty in one of four areas—plant protection, animal sciences, agronomy, and forestry—and concrete plans to initiate three more specialties in the areas of humid tropics, agricultural engineering, and agricultural economics.

Photo/John Vandermeer

Technicians from the Ministry of Agriculture demonstrate new methods of bean seed production to local farmers.

The New World Agriculture Group (NWAG) began its program of scientific cooperation with Nicaragua in 1981. One of the principal institutions in which we began work was the UNAN's *Facultad*. NWAG members taught and conducted research in association with the *Facultad* in 1981, and now continue our work with the ISCA. In February 1986, the two of us arrived in Nicaragua to spend 16 months as visiting professors at the ISCA, under the auspices of the New World Agriculture Group.

The lofty goals of the ISCA, combined with the shortages in material goods and human resources, resulted in a climate of remarkable intellectual fervor. Our own participation in this fervor was diverse, but highlighted by a seminar series during 1986 and 1987 on the philosophy and politics of science with a group of faculty members from the ISCA. Five regular participants (the authors of the accompanying article) were occasionally joined by one or two other faculty in weekly sessions during which critical readings were discussed, mainly with the idea of applying their principles to the concrete situation in Nicaragua.

Readings ranged from traditional history and philosophy of science writings from authors such as Bernal, Bunge, and Kuhn to lesser-known Latin American writers, and included such Science for the People regulars as Richard Lewontin (on hybrid corn) and Richard Levins (on science in the Third World). These discussion sessions continued for approximately six months and were marked by a high level of intellectual activity, enormous interest, and an occasional intragroup comradely combativeness that would easily rival the intellectual debates so common in university settings in the developed world.

After approximately five months of these discussions, the group (independent of the two of us) decided that it would be good for the general intellectual community at the ISCA to be privy to the conclusions we had come to. The group thus decided to commit to writing the analysis that came out of our seminar, with the idea of generating debate on the issues in the ISCA in general. During the next month, our weekly seminars were devoted to the writing of this document. Our own participation was as advisors to our five colleagues.

The resulting manuscript was distributed to key members of the ISCA and has generated internal discussion of the underlying philosophy and direction of that institute. It was published, in part, in the Nicaraguan daily newspaper *El Nuevo Diario*. The first half of the document is published here for the first time in English. The second half is specifically targeted at internal conditions in the ISCA and is thus not of general interest.

We would be interested in reactions to these ideas from Science for the People readers. We remain in continual, if less regular, contact with our Nicaraguan comrades and will share your observations with them. Your comments may be sent to us via the New World Agriculture Group, Department of Biology, University of Michigan, Ann Arbor, MI 48109.

needed. In this triangle, there exist dialectical relationships within the vertices, between vertices, and between the vertices and the external medium.

In this essay, we have been and will continue concentrating on the scientific-technical infrastructure. With regard to this element alone, we can categorize Third World countries into three overlapping categories:

A. Countries with poor education and without a scientific-technical infrastructure or a national consensus for the development of science and technology.

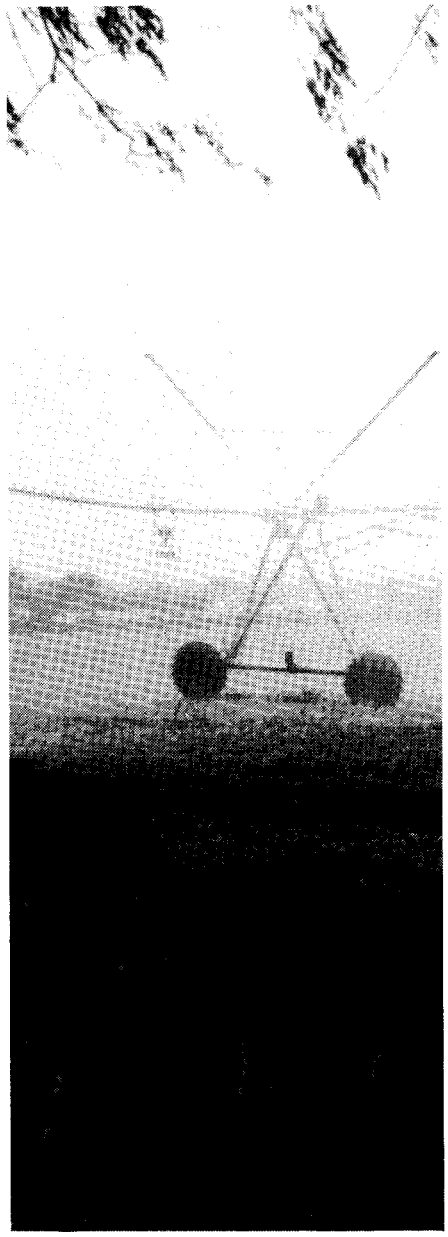
B. Countries with well-developed education, weak scientific-technical structures, and a national consensus for the development of science and technology (at least nominally).

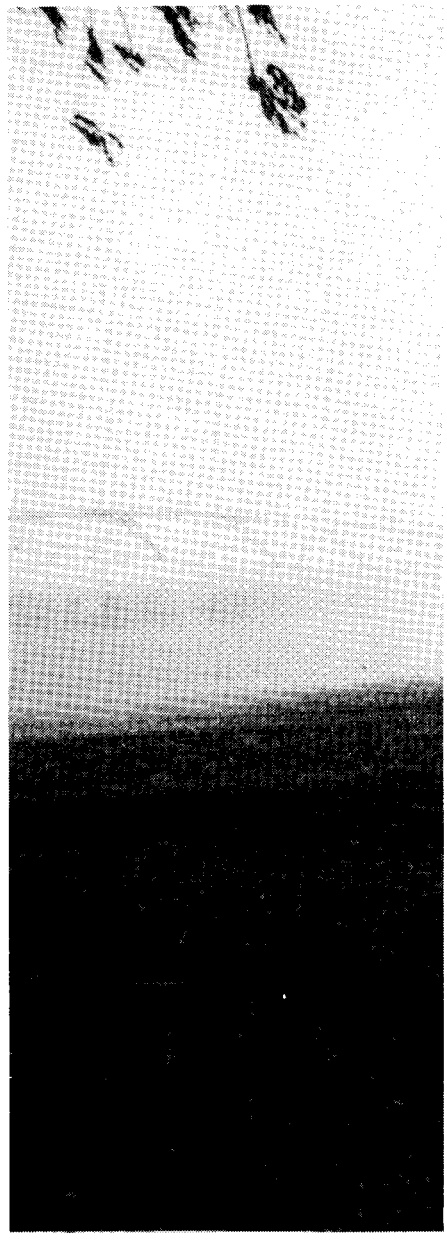
C. Countries with science and technology incorporated into the society, becoming important elements in its wealth, power, and prestige.

Nicaragua belongs in category B and should have the objective to rise into category C. In our case, in place of endless discussions—for example, on whether research should be basic or applied—we should take as our primary principles two fundamental concepts: First, the only manner to reach an infrastructure of research is precisely to engage in research actively. And second, there are only two classes of scientific research: good and bad. Therefore, we should be striving actively to carry out research, and we should strive to make that research of a very high quality.

In the process of developing high-quality research activities in our country, it will first be necessary to develop our capacity for doing scientific research. For this goal, we see two types of action as necessary. The first action should be the strengthening of the scientific-technical infrastructure, which means increasing the quality and quantity of research, making changes in the structure of the university, reinforcing the existing centers of research and creating new ones, drastically changing the salaries and status of scientific personnel, helping the industries that promote investigation, and developing effective systems of scholarships and fellowships. Also, it is necessary to protect researchers from institutional instability.

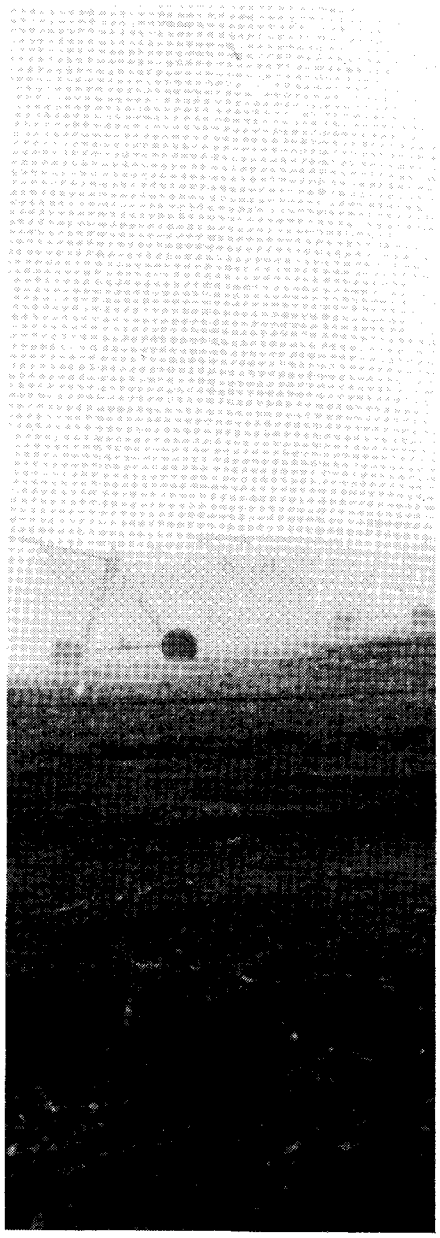
It is worthwhile to note that, in Nicaragua, this first action is not inevitably frustrated, as it frequently is in other countries in category B. We are, in many ways, a germinated seed. With the triumph of the revolution, we have acquired certain tools (not all that would be necessary, by any means) that will help us overcome the obstacles and problems that traditionally plague a country in category B. We feel that we are now in a position to grow to a seedling and finally bear fruit, due to the special conditions created by the Sandinista revolution.





The second class of actions we feel are especially important. They are those that promote the popularization of science. These actions are driven by the fact that the society in general must understand (and be convinced of the fact) that science and technology are, in essence, creative processes. The lack of comprehension of this fact, at its fullest development in the leadership class, is one of the key factors why, in the B countries, the consensus about science and technology remains nominal and unrealistic.

At every opportunity, the responsible authorities are quick to point out that science and technology are "absolutely vital for the health, prosperity and security of the country." But the reality is that the effective support for this position is minimal, despite the fact that the country's economy could tolerate more. This attitude indicates that while authorities understand that science and technology should be developed, they do not really have confidence that it can be done.



The principal argument, often concealed, is this: "Science and technology have advanced so much that we can never catch up. The only option for us is to import all the science and technology we need from the developed countries. The conditions of our country do not permit the pursuit of original scientific research and the development of new technological advances."

Yet, as proponents of this argument are totally negating the possibility of significant indigenous scientific creativity, a rich aesthetic creativity flourishes around them. The same society that excludes the development of science is capable of producing poets, writers, painters, and musicians who are equal to and frequently excell over their contemporaries in the developed world.

This situation is a consequence of diverse factors, but the most important one is that, with respect to the arts and letters, all members of our society know full well that the creative process is a human characteristic that cannot be dominated or monopolized by any country. In the case of science, few know or admit that the same or a similar creative process is involved. We encounter a typical example in Nicaragua, where we have seen a great flowering of artistic activity in diverse fields such as dance, music, and poetry, while advances in science and technology are virtually nonexistent.

These actions must establish a creative environment for science and technology similar to that which exists for the arts and letters. Each member of the society must come to really believe that "the development of a nation cannot be achieved if science and technology are magical, imported things. They must be converted to a habit of the people." In essence, the popularization of science is absolutely indispensable.

Similar to the first class of actions, this class is applicable to Nicaragua in a distinct way. Certainly Nicaragua has achieved some structures that will make such actions easier than in other B countries. Some of the leadership understands the need to develop scientific research and has the will to carry out such development. We have concrete examples of popularization in our science fairs and production fairs, the university days of scientific development, and the innovators program. Nevertheless, this is the action that requires more institutional support to become of major importance, so as to take its proper place in the educational system and thus diffuse among all sectors of the population.

A center pivot irrigation system at a cooperative just outside of Managua. Although such high-tech equipment is available to cooperative farms, this coop is losing money every year due to the high energy costs associated with running the irrigation system.

BY ROBERT V. LANGE

I returned from Tanzania in early April of 1987. I had been teaching as a visiting associate professor of physics at the University of Dar es Salaam. In my state of returnee shock, I drifted around, trying to get the familiar to make sense once again (and at times not sure that I wanted it to). People asked me what I had been doing in Tanzania. When I answered that I had been teaching physics, they would often blurt out, "But they don't need physics there."

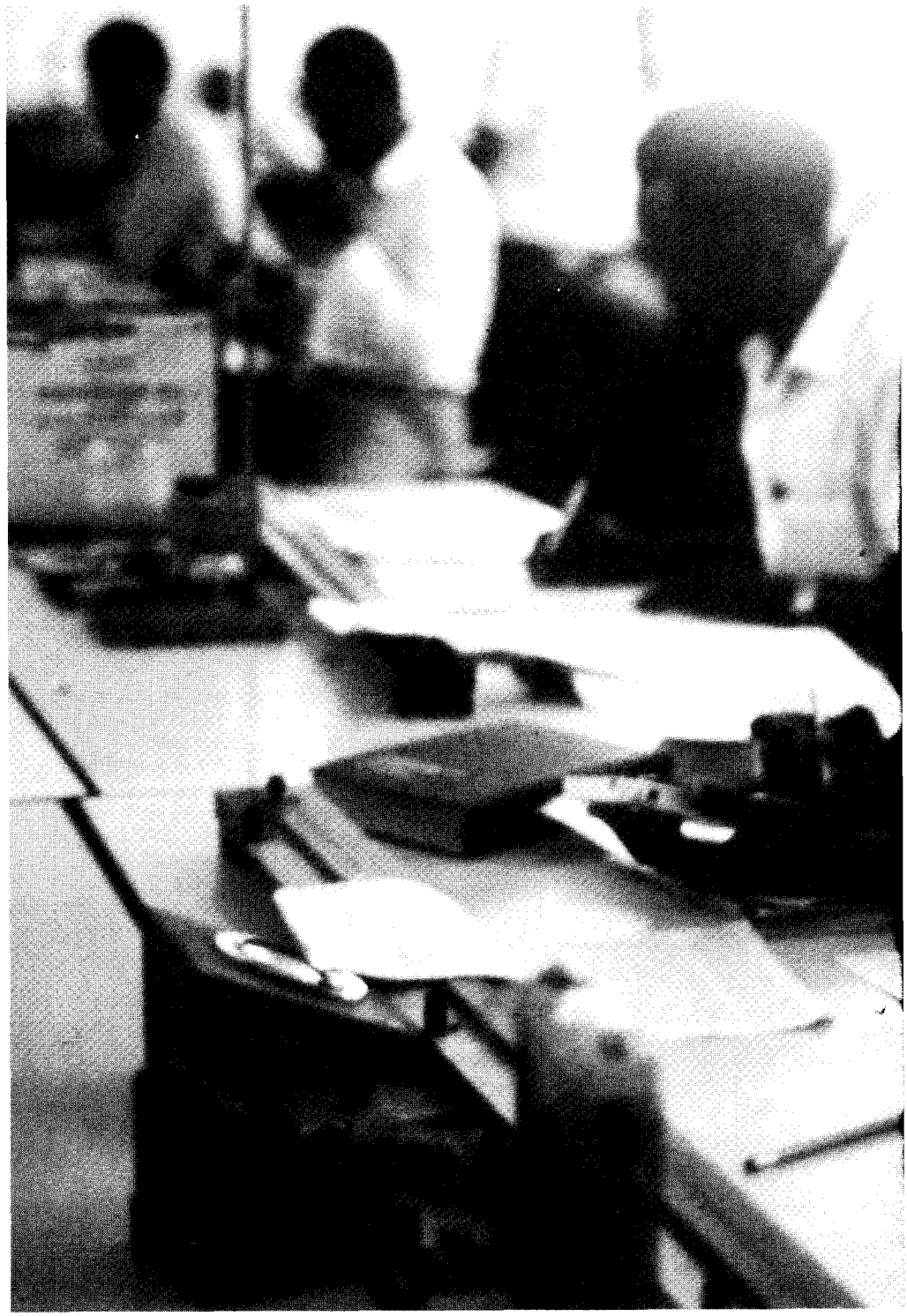
There are strange bedfellows with the idea that in a country like Tanzania, in its stage of economic development, science is the last thing anyone would need. You might hear it from a university professor: "We had an African in our department. What were we doing for him? We just gave him the taste for things he can't possibly use at home. When he gets home, he should be helping to solve basic problems in health and agriculture, and now he will want to work with fancy equipment on abstractions."

