# Juarez: An Unprecedented Radiation Accident

*Since December, 200 people have received unsafe doses of radiation; 20 houses and 4000 tons of steel have been contaminated*

Two months ago the government of Mexico realized it would have to clean up a nasty radiation accident in the city of Juarez. Now it has become clear that the accident was probably the worst spill of radioactive material ever in North America, exposing the public to gamma radiation 100 times more intense than at Three Mile Island 5 years ago. The crisis is not over, for not all of the spilled material has been accounted for, and some Mexicans are still being irradiated unknowingly.

One measure of the problem is a reading taken recently in El Paso, Texas, the city opposite Juarez on the Rio Grande. A city health official told *Science* on 2 March that just a week before, his department detected a gamma-ray source (reading between 1 and 7 milliroentgens* an hour) near a local high school. After searching, health officials discovered it to be a "hot" pickup truck that had been dusted with cobalt-60 when it was in a Mexican junkyard 3 months earlier. The truck, impounded in a fenced area, at this writing is parked on the other side of the Rio Grande from El Paso, in Mexico. Yet it still trips Gieger counters across the river, at a distance of 300 yards.

"Until last week," says El Paso's air pollution chief, Jesus Reynoso, "we all assumed the truck had been buried." Not so. Mexican officials are still looking for a place to stash it "outside the city."

The crisis began in December when junkyard workers in Juarez unwittingly opened a cancer therapy device and spilled out the "source"—6010 metal pellets, each a millimeter in diameter and each containing about 70 microcuries of cobalt-60. These tiny cylinders have been scattered in many directions. The Picker C-3000 therapy unit that contained them, according to Mexican officials, was stolen from a warehouse in Juarez and carried to a nearby junk dealer as scrap. The whole sequence of events became known by accident a month later, on 16 January, when a truck loaded with steel rods made from scrap took a wrong turn at the Los Alamos National Laboratory in New Mexico. The truck happened to pass over a unique radiation sensor and set off an alarm.

Since then, troubling details have come to light in Juarez and Chihuahua, where workers and bystanders were severely exposed. At least 200 people received significant doses of gamma radiation ranging from 1 to 50 rem. (The highest exposure a bystander at Three Mile Island could have received was about 100 millirem, or a tenth of a rem. A chest x-ray gives around 20 or 30 millirem. A dose to the entire body of 300 to 400 rem is considered lethal for half the people exposed.) Two Mexicans received enormous doses to their hands and feet. One received around 10,000 rem and has developed wounds on his hand. The other has blisters on his feet, but his doctor has told U.S. officials that the injury is the result of athletic activity. Four workers received 300 to 450 rem in doses to the whole body.

> "A lot of people were exposed, but most of the doses were very low. We are very optimistic about the junkyard employees." By U.S. standards some received lethal ($LD_{50}$) doses.

Two steel foundries in Mexico and one in the United States handled radioactive metal. Mexican workers were exposed to airborne cobalt-60, some of which may have stuck to hair or clothing. More than 60 radioactive pellets were scattered along the roadways and recovered by Mexican authorities. They probably adhered to tires of trucks coming into the junkyard, and U.S. officials worry that some may not have been found yet. The Jonke Fenix, a busy junkyard in Juarez employing over 60 people, was seriously contaminated and remains a threat to public health. The pickup truck upon which the therapy unit was dismantled remains highly radioactive. It is the same one identified by El Paso officials. At the last measurement, it was emitting 8 roentgens per hour on one side and 50 per hour on the other, at a distance of 1 meter. It may have done some harm, for it was parked for over a month in one neighborhood, close to two houses. Children played on it.

In addition, the steel foundries melted radioactive pellets along with scrap metal and sent about 500 tons of hot reinforcing rods north to the United States. The highest reading taken from one of these bars was 600 or 700 milliroentgens per hour, according to the U.S. Nuclear Regulatory Commission (NRC) and the state of New Mexico. In addition, a number of metal table supports shipped to the United States contained cobalt-60, but in less hazardous amounts. Another 3500 tons of radioactive rods stayed in Mexico, and around 20 houses are now radioactive. Some will have to be dismantled. In New Mexico, two homeowners had to remove basement foundations and replace them with nonradioactive ones.

One physician, Karl Hübner of the Oak Ridge Associated Universities, told *Science* 12 days after visiting the Jonke Fenix that he is concerned that the cleanup in Mexico may not have been thorough enough, and that the public may still be exposed to unsafe levels of radiation. He took his own Geiger counter along on his visit and says he detected gamma radiation levels of 3 to 30 milliroentgens per hour outside the junkyard.

