



I have an "Ecology Now" sticker on a car that drips oil everywhere it's parked.

Mark Sagoff

Earth Ethics, Summer 1990

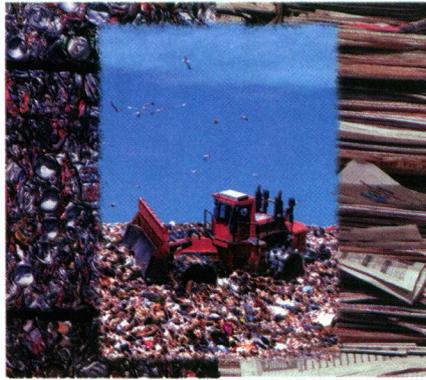
Forum

NRDC Report Trashes Recycling Critics

On 30 June 1996, *The New York Times Magazine* published an article, "Recycling is Garbage" by John Tierney, that blasted recycling and its proponents. The article nominated recycling as "[maybe] the most wasteful activity in modern America" and declared that popular interest in recycling boils down to the U.S. public's need for a "rite of atonement for the sin of excess."

The National Resources Defense Council (NRDC) responded to Tierney's article with a report published last February entitled *Too Good to Throw Away: Recycling's Proven Record*. In the 86-page report, NRDC senior scientist Allen Hershkowitz takes Tierney to task, unequivocally defending recycling. The report also illustrates the ferocity of the battle between recyclists and antirecyclists—a muddy battle in which selective emphasis and reading out of context are all-too-frequent weapons, and consensus on virtually any point is rare. The sticking point appears to be a misalignment of priorities—the antirecycling faction's insistence on the importance of economics versus what Hershkowitz calls "a philosophical belief that people throughout the world are interdependent . . . [which necessitates] an important awareness of one's relationship to others and responsibilities to them."

The NRDC report compares the pollution produced by virgin-resource processing to that produced by recycling, with results that appear to directly contradict Tierney's data. For example, Tierney wrote that "recycling newsprint actually creates more water pollution than making new paper: for each ton of recycled newsprint that's produced, an extra 5,000 gallons of waste water are discharged." Hershkowitz retorts that new mills that recycle 100% newsprint don't even discharge a *total* of 5,000 gallons of water per ton of manufactured product, much less 5,000 extra gallons. The report observes that Tierney's example came from a study that, despite the issue of extra waste water, eventually found "clear and substantial environmental advantages from recycling all of the grades of paper [examined]." But Tierney maintains he chose his example "to show readers that recycling isn't inherently better in all environmental aspects"—even though the net result may be favorable.



Recycling versus the landfill. While some contend that recycling helps nothing but our consciences, others say such claims are trash.

Chapter 2 of the NRDC report focuses on landfills. Tierney called them the logical choice for garbage disposal—safe, cheap, and convenient. The report says landfills are expensive and environmentally dangerous, causing air and water pollution that can not be adequately handled with today's technology. How much pollution is actually caused by the recyclables included in the garbage stew? Commenting on his story, Tierney says that "most of the materials involved in recycling—paper, glass, and plastics—pose little toxic risk in themselves. Removing newspapers, junk mail, and juice containers from landfills is not going to make landfills significantly safer." But the report says even seemingly benign trash can be a potential health hazard. For example, yard waste, food waste, and paper emit methane gas upon decomposition. In fact, Hershkowitz writes, "U.S. landfills are among the single greatest contributors of global methane emissions."

The report argues that recycling's high cost is largely due to the inevitable growing pains of any new industry. Responding to Tierney's statement that recycling one ton of garbage in New York City costs \$200 more than landfilling the same amount, Hershkowitz points out that New York is "perhaps the only city in the United States" that doesn't charge a tipping fee for dumping trash. He calls for cities to commit to funding and broadening their recycling programs, and also advocates consumer and manufacturer responsibility, including using less packaging and implementing container-deposit programs.