Or you might hear criticisms from someone grappling with feminist theory: "Physics as we know it is coming out of a culture and economy bent on control and exploitation, and ultimately on domination and power. It is precisely in the Third World where we must not impose our ideas of science, but let a new science have a chance to be born, coming out of cultures not yet obsessed with the domination of nature, as is ours."

These are two ostensibly progressive formulations which, simply put, say that for the sake of people in Third World countries, or in the hope of cultivating a new science for all of us through the practice of people in these countries, we shouldn't tell them how or what to think. There are also reactionary and racist reasons for refraining from the teaching of science in Third World countries. These are based on overt paternalism, superiority, supremacy, and plans for exploitation, and need not be elaborated in this article.

But the Tanzanians I met at the university—as citizens, intellectuals, and as students and teachers—certainly want physics to be a part of what they learn and work on. And while I make no claims to have deeply experienced the popular culture and cannot speak for the typical Tanzanian villager, I did meet and get to know people away from the campus and never heard any negative reaction to the idea of teaching science in their country.

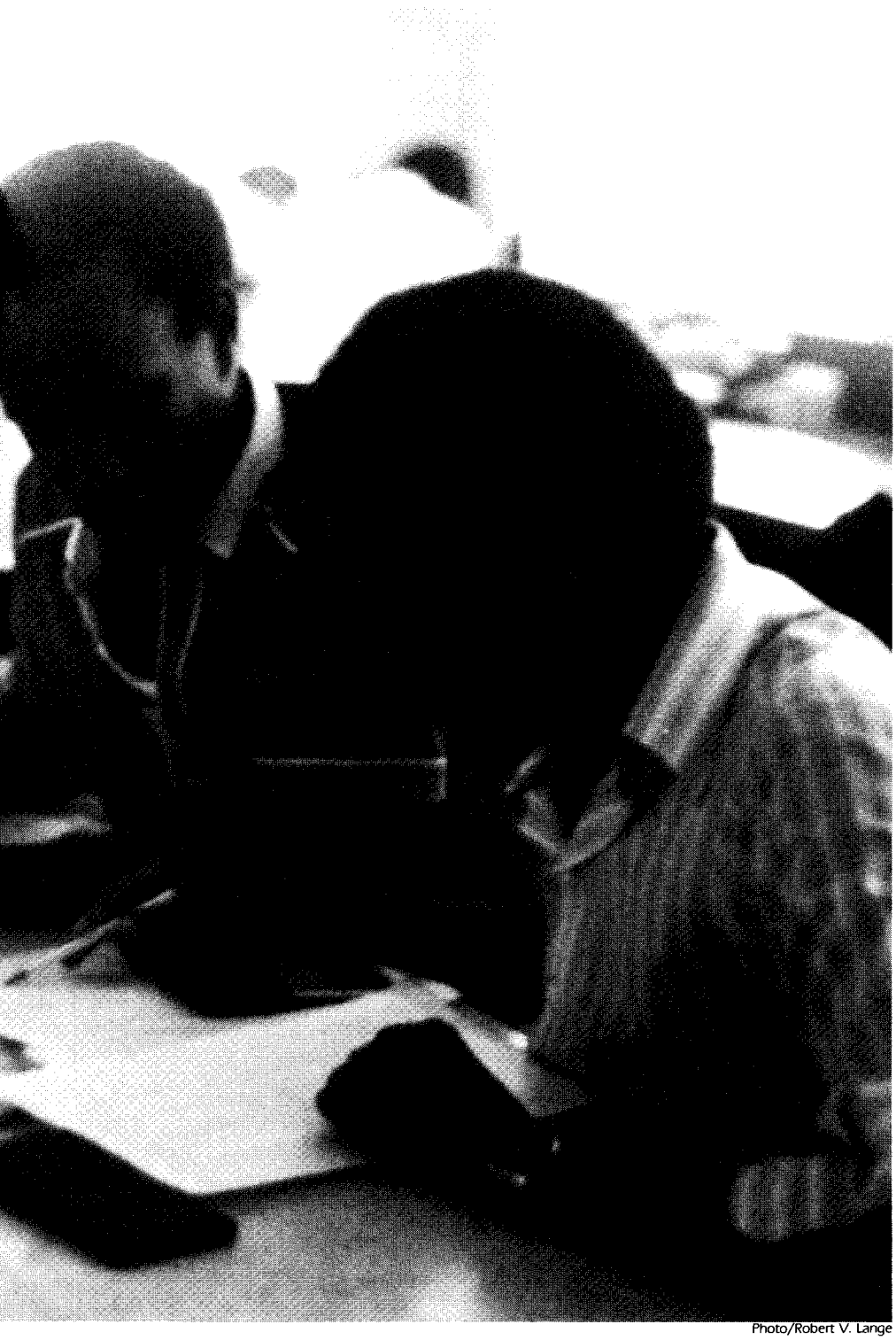
The educational system in Tanzania, as in much of the postcolonial world, has a complex mix of styles and institutional



TEACHING PHYSI

SCIENCE AS E

Robert V. Lange teaches physics at Brandeis University and develops multicultural educational programs for science teaching. A longtime member of SftP, he is active in our Science for Nicaragua program.



Photo/Robert V. Lange

CS IN TANZANIA
MPOWERMENT

practices derived from local, national, and international influences. I do not have the experience to completely sort out these influences, but one can see institutional practices explicitly modeled after the systems of European colonial and religious institutions. This is most evident in Tanzania in the system of syllabi that control rate of work and course content, as well as in the entrance and university examination system.

INTERVENTION AND INTERNATIONAL PARTICIPATION

We are inspired by societies that break with domination and dependency, striving for self-rule and self-reliance. Tanzania, independent since the early 1960s and working toward a noncapitalist and economically mixed development scheme, along with Nicaragua—to mention one other obvious choice—are arenas for our support and possibly our participation.

Healthy and constructive participation in the development of science and technology in so-called Third World, developing, low-income, southern, revolutionary countries is possible and desirable. And I think that the teaching of basic and even "pure" sciences is not only an acceptable thing to do, but ultimately a very helpful and constructive activity, and may even be one of our most positive contributions. But we must confront some deep and difficult questions connected with this sort of participation and intervention.

Who are we foreigners who transport our technical skills? We are wealthy, healthy, traveled people with a lot of information about many things. We are powerful in that wealth and experience, and perceived as powerful. We do not really understand the host culture, but rather are carrying preconceptions that were powerful enough to get us to travel there in the first place. But the power of those presumptions may complicate our ability to perceive the reality we have entered.

Some aspects of our preconceptions are important to us, regardless of their veracity. We may need to idealize the country we are visiting, convincing ourselves that its culture is better in aspects that disappoint us at home. We may want to believe that there is an indigenous science that surpasses our own in certain areas. We may want to find that our hosts have more respect for nature than does our own culture.

We may be unprepared for the authority relations and hierarchies we find operating. We may be uncomfortable in the role we seem to have in these relationships. Gender politics may be very much behind the times from our point of view, with opportunity and social position for women confusing,

limited, and upsetting. And public priorities may be disturbing, with the government seeming to want forms of development that we wish it would not.

There is a large community of Americans (called North Americans in Central and South America, and just known as Americans nearly everywhere else) who have ventured out, well meaning, perhaps conscious of the need to avoid "cultural imperialism" and general arrogance, armed with antimalaria pills, diarrhea remedies, books, floppy disks, and ball-point pens. We have traveled in a variety of ways: sometimes as parts of aid programs, with or without fellowships, to do our thesis work, as part of the Peace Corps or solidarity movements. We have all had our lives transformed in one way or another.

At the University of Dar es Salaam, there were a few people on Fulbright fellowships, two Peace Corps volunteers, about twenty students from Brown and Saint Olaf's doing their junior year abroad, and a couple of those wonderful people you find around the world who are still American or British or whatever, but simply never found their way home again, for the right reasons.

I had obtained a job as a visiting professor by approaching the department directly. I was not in any of the programs connected with U.S. institutions and had not used the normal channels and procedures of the university to get my position. This gave me a pleasant sense of independence that was a great help to me in my adjustment to the new environment and situation.

DELIVERING FOREIGN AID

Outsiders, in spite of our various motives, are all delivering "foreign aid." Most of the *gringos, wazungu,* or other foreigners who are doing much the same work with us are explicitly there on government-sponsored projects. German and Swiss engineers are in Tanzania installing equipment in the new buildings of the engineering department. They are paid by their home governments, in hard currency, sometimes in the amount of $300 or $400 per day, in addition to local benefits.

Lots of activists participating in European programs analogous to the U.S. Peace Corps are found in these countries. Medical and educational missions abound. There are Dutch doctors working in villages, German curriculum developers, teacher training experts, Japanese road builders, and people installing factories for textiles, building materials, and other industries.

Most of the time, we associate foreign aid with governments trying to solidify patterns of hegemony and control through the distribution and manipulation of needed material and information. But our interventions do not automatically avoid the pitfalls that other aid programs encounter. Just because we are "from the left" or mean well or are nongovernmental doesn't guarantee anything.

All people administering aid who are not directly connected with counter-revolutionary or short-term profit motives think of themselves as progressive. They all grapple with questions about the appropriateness of their projects, the involvement of local people in project design and implementation, and their ultimate transfer to the people of the region.

We must work hard to find out how we can, both in spite of and because of who we are, participate in a process of empowerment rather than a process that entrenches the relationships of dependence.

BEYOND TECHNOLOGY TRANSFER

Historically, colonial engineering, and often postcolonial engineering as well, consisted of installing and operating equipment. Engineering knowledge, to the extent to which it was transferred in the colonial setting at all, was just the information required to perform the tasks.

Dr. Romulo Ballestero, a physicist teaching at the National Engineering University in Managua, made this point to the Science for the People delegation to Nicaragua in 1986. He went on to say that physics and the other sciences had been traditionally conceptualized and taught to conform with that idea of engineering. Put another way, this engineering consists of implementing processes and procedures conceptualized outside of the society where it will be introduced and selected for their specific function. It is not the engineering of problem solving through invention.

What is the science that is analogous to the engineering of installation? It is certainly not the science of the inventor, who sees the "laws of nature" as themselves inventions of people bent not only on seeing how the world is, but also driven to change some things about it so that the world becomes more like it should be.

Feminist criticisms and theory are giving us insight to better understand obsessions with the power to alter the world, to shape it, and to finally sell it one way or another. But what we might call scientific behavior does not lie along a one-dimensional continuum, with the frantic destructiveness of a masculinist science run amuck at one end, and a total renunciation of the urge to transform the world at the

Photo/Loriana Castellani

Photo/Robert V. Lange

other. Passivity and destruction must not be our alternatives. In particular, the people in Tanzania and Nicaragua, and other countries that we are drawn to support, have many transformations to make on their world, and they have a role for science in all of that work.

While some of the motivations and decision-making processes may have changed, the delivery of single-purpose, targeted technical assistance was the aim of colonial technology and still goes on today in most aid relationships. The masters, or now the mentors, decide which elements of modern technology are appropriate, and these elements are delivered in isolation. This method is efficient, goal oriented, and even absolutely necessary in some crisis situations. But in the absence of the development of local inventiveness, such technological paternalism perpetuates dependency and weakness.

Technology, in this pattern, consists of the delivery of isolated machines, methods, or projects which can solve specific problems. The technology is provided from the outside, already chosen to suit its targeted need. Local people are trained and work alongside the provider, and a phenomenon called technology transfer is supposed to occur. The experience of working with the donors is supposed to cause some permanent change in the recipients so that they will continue the work, keep the machines going, and develop a level of competence that will make the transplanted technology thrive. It often does not.

The weakness of the technology transfer process has been the subject of intense study. In Tanzania, textile plants were installed by five different countries wishing to help decrease imports and add value to exports. Productivity in these plants has been dropping since the first surge that accompanied their establishment. The experience of helping to install a factory or an engineering machine shop does not automatically lead to a transfer of those characteristics of labor management and working conditions in western industry that seem to keep an enterprise going and expanding.

MAKING ENDS MEET

Tanzanian educational institutions work with very limited economic resources and shortages which constrain the system. All teachers must pay attention to financial projects outside of their formal jobs in order to make ends meet. This phenomenon, the existence and absolute necessity of the so-called informal economy, is found worldwide, and must be understood.

Here in the first world, many of us academics have a hustle or two on the side, an extra job, or a little project to make some extra money, but we do not depend on these to live. In countries like Tanzania and Nicaragua, this extra economic activity is absolutely necessary for survival itself. The level of this activity can vacillate and depends on inflation, a person's family situation, the need for hard currency, the fluctuations in the availability of goods, and many other factors. When I was in Tanzania last year, a person on or near a minimum wage had to multiply their income by a factor of about four to live without constant economic emergencies.

The variety of activities of the faculty members was impressive. Becoming involved in transportation was one enterprise for some. With about $3,000 dollars saved while abroad doing graduate work, one could have a reconditioned Japanese pickup truck delivered to Dar es Salaam. A cousin from up-country, living with you in your university house (provided on campus for twelve percent of your salary) could drive the truck in the

city all day, transporting goods and people.

Many of the faculty have *shambas*, small plots of land, and grow cassava, pineapple, or other produce. Often a relative lives in a hut on the *shamba,* tends to the plants, and prevents theft. A well-managed plot can more than double a faculty salary.

The margin for accommodating misfortune in all activities, official as well as in the informal economy, is small. That is, while things may be working pretty well, small problems can cause major disruptions. The most obvious is vehicle breakdown: spare auto parts are scarce. In operating a *shamba* near a city, water supply is affected by fluctuations in distribution. Water isn't always available. And theft in any enterprise can be sudden and total.

In teaching, supplies fluctuate. For example, the physics department office at the university had one roll of scotch tape. But that roll could be misplaced, or the person with the key to the drawer in which it was locked could be away for awhile, and any activity needing the tape had to be put on hold.

THE POWER OF TEACHING SCIENCE

Science teaching in Tanzania raises issues about power relations that are more pronounced, but similar to those in the U.S. Science is approached through a religious state of mind. Science is the WORD. Science is a collection of laws and facts that must be learned. They come from afar. Facts and laws have domains. They have applications. They have truth.

When I began teaching in the University of Dar es Salaam, I was given the first year core course for physics majors. It was to be a rather typical calculus-based course of the type one finds in universities all over the world. However, there were no text books for the students. They had not been imported due to the general shortage of hard currency. The student book allowance amounted to only a few dollars a year of real buying power anyway, so had there been books in the bookstore for my course, the students would not have been able to afford them.

The students did have paper for taking notes, but normally there was no paper available to mimeograph problem sets or lecture notes. There was a small photocopier in the office of the departmental chairperson, and I knew where there was a little secret pile of photocopy paper, but that had to be used only in emergencies. When I wanted to give a quiz, I would make sure the departmental secretary typed the mimeograph stencils a week or two before the quiz date, because that way, if some paper for the mimeograph machine came through, I would be able to jump on it in time.