By definition, this has been an international accident, one "without precedent," in the words of Joel Lubenau, an NRC health physicist focusing on the Mexican scene. Yet despite the obvious need to move quickly and broadly to contain the spill, some experts in this country feel their offers of help were not acted upon. Officials at several agencies say that Mexico has been slow to respond to such offers, maintaining that it can deal with the situation quite well on its own. Thus the Department of Energy's airborne monitoring team, which

* There are a thousand milliroentgens in a roentgen, a standard measure of radiation in air. Millirem and rem are the corresponding measures of radiation exposure in animal tissue. Nuclear workers may be exposed to 5 rem per year. Members of the general public are meant to be exposed to no more than 0.5 rem of manmade radiation per year.

has been poised to move into Juarez, has not yet been invited. However, on 2 March it did begin surveying El Paso and a section of New Mexico. The Pan American Health Organization, a subdivision of the World Health Organization, is trying to serve as an intermediary, bringing the same expertise into Mexico that could be had through a direct link with the U.S. government, but without the emblems of U.S. authority.

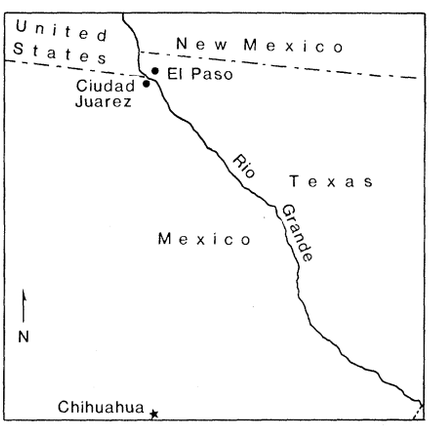
Roberto Trevino, technical secretary of Mexico's National Nuclear Safety and Safeguards Commission in Mexico City (known as the CNSNS), is in charge of the cleanup. He says: "A lot of people were exposed, but most of the doses were very low. We are very optimistic about the junkyard employees," who received what are regarded in the U.S. as lethal doses. These people are being treated on an outpatient basis. "Up to now," Trevino reports, "they are getting better all the time," in that their blood counts are improving. "Seventy or 80 people in the neighborhood where the truck was parked were monitored," he says, and one or two had lowered blood counts. "That was 3 weeks ago. Now they are normal." Trevino anticipates no large-scale health problem.

More surveys will be made, Trevino says. And "maybe we will do a long-range study with the Americans" in order to look for delayed health effects. He believes that all the cobalt-60 has been isolated and collected now, although there are "still some pellets scattered in the junkyard." The radioactive steel and truck will be buried at a site not yet chosen. Some houses in Mexico may have to be dismantled to remove the reinforcing bars. But the government may decide to use the less intensely radioactive bars in public works projects, such as dams.

The cobalt-60 traveled a long way before reaching Juarez. According to Norman Kelbley, a former employee of the Picker company of Cleveland that made the irradiation device, the machine originally was sold to the Methodist Hospital in Lubbock, Texas. The model was not one Picker was fond of; it developed mechanical and structural problems such that the company made a policy of not refurbishing it. This particular one was made no later than 1963 and received its most recent resupply of cobalt-60 in September 1969—2885 curies worth. Having a half-life of 5 years, that "source" dwindled to less than 450 curies, Kelbley estimates, by the time it was breached in December 1983.

Picker (now owned by Advanced Medical Systems) would have dealt with the machine in a standard way if it had been consulted, Kelbley says. The company would have removed the source and sent it to a low-level radiation dump, checked the other parts for residual radioactivity, and scrapped what could not be used. The fee for this service starts at $2000.

Rather than take this option, Methodist sold the machine to the X-ray Equipment Company of Fort Worth. Company president Clyde Peabody declines to comment. NRC officials say that he shipped the unit to the Centro Medico in Juarez in the fall of 1977. The clinic has no license to receive radioactive materials, but Texas state officials, who have been delegated authority in this area by the NRC, say that Peabody's papers were in order. It is apparently simple to export a "reactor by-product," as cobalt-60 is called in the regulations, if one has labeled and shipped the package correctly.




**The El Paso–Juarez border**

*Cobalt-60 was spilled in Juarez and made its way into steel produced in Chihuahua.*

At this stage the trail becomes harder to follow. The Picker unit was stored in a warehouse in Juarez either because the Centro Medico never got around to hiring the cancer therapist who was to run it, or because the machine was taken hostage for unpaid debts. There it sat until November 1983, when someone decided to dismantle it. Trevino says some ignorant people stole it to get "some pesos" at the junkyard. NRC officials believe the doubly encapsulated source was cut open on the pickup truck that carried it to the yard, and that one or two people handled the radioactive material. This happened around 6 December, because the junkyard's paperwork for that day is radioactive.