In response to Tierney's complaint that the federal government and several states have

passed laws requiring public agencies, among others, to buy recycled materials, the report maintains that Congress has never passed a law that actually requires municipalities or companies to recycle. Of his report, Hershkowitz says, "[T]he preface, by a republican governor, and the epilogue, by a senior representative of a democratic president, confirms the bipartisan support recycling enjoys." Bipartisan support doesn't cut any ice in some quarters. Commenting on the arguments outlined in the NRDC report, Tierney says, "Warnings do not refute facts." But when it comes to recycling, defining just what the "facts" are seems a tricky prospect.

Environmental Aces

Because of the work of Alexander Nikitin, in 1996 the world got an unprecedented look at the Russian Navy's aging nuclear fleet and the potential for disaster in northwest Russia, where 18% of the world's nuclear reactors reside. Because of the work of Biruté Galdikas, the endangered orangutans of Indonesia are being studied and protected, along with thousands of acres of the rainforests where they make their homes. Because of the work of Terri Swearingen, the United States revised its rules for hazardous waste incinerators, implementing stricter limits on the release of dioxin and heavy metals. Because of the work of Nick Carter, African governments have joined together in a multinational effort to stop illegal wildlife trade.

These people were recognized this spring, along with other activists from around the world, for making extraordinary efforts to protect the environment and to raise the public's awareness of environmental issues. The Goldman Environmental Prizes were awarded on April 14, and the Tyler Prizes for Environmental Achievement were awarded on May 2. The six winners of the Goldman Prize received \$75,000 each for their dedication to environmental causes, while the three winners of the Tyler Prize shared a \$150,000 award.

Established in 1990, the Goldman Prize recognizes grassroots activists from around the world by annually awarding one person from each of the world's six inhabited continental regions. Swearingen, a nurse from East Liverpool, Ohio, was the 1997 Goldman winner for North America. Though

Swearingen's protests have led to her arrest on many occasions, she continues to steadfastly oppose the construction of hazardous waste incinerators in the United States and has gained national attention for her work. The day after she held a demonstration at the White House, the Clinton administration declared an 18-month moratorium on new incinerator construction so that old regulations could be overhauled.

Nikitin, a former naval captain in the Soviet Northern Fleet and inspector for the Nuclear and Radiation Safety Inspection branch of the Soviet defense department, was the Goldman winner for Europe. In 1996, he coauthored a report titled *The Russian Northern Fleet—Source of Radioactive Contamination* that described the potential for environmental crisis in northwest Russia and reported on Russian nuclear submarine accidents. Though he was imprisoned on charges of high treason for his work on the report, which has been banned in Russia, Nikitin was successful in bringing worldwide attention to the problem. Though Nikitin was later released from prison, the charges against him still stand.

Loir Botor Dingit, paramount chief of the Bentian Tribal Council, was the Goldman Prize recipient in Asia. For hundreds of years, the Bentian people have cultivated rattan in the forests of Indonesian Borneo, utilizing a unique system that preserves forest biodiversity. Since his appointment to paramount chief in 1996, Dingit has been working to secure property rights for his



people and to prevent Indonesia's powerful timber corporations from harvesting the forests. In September 1996, Indonesia's Ministry of Forestry announced its intention to start a pilot project where forest communities were given the legal right to manage up to 10,000 hectares of forested lands, marking the first time these communities were officially recognized by the government.

Juan Pablo Orrego was awarded the Goldman Prize for South America for his work in Chile to halt dam construction on the Bío Bío River. Until recently, the Bío Bío was one of the last free-flowing rivers in the world. Now, after completing one dam on the river, the utility corporation ENDESA wants to construct a larger dam that would flood more than 70 kilometers of rich river valley, leaving portions of the river dry for months at a time and dislocating the Pehuenche, an indigenous people of pre-Columbian ancestry. By bringing the dam's drawbacks to the attention of the Chilean government and the international organizations that have provided funding to ENDESA, Orrego's Grupo de Acción por el Bío Bío has foiled ENDESA's attempts to quickly win approval for the project.