This sort of general shortage only makes your words even more sacred. The very sentences you utter become the course content because there is no alternative source. Furthermore, the courses are organized around rather specific syllabi that must be covered and examined, which establishes an atmosphere requiring strict adherence to the material, no matter what. The students were generally loaded down with course work and labs from early morning to late afternoon. Independent study and visits to the library, where some books and alternative sources could be found, were difficult.

The grading system is based on British-style percentages: 75% is an A, 68% a B, and so on. All of my grades were reviewed by the department as a whole, and all exams were evaluated by the examination committee of the department before they were administered.

What I am describing is a system that is rule-laden. Of course, the faculty members administering and implementing this system were at times flexible, cared a great deal for the students, and were themselves interested in the science they taught. But one can see how the educational structure, coming from a mixture of indigenous and ex-colonial cultures, interacts with material shortages to enhance the promulgation of the belief that science itself is a given. However beautiful and interesting, it is not a science of human invention that invites participation.

In this context, the teaching and intellectual style of an American carrying already anti-authoritarian tendencies engendered in the U.S. could be an exciting but a confusing and threatening problem for the students. My students told me of the anxieties I created for them. They said to me individually, and through their elected class representative, that they understood what I was trying to do and they appreciated that I was taking the time to actually explain things to them. But they feared that I would not cover the syllabus, would have my final thrown out by the external examiner, and that they would lose a whole year in their physics education.

I discovered that it was impossible to have what was just a conversation about the physics I was teaching. Students who I thought were chatting with me in my office about possible approaches in an optics project they were working on with me put my remarks into their written reports. In the atmosphere of authority and shortage, my remarks took on a significance I could not anticipate.

THE SCIENCE OF EMPOWERMENT

This may provide a glimpse of the situation in which one faces the questions of empowerment versus domination. At the personal level, in terms of one's own voyage through this life, the experience of living and working in a culture, meeting the people, learning how to cope, and growing and learning may be sufficient ends in themselves. Such selfishness may be acceptable if acting it out is not destructive of those around you. But as activists, educators, and people with values that make us care about the self-determination of others, the hedonistic rationale is not sufficient.

If we want to participate in empowerment rather than domination, the key is to find ways to teach that encourage activism, invention, and choice. We can see in ourselves those attributes tied to our worst side, the side that is arrogant and manipulative, but which also give us the power to act, to solve problems, and to take control of what needs to be controlled. But this active attitude toward science can never be shared, or even communicated, as long as we continue to think that we can identify and deliver those things "they really need."

We do not know which parts of science and technology are the ones that make us inventive and powerful. We cannot isolate them and deliver them. We only know that within the body of scientific knowledge and practice lies the possibility of self-directed and constructive activity. We must share all of science.

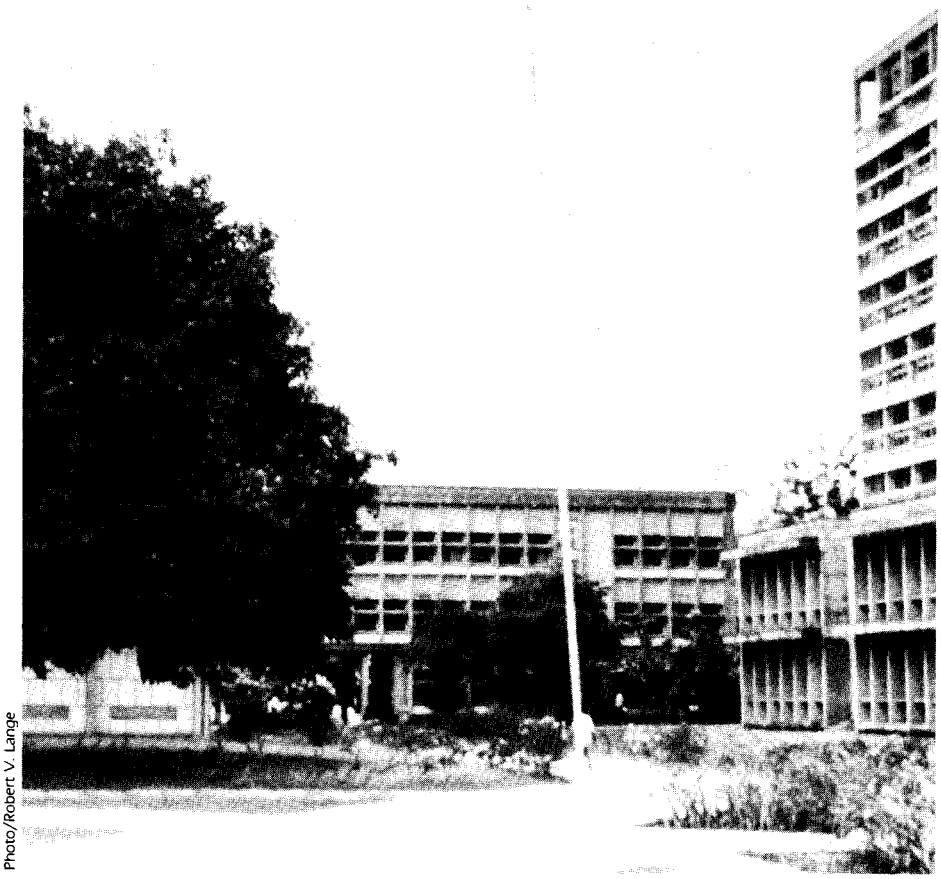
So we must finally explore the act of giving. Is generosity possible? When we approach the interface between two peoples, and that interface is a power interface and not just a cultural one, can we speak and not control? Then what is the basis of sharing power?

GIVING WHAT IS ALREADY THEIRS

In their book *The Dialectical Biologist*, Richard Levins and Richard Lewontin have grappled with this question. We must all bring our experience to the problem of sharing the power of science, and I will try to add my few words to help. The key is to realize that the science you know, that you are connected with, already belongs to them. Contrast this with the idea that scientific knowledge is yours, and you are going to select and deliver to them that part of what is yours that you have found them to need.

Think about the implications of giving to someone something that is already theirs. First, you do not control what they do with it. If it is truly theirs, it is theirs to control. Something that is yours is used according to your own choices.

Second, you do not decide which parts of it they should have. That is not your business. You can help them see the entirety of what they and you own, and you can explain how you have found certain parts of it useful in particular ways. But it is all theirs. We admit that we do not know the full anatomy of creative science.



Photo/Robert V. Lange

Photo/Robert V. Lange

We do not judge which parts are necessary for a flowering of creativity. The esthetics, the abstractions, the theoretical and practical are interrelated, and it is their task as much as ours to make sense of this interrelation.

Third, you realize that they will want to see how the parts make sense and acquire priorities according to the relationship to their own culture. The science you introduce may replace some of their culture in ways we might wish it wouldn't. But it is theirs.

Fourth, science history is their history. Isaac Newton is theirs. He has as much to do with an East African as he does with me. Neither the color of his skin nor his European home make him belong to whites or Englishmen. It is not our place to share the works of "our" Newton. We had to choose among his accomplishments, given our culture and intentions. They will do the same.

Finally, the understanding that you are distributing something already belonging to the culture which you are visiting releases you to be a person of your own culture: to argue, to disagree, and to struggle with your hosts about values, the uses of science, gender issues, and the politics involved.

The realization that you share science completely, in spite of the absurdity of its maldistribution and the power that gives you, is finally your liberation too. Now you can approach your hosts as an equal. You do have ideas and priorities and experiences and values. The embarrassment and false humility can be abandoned.

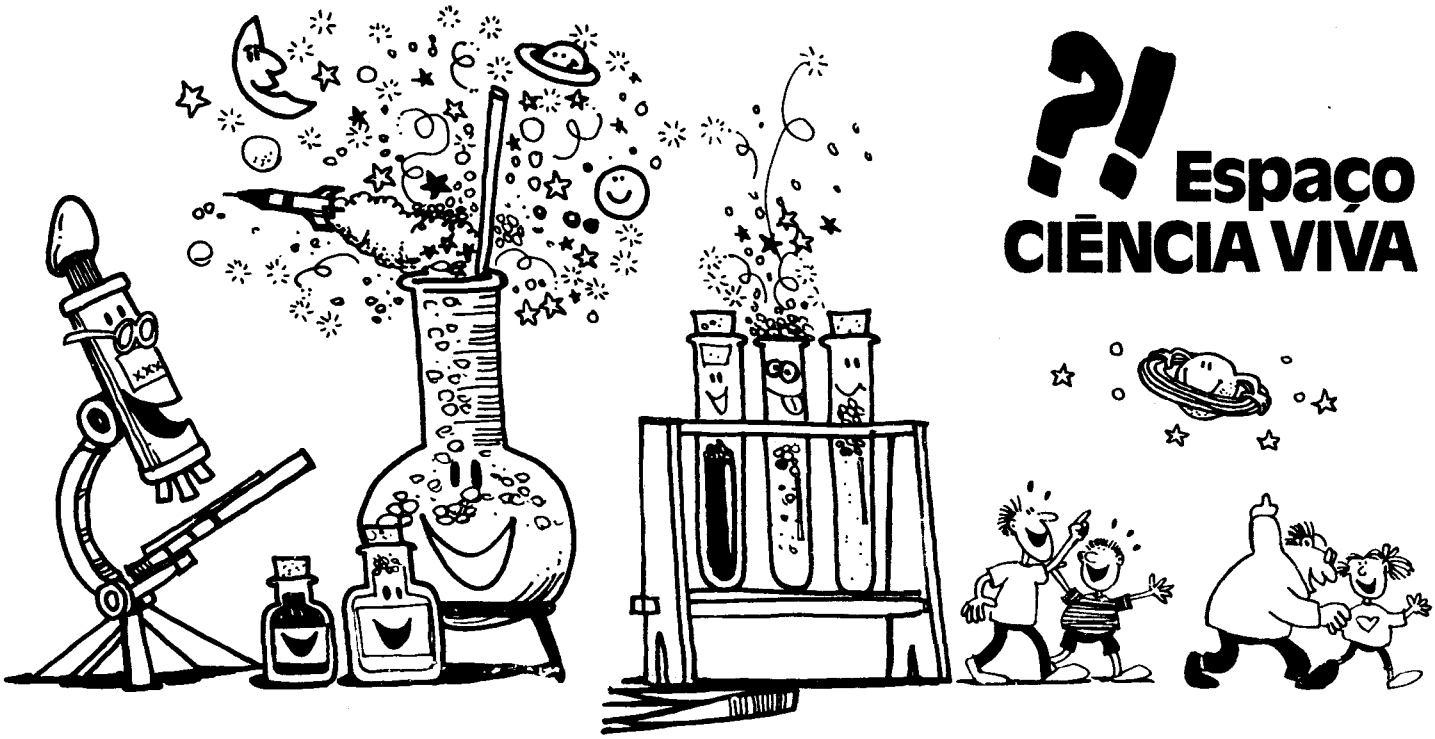
You arrive, finally, as who you really are. You are an American. Your culture has some beautiful things about it, alongside the ugly. Americans are inventive, we are playful, we are confused about authority, we are diverse, and we get dissatisfied easily. We are not sure about education and how it should be organized. We experiment and admit failure in our experiments.

When you work all this through, in Tanzania, it is like going through an initiation ritual to join a wonderful organization, and none of its members either give you advice or set obstacles in your path. The Tanzanians were a warm and generous people in their interactions with me. It is as if they, and the foreigners who have passed through this process before, are watching you, hoping you will make it, hoping you will prove to be one of those who finds the way.

When you finally come through you are yourself, owning your culture, and accepting the full responsibility of an equal who has been the temporary custodian of some common possessions. Science and technology in their diversity are those wonderful and horrible possessions.

The Tanzanians welcome you to their country. *Karibu sana.* You welcome them to the power that is already theirs.

LIBERATING EDUCATION IN BRAZIL



Taking Science to the People

BY MAURICE BAZIN

Both religion and science justify themselves by appealing to universality, absolute truth, superior beauty, and infallible solutions. Could these absolutist attributes be compatible with social change and active humanism in favor of all men and women? To the progressive scientists in Brazil who have created the innovative A Space for Living Science project, the answer is a resounding "No!" Instead, these scientists are infusing their work with the values of liberation theology and the scientific perspectives of critical consciousness.

All sciences are usually taught as established knowledge, always exterior to the learner. Each specialized field has its experts who reserve for themselves the right to use knowledge, while the rest of society can admire them and give up its right of intervention. As liberation theologian Richard Shaull has observed, "objective scientific thinking, when used to analyze society, can easily become a language of domination in the hands of a technocratic elite. Once it is accepted it destroys the confidence of men and women in their own perception of things, besides destroying the language which they constructed from their own experience, thus forcing them to become even more dependent upon experts."

In his book *The Pedagogy of the Oppressed*, Brazilian educator Paulo Freire echoed Shaull's views. Freire asserts, "Any situation in which some people prevent others from engaging in the process of inquiry is one of violence. The means used are not important; to alienate people from their own decision-making is to change them into objects."

A few Brazilian scientists were touched by this new perspective, which resonated with some suggestions made by their colleague, North American physicist Richard Feynman. Feynman reminded them that science was elaborated by normal human beings and thus could be rediscovered by other normal beings in a lively teaching process. Furthermore, Feynman proclaimed that "doing science is first not believing in experts."

During his classes at the Federal University of Rio de Janeiro, Feynman demonstrated the false perfection of formal presentations and denounced the bookish training of students who could not develop physical feeling as they memorized prepackaged formulae. During his last public lecture at the university, he opened a physics textbook used for training teachers at random and read aloud: "Triboluminescence—Triboluminescence is the light emitted when crystals are crushed."

He then exclaimed, "That is not science. That is being told what a word means in terms of other words. You haven't told anything about nature—*what* crystals produce light when you crush them, *why* they produce light. Did you see any student go home and *try* it? He can't. But, if, instead, you were to write, 'when you take a lump of sugar and crush it with a pair of pliers in the

Maurice Bazin, a physics professor at the Pontificia Universidade Catolica in Rio de Janeiro, Brazil, is a founding member of Science for the People.

dark, you can see a bluish flash. Some other crystals do that too. Nobody knows why. The phenomenon is called triboluminescence.' Then someone will go home and try it. Then there's an experience of nature."

As he finished this lecture he summarized the situation with a certain sadness: "I can't see how anyone could be educated by this self-propagating system in which people pass exams, and teach others how to pass exams, but nobody knows anything."

While Feynman was urging his students to pick up a piece of Polaroid with their hands and discuss the polarization of light as they observed its reflection on the water of the Bay of Rio de Janeiro, theologian Richard Shaull's disciples were also learning how to look across the Bay and discover the population of suburban slums which surrounds it. The perspective of a theology for liberation alongside a teaching for liberation was slowly being born. In theology, God was to be experienced in everyday reality and in the hopes of all. In pedagogy applied to science, new avenues could be opened up by similarly insisting that science be put within the reach of everybody.

A liberating pedagogical perspective affirms, and demonstrates in practice, that the study of the physical world is within the reach of all persons. Each of us is capable of proceeding in our construction of a scientific understanding of the physical world from individual experience and the capacity to question and experiment with nature. This democratization of scientific understanding is threateningly revolutionary in Latin America, considering the reduced size of the privileged classes.

Created in Rio de Janeiro in 1983, the Space for Living Science program is a community of scientists who value the sharing of knowledge and believe that science, as a branch of knowledge, should be done by and for the people. Outdoor events which bring scientific learning into public squares and gathering places put these scientists in direct contact with the community at large.

A Space for Living Science's activities guarantee a pedagogical influence among teachers, who are especially invited to participate in the events and "do" science with their own hands. For many teachers in Brazil, this may be their first contact with experimental science.

In order to break the barriers which separate the protected laboratories from the general public, those who created A Space for Living Science had to be able to build an internal strength through which they could open up their scientific practice so that everyone could participate. As they shared in the creation of participatory experiments, this group of biologists, physicists, and mathematicians had to learn simple things, first from each other. They discovered that through modesty, pedagogy becomes easy.

As a group, they followed Shaull's precepts: "the only form of community which has worth is one which encourages its members to become their own subjects, to develop their own individuality in interaction with the others, so that each person can shape his or her own world." At the same time, Shaull states that "for the life of a community to be rich the individuals involved must become open and vulnerable to each other, must evolve and grow as they relate to people in identical situations."

If a science teaching community can maintain itself around these principles, it will be able to encounter the liberating character of dialogue in education proposed by Paulo Freire in *The Pedagogy of the Oppressed*: "the efforts of the humanist, revolutionary educator must be imbued with a profound trust in people and their creative power. To achieve this the educator's relation with the students must be a partnership.... The teacher cannot think for his students, nor can he impose his thought on them. Authentic thinking, thinking that is concerned about *reality*, does not take place in ivory tower isolation, but only in communication."

As a counterpoint to Orwell's predictions for the year 1984, the professional street theater group "We're in the Street" joined A Space for Living Science in a public square in the center of Rio de Janeiro. The scientists installed a dozen telescopes in the square, a model of the solar system with planets to scale hanging from a rope stretched between two trees, and NASA photos of those planets which could be observed directly through the telescopes that night.

In the midst of all this, the actors presented a scene from *The Life of Galileo*, by Bertold Brecht. The scene depicts the court mathematician and philosopher arguing with Galileo and refusing to put their eyes to the telescope because they knew *a priori* that the celestial world could not present defects for people to see.

Illustrations courtesy of A Space for Living Science

It was certainly no accident that the first joint cultural intervention of the theater and science groups involved the observation of the planet Jupiter. It was this planet, with its four bright satellites, which convinced Galileo of the improbability of Earth being fixed at the center of the universe — a conviction that generated conflicts which reverberate up to this day.

All of these activities take place in the street, a place which belongs to all people. Thus the argument of Galileo against the "learned men" takes on its full meaning: the power to observe nature and draw one's own conclusions must be made available to *all* persons, and thus the only way to know the world is through personal observation and experimentation.

In the squares of Brazilian cities, the derogatory comments of the "learned men" fall quite flat as actors and common people mix, as curiosity leads to direct observation, and as legends and detailed photographs get confronted. The actor portraying Galileo concludes the scene by leading the public towards the telescopes to talk with the scientists who aim them at the planets and help them see for themselves.

If someone asks if one can see the details of the face of the "Man in the Moon," a scientist will help that person scan the pock-marked surface of the moon with the telescope and decide for him- or herself. Then we see the mottos of the two groups come alive: "There are no spectators in the square; everyone is an actor," and "There are no spectators in the square; everyone is a scientist."

When the scientists of A Space for Living Science choose as the theme of their activity the living cell as the basic unit of life and observe a variety of cells under microscopes, the question of reproduction naturally comes up. Picking up flowers, people can see pollen with low-power microscopes. From the tip of onion roots, the scientists scrape off some cells undergoing division and fix and stain them to observe the various stages in mitosis.

Using sea urchins, which still live on the rocky peninsula of Urca near Copacabana, one can witness sexual reproduction: male urchins expel sperm and female urchins expel ova. Under natural conditions, the ova are fertilized in the ocean water. But both ova and sperm can be collected from the urchins, and people in the square can mix the two liquids and observe the fertilization process under the microscope. They see the large brown ovum surrounded by a swarm of minuscule sperm, and with some patience, they may suddenly observe that the once perfectly round ovum has now become two cells. Then one of the cells may divide again, but by that time the small drop has probably dried up under the microscope!

What could the street theater people contribute to this out-of-doors introduction to sex education? They decided to take on the subject of human reproduction. Among the tables loaded with microscopes and aquarium pumps bubbling air into picnic boxes to keep the urchins alive, the actors create a sketch which follows a very scientific-sounding text:

There are millions of sperm always ready to enter into action and look for the rare ovum produced only once per month and

CONTINUED ON PAGE 32

IN THE SHADOW OF THE CLOUD

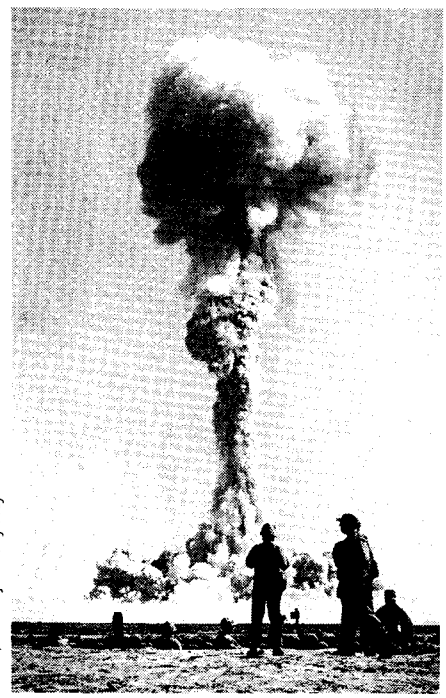
AMERICA'S ATOMIC VETERANS

BY JIM LERAGER

Between 1945 and 1960, an estimated 235,000 U.S. servicemen were exposed to nuclear weapons testing during military duty. Almost 1,500 nuclear devices have been detonated since 1945. Approximately 250 of these were American atmospheric nuclear weapons tests. The United States and the Soviet Union stopped surface testing in 1962 due to international pressure, but underground testing continues.

Another estimated 115,000 military personnel were assigned to Hiroshima and Nagasaki and were exposed to the aftermath of the nuclear bombs used at the end of World War II. Still other servicemen were POWs in Japan in the Hiroshima area and witnessed the U.S. use of the atom bomb in war time.

Old photos and films show military personnel in the Nevada desert test sites walking toward the mushroom clouds, through dust and debris, with no protection other than a rifle and a helmet. These men witnessed test series such as Ranger, Buster-Jangle and Tumbler-Snapper. Other servicemen spent their tour of duty on ships or stationed on bases on or near irradiated lagoons in the Pacific. They were ordered deck-top or to the beaches to watch the tests, such as Shots Able and Baker at Operation Crossroads, Shot Wigwam and the 17-shot Redwing series. They slept on the ship decks, exposed to the atmospheric fallout from U.S. tests. They bathed in contaminated lagoon water and sampled the radioactive atmosphere in aircraft.



Photo/courtesy of Larry Prey

The men and women who were involved in the testing and use of nuclear weapons while serving in the American military now are known as atomic veterans.

Many of these atomic vets are now profoundly ill and live in expectation of an early death, commonly dying slowly and painfully in their forties and fifties. Many of their children are genetically affected. They and their families have had to bear the emotional and financial costs largely alone. Their government claims the tests did not affect the health of these former servicemen and has refused them compensation or medical help, ruling in most cases they were exposed to no more radiation than they would get in a chest X-ray.

X-rays, however, expose tissue to radiation only briefly; a microparticle of plutonium lodged in the body constantly radiates into surrounding tissue. These servicemen lived and worked on contaminated soils, ships and water for extended periods. Plutonium and other radioisotopes could have entered these men's bodies through the air and dust they breathed, the food and water they consumed.

Limited compensation and some medical care has been provided to civilian populations in the Pacific, who are recognized to have extraordinary rates of illness, cancer, premature death, and birth defects as a result of exposure to fallout from American weapons tests. Some $4 billion in claims remain outstanding. Japanese victims of Hiroshima and Nagasaki continue to develop new symptoms and continue to die from their exposure 40 years after the bombing. They too receive limited medical care and some American financial aid. But this help has not been received by the

This article has been excerpted from the book In the Shadow of the Cloud, *which was published by Fulcrum, Inc. on Memorial Day, May 31, 1988. All photos and text are copyright 1988 by Jim Lerager.*

majority of the U.S. atomic veterans. Why have American atomic veterans and their families found it extraordinarily difficult, if not impossible, to receive assistance from their own country? What made these veterans "immune" to the radiation hazards that so seriously affected the Japanese and the Marshallese?

We need to know the stories of these veterans. They need our help. And we need theirs, for we need to know what they have to teach about how man-made radiation affects living tissue over a period of decades, and how it affects the genetic code. We need to know so that we as individuals and as a society can make informed decisions about our future, so we do not become the blind victims of our own technology.

The atom is unleashed. No matter what is done today we all will be living with man-made radiation for a very long time. And, to a greater or lesser extent, we all have been exposed to radiation—from atmospheric fallout, venting from underground nuclear tests, groundwater contamination, leakage from nuclear waste storage sites, accidents and radiation releases at power plants and reprocessing centers, from uranium mines and their tailings, and the myriad ways radiation enters the environment through human activity. We need to know the truth of the long-term effects of exposure to even low-level ionizing radiation that these men can share with us, if we can listen, see and understand. The time has come for us to understand what these lessons of the Atomic Age mean to each of us personally and what they portend for future generations.

DALE BEAMON

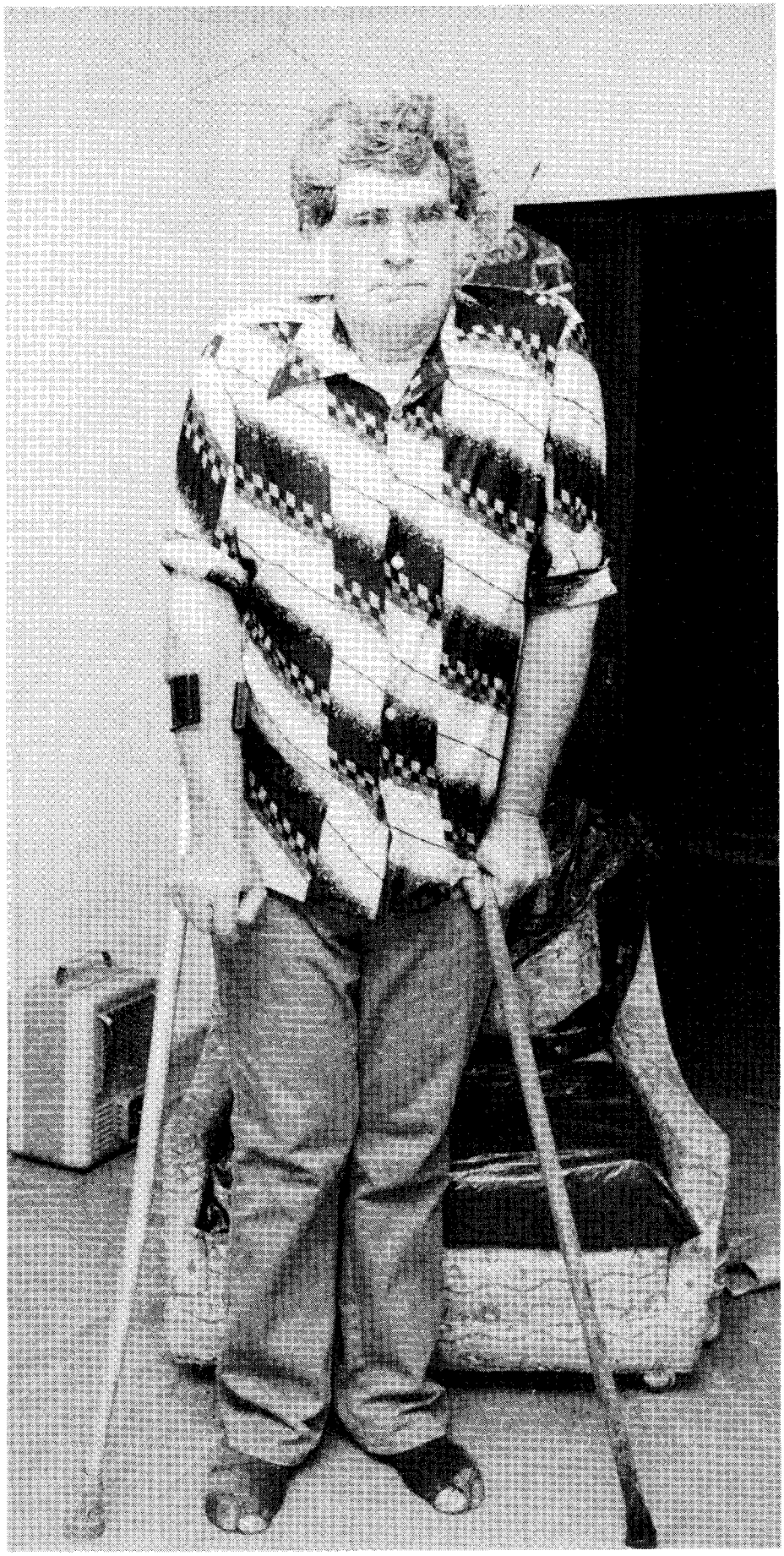
Dale participated in Operation Crossroads, Bikini Atoll, 1946 as an 18-year-old Navy boiler tender, converting salt water to "fresh" before, during and after tests Able and Baker. Baker was an underwater atomic explosion in the lagoon from which water for the boilers was drawn.

Dale has had colon cancer, kidney surgery, migratory muscle spasms, musculo-skeletal deterioration and suffers from diabetes and hypertensive heart disease. Son Doug, 18, has severe musculoskeletal and connective tissue abnormalities. He has had numerous operations, especially to his legs and knees and he is mentally retarded. His condition is deteriorating. Dale's daughters have congenital joint abnormalities.

"I don't recall feeling tired when I went in the service, but I've been tired ever since I was eighteen. I've had a lot of pain over the years and I just took it. I've suffered terrible."

GEORGE SEABRON

George was a sailor at Bikini Atoll in 1946 during tests Able and Baker. He later spent several months "decontaminating" ships from those tests. His ship also transported other military personnel back



Leon Walker

All photos by Jim Lerager

from Bikini to the United States, many of whom were very sick.

"We were told they were seasick. I thought it was weird. They came off ships, why were they seasick?"

George believes some ships were sold to other countries and private companies. "They dragged back target ships to Hunter's Point, [in San Francisco Bay where they tried to]decontaminate them in dry dock and [finally] took them to the Farallons and sunk them. How many people were exposed aboard those ships? Civilians, who didn't know!"

George developed headaches, rashes, dizziness. He has stomach problems which continue today. Debilitating back, bone and muscle problems began in 1952. He is sterile.

"I'm constantly in pain. Each year it gets worse, [but] I never quit working. That's what keeps me going."

George's health is deteriorating. He had a heart attack in 1986. His blood tests reveal abnormalities now and his condition may point to the onset of leukemia.

DON CORDRAY

Don was a 19-year-old sailor at the two atomic tests at Bikini Atoll in 1946. In the 1950s he set up accountability systems at a top secret nuclear weapons storage and testing facility near Lake Mead, Nevada.

Don first experienced dizziness and back, leg and internal pain in the 1950s. He suffered chronic skin rashes, arthritis, bone deterioration, tooth loss, gastrointestinal problems and constant, severe pain. He had a kidney operation in 1974 and an intestinal operation in 1975. In 1976 he was diagnosed as having oat cell cancer, a virulent cancer which spreads rapidly throughout the body. The cancer was brought under control, but the medical bill totaled $200,000.

"I figured [at the time of service] the government was giving us protection at Bikini, but two senior Navy officers made the statement that they advised against the tests due to what it would do to human health."

The statement Don refers to was made prior to the 1946 Bikini tests. He found the statement while researching Operation Crossroads and his own exposure.

Don was very successful in the Navy and later in private business and therefore had the resources to pay for his own expensive medical treatment.

"I think there's so much sadness that the government can ignore the atomic veterans. I'm more fortunate [financially] than most. They're living by the skin of their teeth. But I'm experiencing physical problems along with the others. More problems come, different surgeries, eventually cancer, disablement, death."

Don died in February 1984 at the age of 56. He looked and moved like a man of 80.