Nick Carter's efforts to impede illegal trade in protected species—a \$5 billion per year industry—were frustrated for many years by lack of cooperation among law enforcement agencies in different nations. Poachers and dealers in endangered species simply had to cross a border to avoid pursuit. In 1992, Carter began working closely with Zambia's minister of tourism to spur cooperation among African nations in fighting this illicit trade. Carter was awarded the

Goldman Prize for Africa for his role in creating the Lusaka Agreement, under which six African nations established the world's first multinational wildlife enforcement body.

Paul Cox, a biology professor from Utah, and High Chief Fuiono Senio of Western Samoa share the 1997 Goldman Prize for the world's island nations. When Cox learned that the village of Falealupo on Savai'i Island planned to sell part of its rainforest to raise money for a new schoolhouse, he volunteered to raise the money himself if the village would renege on the deal. Fuiono persuaded the other village chiefs to accept Cox's offer. Within six months, Cox had raised the required funds for the school, and these were given to the village under the condition that they promise to protect the rainforest for 50 years.

While the Goldman Prize seeks to recognize little-known grassroots activists, this year's three Tyler Prize recipients are well-known scientists and leaders in their fields. Jane Goodall, Biruté Galdikas, and George B. Schaller have each dedicated many years to observing primates and other species in the wild, and this work has led to huge advances in observational biology and conservation. Goodall is the world's foremost expert on chimpanzees, which she has studied for 35 years. She has been instrumental in establishing wildlife sanctuaries, and through books, appearances, and an environmental education program for children, she has brought wildlife and environmental conservation to the attention of people across the world.

Galdikas has devoted 26 years to studying the orangutan and is the world's foremost expert on orangutan behavior and ecology. Her work has led to a better understanding of what was once the least-known of the great apes and has spurred conservation



1997 Goldman Prize Laureates. (clockwise from top) Juan Pablo Orrego; Tatiana Chernova (wife of Alexander Nikitin); Nick Carter; Loir Botor Dingit; Paul Cox; Terri Swearingen; and Fuiono Senio (center).

efforts aimed at protecting the natural habitat of the orangutan. Galdikas was instrumental in establishing the largest national park in Borneo, and she is involved with numerous conservation efforts in Indonesia. She has also been involved with the maintenance of a care center for orphaned orangutans and educational programs for children.

In the late 1950s, Schaller conducted the first scientific study of the mountain gorilla, and his book, *The Mountain Gorilla*, led to the establishment of the Virungas National Park in Rwanda. He has also studied tigers, lions, snow leopards, and pandas, and his books are known by field biologists around the world. As director of science for the Wildlife Conservation Society, Schaller has been a leading champion of conservation practices, and his efforts have led to the establishment of national parks in Brazil, East Africa, Mongolia, China, Tibet, and the United States.

Fake DNA

The outlines of chromosome function have been clear for decades, but a new development—the creation of the first artificial human chromosome—gives scientists the tools to fill in the details. Reported by researchers at Cleveland's Case Western Reserve University School of Medicine in the April 1997 issue of *Nature Genetics*, the new chromosome should allow scientists to study gene expression and evolution, and will potentially improve gene therapy.

The finding also provides a model for studying environmental health, says Huntington F. Willard, a genetics professor and senior author on the study. For example, researchers can test how environmental agents cause chromosomes to malfunction during cell division and how toxins cause mutagenesis. Being able to work with an artificial human chromosome brings an experimental dimension to the Human Genome Project, says Willard, whose research has received funding from that project for several years.

Artificial chromosomes could correct some defects in approaches to gene therapy as well, the authors contend. Current methods of gene therapy are hampered by unpredictable gene expression and vector short-

comings. For example, viral vectors can foster immune reactions, cause cell toxicity, and transfer only small amounts of genetic material. Available nonviral vectors do not segregate properly during repeated cell divisions.

"We decided the perfect vector would resemble a normal human chromosome," says John J. Harrington, the study's lead author and vice president of Athersys, a Cleveland, Ohio-based company that hopes to develop the new technology. "A micro version small enough to be manipulated and delivered to cells is the optimal way to go." Harrington looks toward a future where physicians can use ready-made chromosomes to treat a variety of genetic diseases.