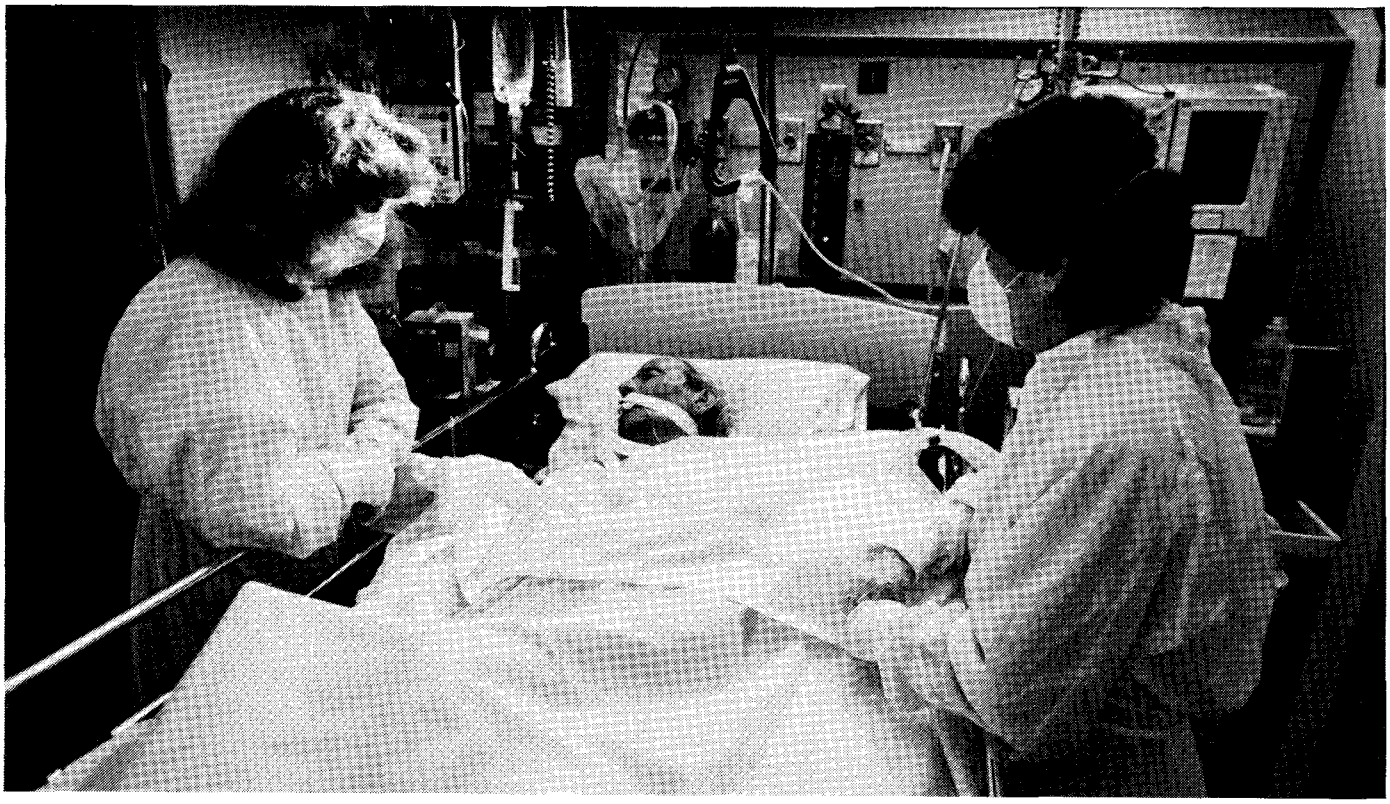
AL MAXWELL

Al joined the Army in 1939, was sent to the Philippines in 1940 and was taken prisoner by the Japanese at Bataan. He survived death marches and slave labor camps. He was among a contingent of POWs laboring in a steel mill near Hiroshima on 6 August 1945.

"We were aware of a large explosion which lit up the sky. Dark clouds came over us and a dirty rain.... Fifteen of us were sent on work details into Hiroshima, sent in to clean up debris. We saw the devastation, could see the white outline of bodies.... We developed rashes anywhere skin was bare."

Al has had gastrointestinal problems and lived with chronic pain. He had severe muscle spasms. In 1981 he was diagnosed with and treated for multiple myeloma, leukemia of the bone marrow. He has had ribs crack just from sneezing.

Al and Jackie were Mormons. Both came from very large, healthy, long-lived families. They were determined to have children. Jackie had six pregnancies, beginning in 1948. One pregnancy did not come to term. The fetus was badly malformed. Two births seemed normal, but the babies died within 36 hours from lung complications. Two babies were born hydrocephalic and with all four heart chambers defective. One lived 15 months, the other five years. After the first two pregnancies, doctors asked Jackie repeatedly if she had been exposed to radiation. Finally one doctor questioned Al, and Al told him about being in Hiroshima. (He had not told Jackie.) This doctor had had three colleagues who worked in early radiation studies and all three had died. They had had children with genetic defects. He advised Al



WHO IS THE ENEMY

BY KARL Z. MORGAN

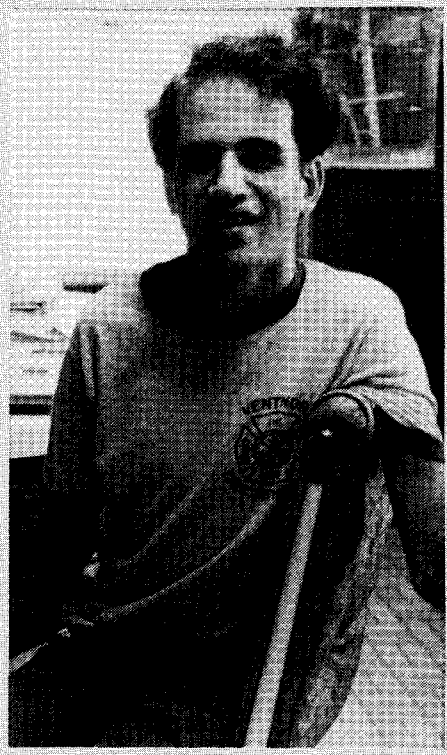
Men in the military are trained to defend our country from attack and destroy the enemy. In the case of exposure to ionizing radiation, many servicemen today are asking, who is the enemy? Why were we exposed? Is the Veterans Administration set up to help us who are suffering and dying from radiation exposure we were forced to receive in the line of duty?

Ionizing radiation is so called because it has sufficient energy to remove electrons from atoms, or ionize them. It is measured in units of the rad (energy delivered corresponding to 100 ergs per gram) or in units of the rem. The rem and the rad are the same for X-rays, gamma rays and beta radiation, but in the case of alpha rays or neutrons, one rad equals 20 rem. The man-rem is the average dose received by a given population multiplied by the number in this population.

X-rays, gamma rays and neutrons are very penetrating and can pass through a man; beta rays of high energy can penetrate over a centimeter into the body surface, while alpha rays cannot penetrate the protective layer of human skin. However, when alpha-emitting radionuclides such as plutonium or americium are deposited inside the body, the exposure can be very serious. The alpha energy is about 10 times the average beta or gamma radiation, because each rad equals 20 rem and the long residence time in the body. For example, the residence time of plutonium in the human skeleton is 200 years; that is, it would take 200 years for the body to remove half of it.

At very high single doses (over 20,000 rem) ionizing radiation can kill a person in minutes. The mid-lethal single dose is considered to be about 300 rem, meaning that about half such exposed persons would die of the radiation syndrome in a month.

The radiation exposure of our servicemen was from alpha, beta, gamma and neutron radiation and perhaps in every case less than the mid-lethal dose. Probably most of the officers that commanded men in the military to engage in operations that resulted in gamma and neutron doses of 10, 50, 100 to 200 rem and accumulated internal alpha doses of 500, 1,000 to 10,000 rem were not aware of its consequences. There is no question, however, but that those in higher levels of command were fully aware that such exposures would be expressed in symptoms of erythemia (skin reddening) and nausea shortly after exposure and would represent a high risk of radiation-induced cancer and other body ailments later in life.



Rudy Florentine, Jr., born with multiple birth defects.

Rita and George Seabron, who suspect the onset of leukemia for George.

I know this to be a fact because during this period I often had discussion of these risks with the commanding officers and other high ranking military officers during the tests. I was never able, however, to fully convince them of two major hazards: 1. inhalation of radioactive particles, especially alpha-emitting particles such as those containing plutonium, and 2. external exposure to beta radiation.

I was very concerned about the latter hazard and said so to my colleagues on board. We were stationed on the USS Haven and I made such a fuss about the fact that no measurements were made of the beta dose following tests Able and Baker that one of the high ranking military officers jokingly threatened to have me thrown overboard to the sharks. I was persistent and became such a nuisance that I was assigned a landing craft and six servicemen to take beta-dose measurements. We traveled to several of the Bikini Islands and boarded a large number of ships—both target ships and resident ships. We found that on the average the beta dose was three times the gamma dose and were shocked to discover that on some substances (tar, rope, rust, barnacles, etc.) the beta/gamma ratio was very high; the highest value measured was 600.

I reminded the colonel that many of the men were sleeping nude top side on their ships in areas above five rem per hour because the temperature was above 100 degrees Fahrenheit, but I never knew if warnings were passed on to officers on the various ships and islands of the atoll. I also found very high gamma radiation levels in the boiler rooms and near sides of the ships and gave warning to the men whenever I had the chance.

Later I visited the San Francisco Navy Yard on two occasions and was not surprised at the high levels of radioactive contamination and the difficulties in decontaminating these ships. Those servicemen who resided on these ships and engaged in the renovation operations must have received very large doses, especially of beta external radiation and internal alpha radiation.

I attended numerous nuclear weapons tests at the Nevada test site during the period of atmospheric testing. Here again I was rather frustrated. One of my former junior employees at Oak Ridge National Laboratory was in charge of dosimetry, but he and others in charge gave very little consideration to internal dose (especially from alpha radiation) and external beta dose.

Not only was measurement of these doses almost entirely lacking, but few

CONTINUED ON NEXT PAGE

Dr. Karl Z. Morgan has been working with ionizing radiation for 56 years. He was director of the Health Physics Division of the Oak Ridge National Laboratory for 29 years. He served as a principal organizer and founding president of the Health Physics Society and the International Radiation Protection Association.

WHO IS THE ENEMY

CONTINUED

precautions were taken to minimize these doses. I was appalled when I learned that servicemen had been stationed in trenches only a few miles from ground zero and were ordered to hurry into the area of ground zero immediately after the weapons detonations. At the time of the flash, some of the men could see the bones in their bodies and I calculated this corresponded to over a 50 rem dose.

During some of the Nevada tests I had experiments under way at the test site to measure the dose at various distances from ground zero and in Japanese-type houses in order to determine the dose received by the Japanese survivors of the explosions at Hiroshima and Nagasaki. After an explosion my men would rush into the area in their trucks and retrieve our dose meters which were contained in steel balls.

On one occasion I took part personally in the retrieval experiment. We drove our truck at top speed to the remains of the Japanese houses, located and threw on the truck the steel balls containing our instruments. We actually ran across the desert floor in this operation because of the high dose rate. We kept an eye on our rad-meter; it went off scale on the one rad per hour and we switched to the 10-rad-per-hour scale. In my case, it ran off this 10 rad per hour scale and, seeing a dark object ahead of me (probably part of the weapons tower), I changed direction and the meter dropped back to less than 10 rad per hour.

Ionizing radiation is a very insidious and sneaky type of hazard. Single doses less than about 10 rad are not detected by the human senses, but there have been many reports of human detection of flash doses in the range of 10 to 100 rad; above this the radiation syndrome begins—at higher doses in some and at lower in others. At flash doses of about 10 rad it is possible that many persons will sense a fluorescent light flash to the retina and detect a slight burning in the nose, probably due to the formation of ozone and nitrous oxide (the human sense of smell can detect only a few molecules).

I believe the radiation damage to the veterans was mostly of five types:

1. Beta dose erythemia followed later by various forms of skin, muscle and glandular damage;

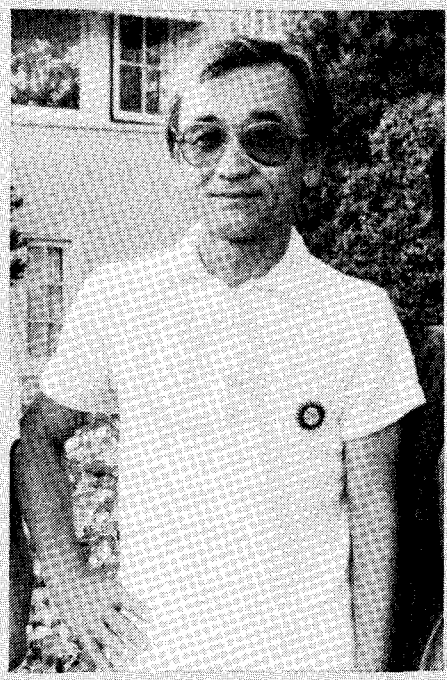
2. Cancer of many forms, especially lung carcinoma, colon cancer and brain tumors;

3. Lens cataracts due mostly to beta radiation;

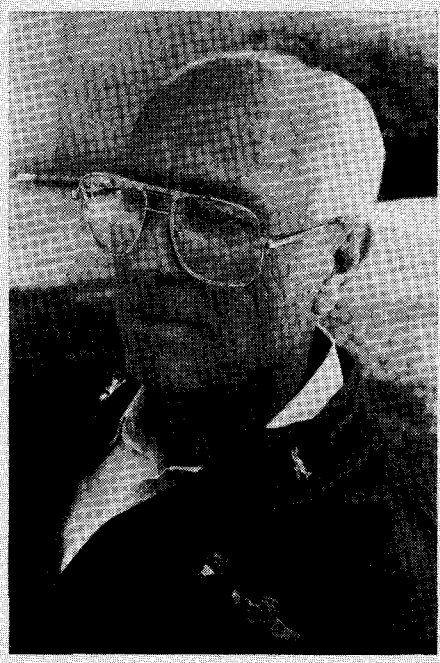
4. Damage to the immune system (reticuloendothelial system) and a host of common diseases;

5. Genetic damage.

The beta doses (one and three above) may have been very high in some cases (up to 10,000 rad) and thus resulted in an early response (burning of the skin, like intense sunburn) and eye problems. Those who received very large doses had the usual symptoms of transepidermal injury (dry and wet dermatitis, blisters and painful raw wounds) after a week or two, but unfortunately the medical doctors had information only on the gamma dose and it was too low to be the cause of such symptoms. They were apparently not aware of the large beta dose and the fact that the beta particles emitted by many of the short-lived fission products and induced radionuclides after a nuclear detonation have very high energy and correspondingly deep penetration into the body.



Harvey Kokka



Colonel Langdon Harrison

The data on radiation workers at Hanford indicate a cancer risk of about five fatal cancers per 1,000 person-rem. I do not believe any value less than one fatal cancer per 1,000 person-rem can be justified at the present time (1987). Reports of the Government Accounting Office and more recently of the Radiation Effects Research Foundation support a number of publications by Drs. A.M. Stewart, R. Bertell and myself showing that at low doses one can expect more cancers per rem than at high doses, so I expect that the value of five cancers per 1,000 person-rem is more appropriate for application to the gamma ray and neutron exposures of the veterans who were exposed.

The reason one would expect a high incidence of radiation-induced lung and colon cancers among these exposed men is because of inhalation of dust-bearing radioactive material. A high prevalence of common diseases is expected because of the serious damage to the immune system. Genetic damage from gonad exposure expresses itself not only on the children but on those to be born hundreds and thousands of years to come.

Finally, the Veterans Administration discounts radiation damage to the veterans because of the low recorded dose as provided by the film badges worn by some of the servicemen. These badges do not record the external beta and neutron dose, give no information on the internal alpha, beta and gamma dose and are only a poor estimate of the external gamma dose of the person wearing the badge. In many cases the badges were lost and the film ruined because of the high temperature and humidity, and in some cases a badge was placed on only one in 20 of the men in the trenches who were hurried to ground zero.

I have the horrible thought, what if some of these men not wearing a badge sat down on one of those "hot" objects I spotted on the desert floor that were reading over 10 rad per hour at five feet? The dose at contact could have been greater than 1,000 rad per hour and there would be no record of this dose! The Veterans Administration insists the servicemen's dose was no greater than two rem. Who is the servicemen's enemy?

and Jackie not to try for more children. Al and Jackie have one normal child from Jackie's fourth pregnancy. Their daughter now has two healthy children.

Al entered the hospital for the last time in June 1986. He died after a prolonged struggle on 21 February 1987.

Jackie works part time and is dependent on the charity of relatives. She still seeks benefits, but has been told by the Veterans Administration her husband died of pneumonia.

HARVEY KOKKA

Harvey was in the Army Signal Corps from 1954 to 1957. He was stationed on Eniwetok Island for 13 months and participated in Operation Redwing. An atomic device was detonated on the atoll during his tour.

"We figured the Army knew what it was doing and wouldn't endanger us. I visited one of the islands where they did some tests years and years before. There was practically nothing growing on the island."

Harvey had an operation for colon cancer in 1977. He is experiencing progressive, involuntary twisting of the neck, cramping of the hand, vision deterioration, skin growths on his face and increasing difficulties at work from physical ailments.

"A year ago I could control the cramping mentally. I can't today. I still wait for the other shoe to drop. I think of these other vets and I think, 'Jesus Christ, is something like that going to come to me, and if so how will I deal with it?' "

LEON WALKER

Leon was at Operation Crossroads in 1946. He was in the Navy and was ordered on deck for both tests Able and Baker.

"I saw through my eyelids and arm. I turned around in time to see a [target] ship actually out of the water in a vertical position. We were that close."

The ship that was lifted vertically out of the water was the battleship Alabama. Navy photographs corroborate Leon's statement.

Leon was among the sailors ordered aboard the aircraft Saratoga, one of the target ships, after the detonations. He and many other men from his ship became sick at Bikini. "I suffered severe headaches, nausea, weariness and an aching feeling I'd never had before." He and many other men also developed skin rashes at Bikini and what they were told was "seasickness."

He had a heart attack/stroke approximately four years after the tests, while still in his early twenties. His disabilities have prevented him from holding steady employment and he survives on welfare. He remains partially paralyzed on his left side and on crutches. He has hypertension and heart disease.

COLONEL LANGDON HARRISON

Colonel Harrison was a pilot with the Air Force's 4926th Squadron for four years. The squadron was assigned to radiation sampling from 1949 to 1962. The pilots and aircraft of the 4926th, under the direction of Los Alamos Laboratories,

Dale, Doris and son Doug Beamon

collected air samples for analysis following atmospheric weapons tests. At times they were ordered to fly directly through the radioactive mushroom clouds. In Nevada, attempts were made to limit the pilots' exposure to radiation. Upon return to base after sampling missions, pilots were lifted from their aircraft by crane, stripped of their clothing and showered repeatedly. The aircraft were scrubbed down with high pressure hoses.

In 1956, Langdon was assigned with the 4926th to Operation Redwing, a series of seventeen nuclear detonations in the Pacific. His squadron was assigned to make repeated and protracted penetrations of the clouds from large hydrogen weapons immediately following detonation. Pilots were told at the time that they were intentionally being exposed to high levels of radiation. He remembers being told by Los Alamos officials of the risks of birth defects to children conceived after the operation.

This test of pilots and aircraft is officially labeled Human Experiment Number 133. According to film badges, air crews received at least 50 rem of radiation and cockpit instruments indicated exposure levels in the 100 rem range, higher than any previous level. As many as 25 aircraft were in the air after the large explosions. There were no decontamination procedures.

Langdon had surgery for cancer and his bladder was removed in 1985. During the course of his treatment he requested his service radiation records. He was told his total dose had been 8.2 rem. Because Langdon and other members of the squadron were required to monitor radiation levels as part of their duties, he knows that data existed recording much higher levels. "I had over 100 rem. I had all that data at one time, no one wanted it so we burned it all [before leaving the Pacific]." Langdon believes duplicates of the real Redwing data are still on file.

Jim Dennis was one of the Army's best. He was promoted from private in 1939, fresh out of high school, to lieutenant colonel, commanding a crack combat regiment. He fought with Patton in North Africa and Sicily, frequently behind enemy lines, and became one of Patton's favorite young officers. Jim fought through the Philippines with MacArthur and entered Japan on one of the first planes, seeing the devastation at Hiroshima and Nagasaki. And he fought through the battlefields in Korea. He loved the Army and he loved commanding combat troops. He believes in the dictum, "Look after your men and they'll look after you." He became one of the Army's top explosives experts and many of the manuals he wrote in the 1960s are still in use today.

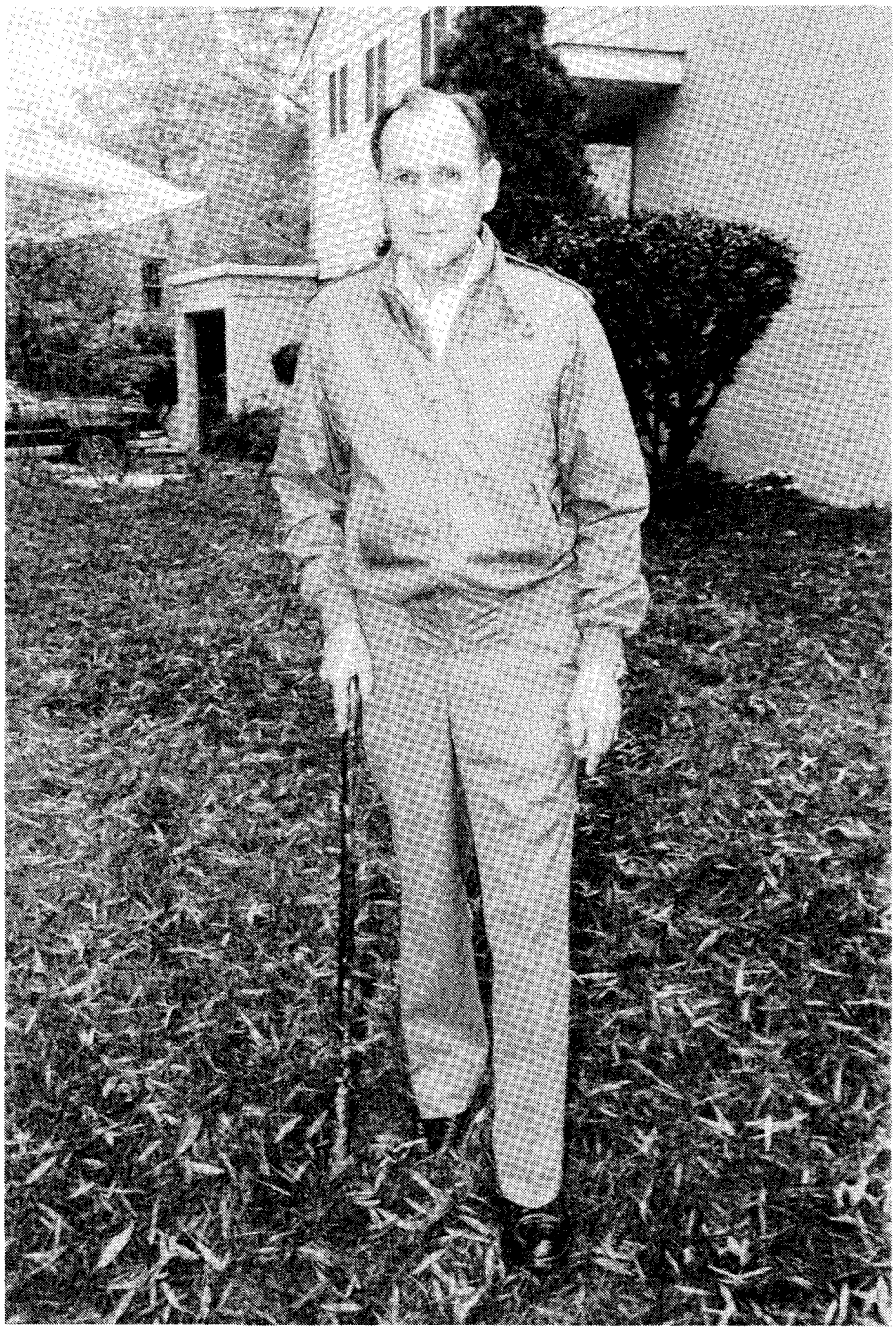
In March 1955, he was ordered to Nevada. He witnessed Shot Bee in the hours before dawn. He was in command of 300 men, at 3,500 yards from ground zero. They received no orientation; they had no respirators or film badges.

"The bomb was detonated on a 50-foot tower. With my hands covering my eyes, I saw the brightest light of my life. The earth felt like heavy seas, 60- to 70-foot waves. I could feel two shock fronts, with heavy fallout from the second. We were told [through loudspeakers] to stand up, turn around, look at the cloud. This was when we got hit in the face with fallout. It was sooty and made our hands, uniforms and faces black. I didn't pay any attention to the soot because molten metal was dripping down through the stem, the most beautiful lavender stem. The tower was only half-vaporized and drooped over. I knew it was an incomplete detonation from my work with high explosives. A partial detonation is much dirtier than a clean burn.

"According to the official Defense Nuclear Agency record, we marched to 700 yards from ground zero and inspected equipment. But I walked directly to ground zero and everyone else did too. The troops were not afraid. Like me, they felt we were being cared for properly. We trusted them.

"I think the AEC, the Department of Defense and the government wanted to know how close they could get troops to weapons without killing us.

"The next day we witnessed Shot Ess, an underground explosion. The dust cloud was 10,000 yards across. It blanketed South and Southwest Utah. We returned by plane to our base. I had a fever, headache, nausea, diarrhea, vomiting for two days. It recurred several months later. I've had dizziness, stomach pain, leg cramps, cardiac problems since 1955."



Jim Dennis

Jim left the military in 1960 and continued to work as an advisor and was later sent to work on a critical accident at the SL-1 military reactor at Idaho Falls, run by General Electric, "because of my detailed knowledge of explosives," says Jim. "The reactor had melted down, an uncontrolled fission chain reaction." His job was to place cutting explosive on the reactor, to break it into pieces small enough for burial.

"I was not told how dangerous the job was. I was given coveralls and a partial face mask. I worked for over nine hours one day on the reactor. Debris penetrated my face mask. They had me shower three times and ran a Geiger counter over me. I returned home."

Jim's health continued to deteriorate until finally he suffered a health crisis in 1977. "In November 1977, I woke up covered in blood. I am blind in one eye from the hemorrhaging. I almost died then and have had many crises since." Jim has bone marrow and blood cancers. He has received chemotherapy and other treatments.

"I did not link my problems to radiation until 1978, when I began to hear about other veterans with similar problems. I first applied for VA benefits for radiation-induced cancer in 1978. I have been turned down many times. I filed a lawsuit against G.E. in January 1981 for my SL-1 exposure. It was my only remaining avenue. If I could have sued the government, I would have, because they loaned me to G.E. for the SL-1 cleanup.

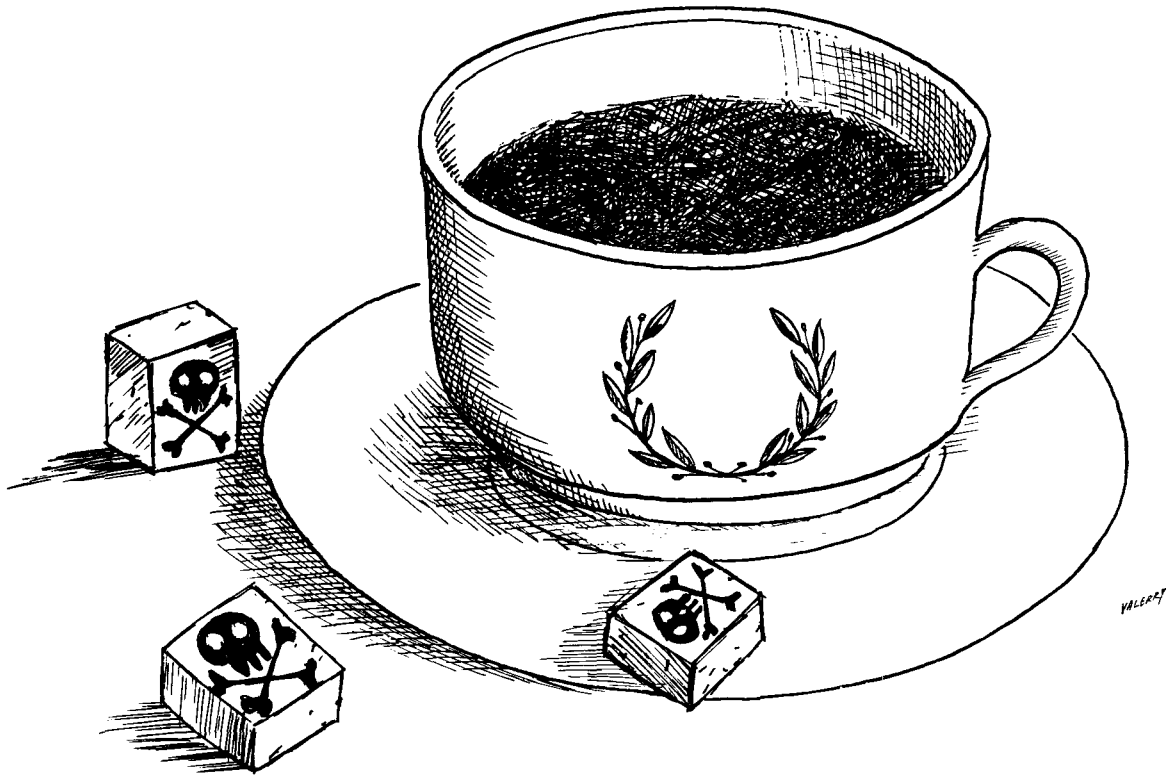
"When I went to trial, the U.S. Department of Justice represented G.E. without showing any authority for doing so. They had up to 11 lawyers in court at one time. They brought in dolly-loads of documents. They had 32 expert witnesses, including one from Sweden, paying each of them a large daily fee. Some of their witnesses sat there for five weeks before they testified. They were being paid all that time. The trial lasted eight weeks. My presentation lasted seven days. Even though I was sick and terminally ill, the chief Justice Department attorney cross-examined me for two and one-quarter days. I felt he berated and insulted me, my witnesses and my wife. I lost the trial. I and others heard the Justice Department lawyers say they had a blank check to win this suit against us.

"At the end of the trial I felt like my life had ended. I felt there was no such thing as justice in this country. I wondered why I ever fought one day for my country. I think the government will take any action, spend any amount of money, to prevent anyone from winning a radiation injury or cancer suit."

Report

EPA'S GAMBLE

Reagan Risks Higher Exposures



BY DAN GROSSMAN

In what may be the Reagan administration's final assault on environmental health regulations, the Environmental Protection Agency (EPA) reassessed the hazards of a number of toxic chemicals last year. The agency applied new and not generally accepted techniques to existing data to reduce previously calculated risks for factors of up to 100, causing some scientists and environmentalists outside of the agency to question their scientific reasoning. "The statement that they have developed new methodologies is a smoke screen for changing policy," according to Gerald Poje, an environmental toxicologist for the National Wildlife Federation.

The Office of Research and Development (ORD) has coordinated a number of these studies, including analyses of arsenic, dichloromethane, and dioxin. Untried methodologies applied by the EPA to estimate the risk posed by these substances has resulted in less conservative figures. When applied to regulations, the effect could be to set lower standards and guidelines, saving industry millions of dollars.