But such applications are years away from use because of technical challenges, says Uta Francke, a genetics professor at the Stanford University School of Medicine and a member of a National Institutes of Health Panel to Assess the NIH Investment in Research on Gene Therapy, whose 1995 report called for better approaches to gene therapy. Still, Francke said of the new chromosomes, "The applications for biological research are very great."

To create the artificial chromosome, Case Western Reserve researchers pared its structure down to three essential components: centromeres, which guide chromosomes during cell division, telomeres, repeating DNA sequences that protect the ends of chromosomes and allow replication, and origins of replication, the sequences where DNA copying is begun. The scientists cloned centromere sequences consisting of repeats of alpha satellite DNA, huge arrays of a repeating 171 base-pair unit. Previous researchers had been unable to clone these large sequences, and had depended primarily on chopping up existing chromosomes rather than creating new ones. The team then added these centromere sequences, telomere sequences, and genomic DNA digested by enzymes to cultures of human sarcoma cells.

Cells absorbed the genetic material, assisted by positively charged lipids known to aid in DNA uptake. DNA-repair machinery within the cells apparently formed the material into chromosomes in three ways. Two involved hitching the DNA to existing chromosomes, which

could disrupt genes. But other cells produced novel chromosomes that resembled naturally occurring ones but were 5–10 times smaller. These microchromosomes replicated normally through six months of mitotic cell division—about 240 generations.

Ethicists expressed optimism that microchromosomes might overcome some disadvantages of gene-therapy vectors, but cautioned that many of the same ethical questions remain. What are the risks of cancer and other side effects? Should adults make such treatment decisions for children? Should new genes be added to germ cells? In addition, questions arise about whether artificial chromosomes could be used to enhance traits such as intelligence, and how to address this possibility, says Michael H. Shapiro of the University of Southern California Law School in Los Angeles. "There are some very serious issues to be discussed," he says.

The Case Western Reserve team built on more than a decade of Willard's work, and on previous studies of yeast genetics. Yeast artificial chromosomes were developed in the early 1980s, and their use has offered insight into gene mapping, function, and identification. But larger, more complex human chromosomes had defied creation until now.

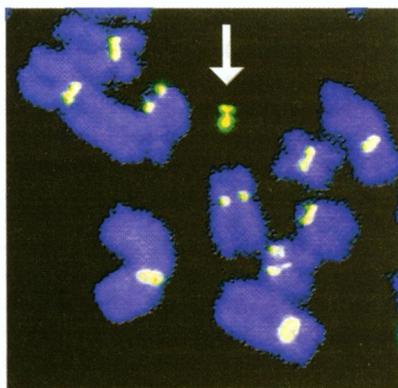
A first step in refining the discovery is ensuring that microchromosomes, not other genetic variants, are formed during the process, and that genes express reliably. Currently, the researchers are building microchromosomes in solution and inserting them into cells in culture to streamline the process. They're planning to inject microchromosomes into mice within the next six months.

The diseases likely to be attacked first with artificial human chromosomes are blood disorders, such as sickle cell anemia. Blood cells are easily removed from the body and reinserted after adding genetic material. Treating other genetic disorders, such as cystic fibrosis, awaits development of new methods for introducing microchromosomes into the body.

A Known Human Carcinogen

A working group of the International Agency for Research on Cancer (IARC), located in Lyon, France, has stated that 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), the most toxic form of dioxin, is a known human carcinogen. Since 1987, the IARC has classified TCDD as a group B2, or "probable human," carcinogen.

George Lucier, chairman of the IARC dioxin working group, which released its reclassification of TCDD on 11 February 1997, said three lines of evidence were taken into account: animal studies, human epi-



Small wonder. The synthetic human microchromosome (beneath the arrow) created by investigators at Case Western Reserve University is surrounded by native human chromosomes. Fluorescent dyes cause chromosome material to appear blue while the centromeres appear green.

John J. Harrington