Last summer, EPA's Risk Assessment Forum, under the leadership of ORD, completed a report on the risk of cancer caused by ingesting inorganic arsenic. "The original risk assessment completed in 1984 would have put a large portion of the water supplies of the country out of compliance," according to Philip Enterline, a biostatistician who reviewed the report for the EPA, "and people said that this was unrealistic." The 1984 study found that arsenic causes lung cancer when inhaled and skin cancer when ingested. A reappraisal in the new report of the likelihood of skin cancer gives a figure approximately one-tenth of the results of the 1984 study.

EPA's Risk Assessment Council, a group of senior managers who advise the administrator on the results of Risk Assessment Forum studies, cut this figure by another factor of ten, since skin cancer can be treated and is thus rarely fatal. This second adjustment outraged environmentalists. "The purpose of the Safe Drinking Water Act is for EPA to set standards for contaminants that cause an 'adverse effect,' " according to Robin Whyatt, a senior scientist at the Natural Resources Defense Council. "The Act did not say 'causes death.' Skin cancer is clearly an 'adverse effect.' "

"If they are going to adopt that tack, they have to define who has access to treatment," says Poje. "Go to the very impoverished and ask their sense of the treatability of skin cancer—it's zero. It is unconscionable to take this approach until medical treatment is guaranteed."

According to Donald Barnes, a member of the Risk Assessment Forum, EPA administrator Lee Thomas, uncomfortable with the decision to adjust for the treatability of skin cancer, asked for guidance from the agency's Science Advisory Board (SAB). But in a January

Dan Grossman writes about science and environmental policy issues from Washington, D.C. He is a past and future member of Science for the People's editorial committee.

meeting of the executive committee of the SAB, a majority opposed consideration of the issue, believing the question inappropriate for a scientific body. The Environmental Health Committee of the SAB may yet review the adjustment for treatability, however. "My view is that this is on the border between science and policy," asserts Barnes, now staff director of the SAB. "There are risk assessment and risk management questions involved."

The discovery of minute quantities of dioxin in incinerator emissions, hazardous wastes, and paper products has focused attention on this potent carcinogen. A draft for internal review of a study on the risk of exposure to dioxin released late last year found the substance to be sixteen times less dangerous than previous agency calculations. In 1985, EPA concluded an assessment of dioxin based upon the assumption that it is a "complete carcinogen" and thus best characterized by a linear "no threshold" model.

According to Barnes, also a member of the group that prepared the dioxin study, EPA administrator Thomas wanted to take another look at dioxin. "There was a tremendous difference between the calculations made by EPA and other federal agencies," he explained. For example, the Centers for Disease Control (CDC) estimate the potency of dioxin to be ten times lower than EPA figures, and some European estimates are more than one thousand times less conservative.

The authors of the new report reviewed data that has been collected since the earlier study and concluded that dioxin might be a "promoter," rather than a complete carcinogen, and thus best evaluated with a threshold model. For any given chemical, threshold models, in general, produce estimates less conservative than nonthreshold models. Since there is no scientific means at present to choose among these alternative plausible approaches, the authors decided to split the difference among the many estimates reviewed.

"There were no new scientific data," asserts Marvin Schneiderman, a former associate director of the National Cancer Institute who is now on the staff of the National Academy of Sciences, "only new data on what other people were doing about dioxin. Averaging is almost surrendering one's scientific knowledge and intelligence."

Although outside scientists who reviewed the report have asserted that the new figure was obtained by averaging the results of other studies, Peter Preuss, who chaired the work group responsible for the report, denies this. He asserts that the group chose to relax the estimated potency of dioxin by a factor of ten as a "matter of professional judgment."

Asked about the effect of the dioxin study, Barnes conceded, "if the potency factor is reduced, our level of concern will be reduced." In the case of cleaning up sites contaminated with dioxin, for instance, "there will be a lot less remediation and less cost incurred by—in most instances—the federal government, and some companies."

An article published in 1986 by D.J. Paustenbach, then an employee of Syntex, Inc.—the company financially liable for cleaning up dioxin in Times Beach, Missouri—estimated that if the one-part-per-billion standard currently accepted by the EPA was relaxed by a factor of ten, costs would drop from $17 million to $11 million. Moreover, a one-hundred-fold decrease in the standard would make cleanup all but unnecessary.

A study, completed in mid-1987, of the risk of cancer caused by dichloromethane (DCM), a common solvent, concluded that the threat of cancer is only about one-tenth of previous estimates. Dichloromethane has been found to cause tumors in both rats and mice, although it has not been shown conclusively to be a human carcinogen. Therefore, risk estimates have been based upon extrapolations of the incidence of animal tumors to humans.

But in a shift from previous protocol, the staff used data on the mechanism by which the offending substance reached the cancer site to adjust for the difference between animals and humans. This so-called pharmacokinetic approach compares the pathway by which toxic agents reach the affected organ in animals with data on the behavior of the same substance in humans.

"This has been urged for a number of years, but has not been tried in practice before," reports Lorenz Rhomberg, one of the study's authors. The EPA's Science Advisory Board is "delighted that the Office of Research and Development has done it and done it well," according to Richard Cothern, an executive secretary of the board's Committee on Environmental Health.

In the case of DCM, recent studies indicated that the mechanism by which the chemical reaches mouse lungs and livers does not exist in humans. Based on this analysis, the staff calculated that DCM is only one-tenth as potent a human carcinogen as previously believed.

Whyatt believes pharmacokinetics to be a worthy field of research, but "there are so many unknowns that it is too early to use it in the regulatory process." She points to evidence that in some cases, the data on children is as different from adults as the differences observed between adults and animals.

Environmentalists such as Poje are disconcerted about the recent spate of ORD studies. "We are very much dismayed that we are making a lot less progress than need be at this time," he remarked. "There is no question in my mind that in the Reagan years EPA has used a number of methods to be less protective. Since the early EPA administrator Anne Gorsuch years, they have become more subtle and more successful."

But Preuss, who participated in all three studies, cautions against hasty conclusions. "There categorically is no new policy to try to change the assessments. This is, simply put, part of a process going on for a decade to reevaluate chemicals as new information becomes available or the need arises." What alarms environmentalists such as Poje and Whyatt is the belief that in the twilight of the Reagan years, the "need" has arisen.

SPECIAL ISSUE

CANCER AND THE ENVIRONMENT

Science for the People is planning a special issue on questions surrounding cancer and the environment. We will focus on epidemiological research published in the last few years claiming that occupational cancers represent only four percent of all cancers, and that most cancers have not increased in the past fifty years. This research suggests that environmental pollutants introduced during that time have not had a strong effect on cancer rates, and that occupational cancers are five to ten times lower than earlier estimates. Furthermore, geneticist Bruce Ames claims that naturally occuring carcinogens in food are of much more concern than pesticide residues, pollution, or other environmental toxins and that most people ingest these natural substances in quantities that are too low to be toxic.

Our special issue on cancer and the environment will analyze this research and its implications for social policy and government regulation of carcinogens. We welcome opinions and suggestions for articles, interviews, and potential authors. The deadline for submission of material for this issue is August 1, 1988.

Evolution and Human Equality

by Stephen Jay Gould

Produced by Insight Video, 875 Main St., Cambridge, MA 02139

Available in VHS, Beta, and ¾", 42 minutes, $200

Stephen Jay Gould has been one of a number of analysts who have described how fables of human inequality are constructed and utilized to justify social and political policies. As an evolutionary biologist, however, he has transcended simple description to point out how scientific evidence about human evolution can contribute to resolving the debate on human inequality. The breadth of his thinking, the clarity of his writing and speaking, and his ability to connect issues of inequality to the lives of individuals make his work particularly compelling.

I am, therefore, pleased to report the appearance of a new videotape as the latest addition to the library of Gould offerings. This 42-minute video presentation, "Evolution and Human Equality," is designed for both college and high school classroom use and would be a valuable supplement to courses in biology, sociology, anthropology, and the history of science.

The tape, a distillation of a longer lecture at Ohio's University of Wooster, is smoothly produced and tightly packed with information. Gould begins by addressing the fact that a number of vested interests are served by promoting the notion that there are profound and innate inequalities among races, sexes, and classes.

Briefly surveying the history of thought about racial differences before and after publication of Darwin's *Origin of Species*, Gould illustrates how theories were developed to serve overtly racist ends and how data were manipulated to fit those theories. For example, although notions of the separate creation of human races were discredited following acceptance of Darwinian theories of evolution, some scientists still held that the separation of the races was sufficiently ancient to allow the accumulation of significant differences among them.

A component of the implicit racist assumptions of science is illustrated by the various attempts to deny the African origins of *Homo sapiens*. Reviewing the recent evidence based on sequence analysis of mitochondrial DNA, Gould shows that it is likely that *Homo sapiens* did indeed originate in Africa, that the evolution of the human species from an ancestral species is quite recent (six to seven million years ago), and that the separation of humans into identifiable racial groups is even more recent (100,000 to 200,000 years ago).

This recent splitting of the various human lineages can be taken as strong evidence for the essential similarity of human races, since profound differences would not have arisen in such a short time. Gould finishes his lecture with the story of Doris Buck, a powerful and moving example of how the practice of science influences social policy and impacts on individual human lives.

Overall, this video will make a valuable addition to any school library and its use should be encouraged in a variety of classrooms. In addition to presenting specific information about the history of scientific thought on race and about current thinking on the evolution of *Homo sapiens*, it exemplifies how scientists can use their knowledge to break out of their own narrow specialties and apply their work to broader issues confronting society.

My one hesitation about the video is that it is so tightly packed with information, much of which will be foreign to the students viewing it. Although the tape, at 42 minutes in length, is clearly designed to be used in a single class period, a more effective strategy in using this tape would be to plan on having it take up two class periods and interrupt the tape for class discussion. In addition, any teacher using this tape should be prepared to do some background reading on the subject, and it would be helpful for Insight Video to prepare a bibliography for teachers. Overall, the video should be a valuable teaching aid and I look forward to using it in my course on the Darwinian revolution. —*Ross S. Feldberg*

How Experiments End

by Peter Galison

University of Chicago Press, 278 pp, $15 paper

In this, his first book, Peter Galison takes a scrupulous look inside the development of modern particle physics, an odyssey which spans four generations of physicists (including most of its giants in the last hundred years) and their corresponding experimental and theoretical methods. In doing so, he chooses a relatively unique point of view in the history of science. Instead of explaining science in terms of its progression from one revolutionary theory to the next, Galison focuses on how theory has been directed by experiment and how together both theory and experiment have shaped our canons of science.

As his starting point, Galison takes the electromagnetic work of Maxwell, Ampere, and Faraday, which identified the electrical and magnetic properties of matter, and then departs into the development of three distinct movements in physics. The first is the search for the charge-to-mass ratio of the electron in the gyromagnetic experiments of such notables as Einstein in the early 1900s.

Next, Galison enters the microphysical realm of cosmic ray experiments during the 1920s and '30s, which eventually led to knowledge of a host of new particles, beginning with the muon. From here, the book explores present-day experiments in mammoth-scale laboratories, focusing on the neutral current experiments of the 1970s. This contemporary generation of experiments delves into the myriad constituents of particles themselves (which were considered to be elementary only a few decades earlier) and seeks to determine how these components interact and what is formed when they do—a taxonomy which is analogous in many ways to the chemists' tables of reactions between atoms.

But Galison has not merely constructed an evolutionary timeline, nor is he presenting a glorious parade of science gurus and their grand theoretical and experimental discoveries. *How Experiments End* is a case study of how science is conducted. It investigates, as the title implies, how scientific research comes to a close—the point at which an experiment stops being merely a puzzle, an investigation, or an interesting clue. The point at which an expermiment is raised to the level of evidence or demonstration marks the point at which scientific knowledge is constructed in the laboratory.

"Between first suspicion and final argument there is a many-layered process through which belief [in a particular experimental demonstration] is progressively reinforced," Galison writes. This many-layered process is precisely what Galison's history is after. To find it, he not only scrutinizes Nobel Prize winners but lesser-known names in physics as well. He ferrets out the dead ends of theories and

experiments (including one of Einstein's), the ideas that went nowhere, the techniques that never produced.

Those who are not privy to the jargon of particle physics may find parts of this book difficult reading. But Galison is not writing exclusively for the scientific community. One of his goals is to create an accessible language capable of describing the projects of science. He exposes the nitty-gritty of brilliant insights in conjunction with equally brilliant errors to find out how they played off against each other and by what means one gained precedence over another.

Two popular myths of science are exposed by studying the frequent and often heated debates during experimentation over what qualifies as admissible evidence and what is thrown away as rubbish. The first is that of empiricism, which views science as a process of extracting knowledge from objective observations—a view in which we need only keep on the lookout for natural laws among phenomena and they will be revealed like prize Easter eggs which lay there hidden all along. To admit, as Galison forces us to do, that data is interpreted and qualified dispels empiricism by denying its foundation: objectivity. Scientists do not merely observe phenomena, they create it and then make laws to interpret it.

Galison's second myth considers science to be guided purely by theory and, at its worst, takes experiments to be nothing more than the tailoring of phenomena to fit human interests. But here Galison shows repeated instances in which elegant and persuasive theories are forced to yield to experimental evidence. In such situations, experimental data leads theorists into new science—not vice versa.

In effect, experimentation and theory place mutual constraints upon each other. Neither is handmaiden to the other, and yet neither is completely independent. If the two go hand in hand, perhaps they go handcuffed together, each forced to reckon with the other's pull.

Galison's analysis of constraints imposed by experiment and theory within science is interesting and worthwhile, and is only diminished by restricting itself to the bounds of science. The author fails to delve into economic and political constraints. The book asks only how scientific knowledge is gained and loosely treats the question of why science is pursued in the first place. However, for anyone wishing to address such questions, *How Experiments End* offers an indispensable insight into the physics community.

—Michael Allen

The Population Alternative

by Jacques Ruffié

Pantheon, 1986, 364 pp

In just a few minutes, each of us could write a long list of contemporary problems which threaten humanity. Jacques Ruffie argues that we currently understand, and therefore perpetuate, these problems with the use of a social Darwinist paradigm. According to this view, people can be separated into discrete groups, identifiable by some character or type, which stuggle against each other.

In *The Population Alternative,* Ruffie challenges the accuracy of this social Darwinist world view. In the first two-thirds of the book Ruffie, a French biologist, develops a biological argument against the typological view of nature. He then argues that views of humanity based on typological and competitive thinking are not only inadequate models of reality, but the source of society's current woes.

According to Darwin, selection removes variation from a population. Thus the best type of a species survives, produces the most offspring, and replaces the inferior types. Darwin's theory challenged the 19th century view of nature's immutable order and the immobility of an individual's position in society. Yet it justified the continuation of a typological view of nature and society. Science, based on typological thinking, has been used in efforts to justify material inequality among races, ethnic groups, and sexes.

Recent advances in molecular genetic techniques have allowed population geneticists to demonstrate that selection does not remove all variation from natural populations. For example, more than 6.7 percent of human loci are polymorphic; this allows for an effectively infinite number of possible genetic combinations.

Therefore, a typological view inaccurately represents the human species. Ruffie reviews evidence which demonstrates that genetic variation is advantageous to the population. So he argues that the population, not the individual, is the fundamental unit of evolution in the living world.

Ruffie's synthesis of the mechanisms of inheritance and evolution has value to both biologists and nonbiologists. He uses analogy and examples of natural history to illustrate difficult concepts in evolution. He resolves contemporary controversies in evolutionary theory with incisive diplomacy. However, to those unfamiliar with genetics, the writing may appear cluttered with technical jargon.

Ruffie ridicules the field of sociobiology for its attempt to causally relate biological and cultural evolution. The evolution of the extensive human neurological system has freed humanity from biological constraints. Cultural evolution has replaced biotic evolution as the mechanism by which humans adjust to their environment. The only connection Ruffie sees between biological and cultural evolution is through our Darwinian view of both.

Ruffie blames the many ailments of our society on our faulty views of the world. Liberalism, capitalism, and Marxism find justification in an antiquated social Darwinism. These theories divide humanity into groups, with mental archetypes based on either biological or socioeconomic characteristics. These groups are destined to eternal competition.

For Ruffie, the real struggle facing us is the survival of humanity. A cooperative society built on a nontypological world view is necessary for our survival. His essential point—that the status quo world view is inaccurate and in desperate need of revision—is well supported. He clearly sees the necessity of dismantling the existing world order.

However, Ruffie's vision of the process of change is poorly developed and, perhaps, simplistic. He wishes away irrational behavior motivated by conflicts of immediate interest among populations. For example, he sees promise in the establishment and advances made by UNESCO (the United Nations agency responsible for education, the sciences, and culture). Yet he fails to consider the reaction of powerful countries once they feel that their interests are no longer being served: in 1984 the U.S. childishly withdrew from and defunded UNESCO because of the organization's genuine concern about Third World issues. Perhaps the restructuring of our society will require more than wishful thinking.

The Population Alternative presents a bold argument for revolutionary change in our existing world order. In light of the continued accumulation of capital by the rich, while more people go hungry and the threat of ecological and nuclear catastrophe lingers, Ruffie's argument deserves serious consideration.

—Jim Bever

EDUCATION IN BRAZIL

CONTINUED FROM PAGE 19

surviving only a short time. The ovum will accept only one of these millions of sperm (which participants remember stormed around each sea urchin ovum under the microscopes) and that will start a new life. The sketch closes with the appearance of a child from the union of the actress/ovum with an actor/sperm—a real child, in fact, loaned by the people participating in this elaboration of life.

The subject of sexual reproduction, usually considered so delicate and touchy, expands naturally from the material that is actually present under the microscope. The work of the actors brings accurate information to all, without mystification and in an atmosphere where imagination and reality interact freely, without either technical or moral distortions. The relationship which establishes itself among the public, the scientists, and the actors forces personal involvement, frank interaction, a common language, and true participation.

There are no time limits, no bells. The desire to learn and discuss is enough; there is no need to "motivate." In the square, participants do participate, experience is acquired, and each individual remains the owner of the information and the truths that he or she encountered. Science becomes an experience lived in common with others, not in a disorganized way, but within a pedagogical structure in which openness and multiple interactions substitute for the purely technical formalizations of standard teaching.

If it is true that the scientists and the actors present in the square know more about science than the public and the invited teachers, then that knowledge is shared through dialogue and not distributed (or even sold) like merchandise. What matters is the explicit respect for the initiatives and questions of all persons involved, resulting in a noninstitutional mode of thinking.

It is not necessary for the scientists to destroy popular images or creeds like the "Man in the Moon" to help people appreciate the variety of shapes in the craters of the moon. We can accept popular imagery and enjoy the songs and poems that it creates. What's important is not to let imagery substitute for material reality.

As people observe the moon through telescopes in the square, the sound system plays a song about Saint George and the Dragon, which is what the Brazilian people see in the shadows of the moon. There cannot be any cultural dogmatism in the way that we present science, just as there cannot be dogmatic avenues towards religious faith in the real world, with both its technical advances and its social sufferings.

Our basic confidence in human beings implies that we can trust their capacity to take advantage of both the scientific method and magical thinking and reach some synthesis of this dialectical contradiction. But this can only be reached without impositions, starting with an open-minded approach to the fascination that we all feel with nature.

As cultural and religious barriers are abolished, what arises is what Shaull terms "the inescapable task of exploring new forms of human relationship and of social organization, forms which can give answers to the new ideas of what is genuinely human." In this search, the groups A Space for Living Science and We're in the Street decided to establish themselves in a common physical space where participative science and theater workshops can be integrated around themes resulting from today's scientific and social realities.

This encounter of art with science, although new to Rio de Janeiro, is not unique. It is already thriving in the first liberated museum of science, San Francisco's Exploratorium, created in 1969 by Frank and Jackie Oppenheimer. The Exploratorium presents itself as "conceived to communicate a conviction that nature and people can be both understandable and full of newly discovered magic. It therefore provides experiential opportunities for learning that are difficult, if not impossible to achieve through school classrooms, books, or television programs ... above all, we hope the visitor can establish a broad-ranging conviction that he or she can learn to understand what is going on in the world, because only with this conviction is it possible for people to decide for themselves what to do and who and what to trust."

Their credo, although developed in a cultural situation very different from the Latin American context, reads like some of the statements of Paulo Freire and the proposals of the theologians of liberation. We should remember that the word *liberation* also appeared in the North American context, associated with blacks, women, and Latinos. Perhaps therein lies the link with Latin America.

The pedagogical break represented by a participatory museum parallels the division in the notion of what makes people holy for the liberation theologian. In both cases, their aim is to liberate the human capacity for creating within the context of daily reality, to modify that reality and thus to take possession of one's future.

Meanwhile, institutional scientists, curators of dead museums, producers of theater-for-spectators only, and defenders of papal doctrines all stiffen up in their privileged positions. But the wretched of the earth have started to learn. Our responsibility is to help them along.

Network

CALIFORNIA: Science for Nicaragua, c/o Robert Van Buskirk, 3217 College Ave., Berkeley, CA 94705. (415) 652-6361. **Bay Area Chapter,** c/o Dave Kadlecek, Box 390871, Mountain View, CA 94039. (415) 960-3639

DISTRICT OF COLUMBIA: Miriam Struck and Scott Schneider, 9311 Sudbury Rd., Silver Spring, MD 20901. (301) 585-1513. Walda Katz Fishman, 6617 Millwood Rd., Bethesda, MD 20817. (301) 320-4034

FLORIDA: Bob Broedel, Progressive Technology, Box 20049, Tallahassee, FL 32316. (904) 576-4906

IOWA: Paul C. Nelson, 604 Hodge, Ames, IA 50010. (515) 232-2527

KENTUCKY: Jeff Levy, 3010 Hikes Lane #3, Louisville, KY 40220. (502) 451-7555

MARYLAND: Pat Loy, 3553 Chesterfield Ave., Baltimore, MD 21213

MASSACHUSETTS: Boston Chapter, 897 Main St., Cambridge, MA 02139. (617) 547-0370

MICHIGAN: John Vandermeer, Dept. of Biology, University of Michigan, Ann Arbor, MI 48109. (313) 764-1446.4318 Michigan Union, Ann Arbor, MI 48109. (313) 761-7960. Alan Maki, 1693 Leonard St. N.W., Grand Rapids, MI 49504

MISSOURI: Peter Downs, 910 N. McKnight, University City, MO 63132. (314) 432-0226

NEW HAMPSHIRE: Val Dusek, 2 Foss Farm Rd., Durham, NH 03824. (603) 868-1793

NEW YORK: Red Schiller, 382 Third St., Apt. 3, Brooklyn, NY 11215. (212) 788-6996. **Stony Brook Chapter,** Box 435, E. Setauket, NY 11733. (516) 246-5053

NORTH CAROLINA: Douglas Bell, 2402 Glendale Ave., Durham, NC 27704. (919) 471-9729

OREGON: Sheila Smith, 925 NW Merrie Dr., Corvalis, OR 97330

RHODE ISLAND: Carolyn Accola, 245 President Ave., Providence, RI 02906. (401) 272-6959

TEXAS: Ed Cervenka, 3506 Manchaca #211, Austin, TX 78704. (512) 447-9481

VERMONT: Steve Cavrak, Academic Computing Center, University of Vermont, Burlington, VT 05405. (802) 658-2387; 656-3190

WASHINGTON: Phil Bereano, 13B Loew Hall, FH-40, University of Washington, Seattle, WA 98195. (206) 543-9037

AUSTRALIA: Brian Martin, STS, Wollongong University, Wollongong NSW 2500, Australia. Tel. (042) 27076. Lesley Rogers, Physiology Dept., U. of New England, Armidale NSW 2351, Australia. Janna Thompson, Philosophy Dept., La Trobe University, Bundoora, Victoria, Australia. Tony Dolk, 17 Hampden St., Ashfield, NSW, Australia

BELGIUM: Gerard Valenduc, Cahiers Galilee, Place Galilee 6-7, B-1348 Louvain-la-Neuve, Belgium

BELIZE: Ing. Wilfredo Guerrero, Ministry of Public Works, Belmopan, Belize, Central America

CANADA: Ontario: Science for the People, Box 25, Station A, Scarborough, Ontario M1K 5B9. **Quebec:** Bob Cedegren, Dept. of Biochemistry, University of Montreal, Montreal 101, Quebec. **Alberta:** Engineering Skills Development Task Force, AHCS, 502 Macleod Building, 10136-100 St., Edmonton, Alberta T5J 0P1. **British Columbia:** Jim Fraser, 848 East 11th Ave., Vancouver, British Columbia V5T 2B6

DENMARK: Susse Georg and Jorgen Bansler, Stigardsvej 2, DK-2000, Copenhagen, Daneland. Tel. 01-629945

EL SALVADOR: Ricardo A. Navarro, Centro Salvadoreno de Tecnologia Apropriada, Apdo 1892, San Salvador, El Salvador

ENGLAND: British Society for Social Responsibility in Science, 25 Horsell Rd., London N5 1XL, England. Tel. 01-607-9615. Science as Culture, 26 Freegrove Rd., London N7 9RQ, England. Tel. 01-609-5646

INDIA: M.P. Parameswaran, Parishad Bhavan, Trivandrum-695 001, Kerala, India. Science for Social Revolution, Sri. K.T. Radhakrishnan, Gen. Secretary, The Sastra Sahitya Parishad, Trivandrum-695 037, India

IRELAND: Hugh Dobbs, 28 Viewmont Park, Waterford, Eire. 051-75757

ISRAEL: Dr. Najwa Makhoul, Jerusalem Institute for the Study of Science, 6 Bnai Brith St., Jerusalem 95146, Israel

ITALY: Michelangelo DeMaria, Via Giannutri 2, 00141, Rome, Italy

JAPAN: Genda Gijutsu-Shi Kenkyo-Kai, 2-26 Kand-Jinbo Cho, Chiyoda-Ky, Tokyo 101, Japan

MEXICO: Salvador Jara-Guerro, Privada Tepeyac-120-INT, Col. Ventura Puente, Morelia, Mexico

NICARAGUA: Science for Nicaragua, De los Ranchos, 6½ Cuadras al Sur, Managua, Nicaragua. Tel. 660502

PUERTO RICO: CONIPCIT, c/o Victor Lopez Tosado, De Diego 444, Apt. 1402, Rio Piedras, Puerto Rico 00923

SWITZERLAND: Bruno Vitale, 8 Rue Des Bugnons, CH-1217, Meyrin, Switzerland. Tel. (022) 82-50-18

WEST INDIES: Noel Thomas, Mt. Moritz, Grenada

WEST GERMANY: Forum fur Medizin Und Gesundheitpolitik, Gneisenaustr., 2 Mehnighof, 100 Berlin 61, West Germany. Wechselwirkung, Gneisenaustr., D-1000 Berlin 61, West Germany. Tel. 030-691-20-32

POSITIONS AVAILABLE in Nicaragua

The New World Agriculture Group (NWAG) seeks professors on sabbatical, graduate students looking for doctoral thesis work, or technicians looking for work in a politically progressive third world country, in the following areas:

- Genetic improvement and seed production of soybean and sunflower.
- Genetic improvement and seed production of sorghum (specifically for the development of a Nicaraguan open-pollinated variety and a Nicaraguan hybrid).
- Integrated Pest Management for the Leon-Chinandega area.
- Integrated Pest Management of weeds.
- Technician for production of bacterial innoculum (mainly soybean).
- Insect taxonomist trained in museum techniques.
- Plant tissue culture (mainly sugar).
- Agronomic practices in vegetable production.
- Weed control, insect control, and soil management in paddy rice production.

For further information, contact John Vandermeer, Dept. of Biology, University of Michigan, Ann Arbor, MI 48109, telephone (313) 764-1446.

Science Resource Center
897 Main Street
Cambridge, MA 02139

Nonprofit Org.
U.S. Postage
PAID
Boston, MA
Permit No. 52696

Science Resource Center

PUBLICATIONS

Decoding Biotechnology

An essential guide to the issues posed by new genetic engineering technologies. Questions concerning hazards and benefits, biological warfare, reproductive technologies, corporate influence over research and development, and the need for public involvement are given comprehensive treatment. Recommended for classroom use. **$4.00**

Computing the Future

A unique collection of articles on computers and the high-tech industry, focusing on computers and the military, industry health and safety, and a special section on computer use in schools. An excellent educational resource. **$4.00**

Biology as Destiny: Scientific Fact or Social Bias?

A provocative look at the controversies surrounding genetic theories of human behavior. A collection of eight articles produced by the Sociobiology Study Group. Recommended for personal or classroom reading, and as a resource for the Sociobiology Study Group's slide/tape show, "Fate or Fiction." **$4.00**

Feed, Need, Greed

The classic high school curriculum guide on hunger, population, and food resources. **$5.50**

Science for the People Magazine

For 18 years, the only national magazine devoted to the political significance of science and technology. Bimonthly. **$15/year**

Also available from SRC:

Fate or Fiction: Biological Theories of Human Behavior

A 30-minute slide/tape presentation for college, high school, and community groups. Explores the link between genetics and behavior, exposing the use of science to rationalize social and political inequalities. **Purchase: $150. Rental: $35**

Science and Journalism: Covering Controversy in Science

Addresses by scientists and science writers on the media's coverage of AIDS, Star Wars, sex role research, yellow rain, genetics and crime. Speakers include Stephen Jay Gould, Leon Kamin, Matthew Meselson, Jon Beckwith, Jerome Groopman, Kosta Tsipis, Vera Kistiakowsky, Anke A. Ehrhardt.

Complete Transcript: $15

Audio Cassette Tapes: $7.50 each
(Send for a list of available talks and speakers.)

Please add $1 postage and handling for each title. Discounts available for bulk orders.

Name _____

Address _____

_____

Send orders, with payment, to:

SCIENCE RESOURCE CENTER
897 Main Street
Cambridge, MA 02139
617/547-5580

Science Resource Center
897 Main Street
Cambridge, MA 02139

Non-Profit Org.
U.S. Postage
PAID
Boston, MA
Permit No. 52696

{ } YES! I want to become an SFTP donor. Enclosed is my donation of:
[ ]$1000 [ ]$500 [ ]$250 [ ]$100 [ ]$50 [ ]other

{ } I wish to pledge on a monthly/quarterly basis. Enclosed is my first pledge of ___ dollars.

{ } I want to become a member of SFTP. Enclosed is my check for $30. Please extend my subscription and sen me the SFN Newsletter and BIOLOGY AS DESTINY.

Detach and mail this form in the envelope inside this issue.

(continued from front cover)

2) Make a quarterly or monthly pledge. About 10 percent of our donors make regular contributions. Such pledges help us build stability into the seasonal fluctuations of our publishing cycle.

3) Become a member of Science for the People. Your $30 contribution entitles you to a one year membership subscription—six issues of SFTP plus six of the Science for Nicaragua Newsletter, and a free copy of BIOLOGY AS DESTINY, our anthology on genetics and behavior.

There is a form above, which you may fill out and enclose in the envelope inside the magazine. Gift and library subscriptions are another great way to help. The envelope inside has a subscription form and prices.

If there is any doubt in your mind about contributing, take a moment to think about life without Science for the People. Who else would carry on cooperative scientific education in Nicaragua? Who else would challenge the claims for a genetic basis for crime? Or expose the Pentagon's dismal impact on the environment? Or provide journalists with an alternative view of military dollars at work in science?

These are important questions. You can be a part of the answer by contributing today. Through your help, we can enter the third decade of Science for the People with renewed determination and effectiveness.

Thanks for you interest and support thus far.

Sincerely,

Leslie Fraser
Editor

Gary Keenan
Publisher