From then until late January, many people were exposed to the cobalt-60 pellets. The junkyard was closed on 20 January, four days after Los Alamos detected the hot steel and called state health officials. New Mexico's chief of radiation control, Thomas Buhl, recalls driving up and down motel row on the night of 16 January looking for the truck that had gone through Los Alamos. The driver turned up the next morning; he had been alerted to the problem by his company's president, who had been called by Los Alamos the afternoon before.

All 50 states and several federal agencies have been working together since then to track down hot steel from two Mexican foundries, Aceros de Chihuahua and Falcon de Juarez. The former made reinforcing rods; the latter, table supports. NRC officials believe that nearly all of the metal parts that came into the country have been located and collected. Most of the rods never left Mexico, but Falcon sent its table parts to the United States. Falcon is set up in a way typical of many companies that allows them to take advantage of cheap Mexican labor without paying duties in the United States. Its U.S. plant, located in St. Louis, receives intracompany shipments of steel from the plant in Juarez, thus avoiding import duties. But the St. Louis plant really functions as a distributor, not a manufacturer. Thus, workers in the United States were not exposed to high levels of radiation, as Mexican workers were.

Although Trevino is sanguine about the future, U.S. experts cite at least three areas of uncertainty. The first has to do with the extent of contamination and the sufficiency of the cleanup. The NRC is unwilling to say that the crisis is over until a thorough aerial survey has been performed. Juarez was surveyed in an amateur fashion by someone carrying a sensor in a U.S. Army helicopter borrowed from Fort Bliss. This effort turned up three more lost pellets on the road south of Juarez leading to Chihuahua, site of one of the steel plants. But experts say this survey cannot be considered adequate, for little is known about the sensitivity of the detector or the accuracy of the spotting instruments in the helicopter. Remote or masked radiation sources may have been missed.

Second, U.S. officials would recommend that the factory workers in particular undergo more screening. Because cobalt-60 has been found in the cleanup water at Aceros de Chihuahua, it is now clear that some of the radioactive material became airborne. It is not enough to take blood counts. Workers and their families should be surveyed with monitors to discover whether any cobalt-60 particles have adhered to their bodies or belongings.

Third, U.S. specialists say that if the most seriously exposed workers were being treated in this country, they would not be handled on an outpatient basis. They would be kept in the hospital in "reverse isolation." This aims to prevent exposure to microbes which can be deadly for people with radiation-weakened immune systems. However, not all hospitals are equipped to provide this kind of protection, and nearly all hospitals harbor drug-resistant bacteria.

Although this may be the worst, it is not the first spill of its kind. Hübner says that similar but better confined incidents have occurred in Algeria and the Republic of China. In another Mexican case in 1962, a child found a gamma source—probably used in radiography—lying in the street. He brought it home and kept it in a cookie jar. Except for the father, who visited on weekends, the entire family died.

More recently, in February 1983, a foundry in Auburn, New York, discovered that the new molten steel coming out of its furnace was radioactive. As in Mexico, the problem was discovered accidentally. Workers noticed one day that the steel thickness gauge, which operates on a cesium-137 source and a detector, was misbehaving. When a repairman came, his Gieger counter began to register radiation the moment he walked in the door. The New York health department investigated and concluded that about 25 curies of cobalt-60 had been included in the scrap for melting. Fortunately, the scrap never left the plant. But neither did anyone learn the origin of the cobalt-60.

The impact of the Juarez accident has not registered as yet. But one activist, Robert Alvarez of the Environmental Policy Institute, believes it could affect plans for replacing the pesticide EDB with food irradiation chambers. Alvarez says that the food irradiation scheme would require deploying huge quantities of cesium-137 on the Mexican side of the border, where a growing quantity of produce for the U.S. market originates. As Alvarez says, "They don't have the same safety standards we have, and Mexico has had a history of severe accidents involving radiation sources."

Federal agencies like the NRC have not yet decided on policy recommendations as a result of the accident. They are still working on the immediate problem. But the NRC's Lubenau says "people are talking about changing export regulations" so that reactor by-products may be shipped only to people licensed to receive radioactive material.

—ELIOT MARSHALL

## Soviets Drop Farther Back in Weapons Technology

The latest annual report issued by Richard DeLauer, the Pentagon's top scientist, does not flatly say that the United States is militarily superior to the Soviet Union. That would contradict statements by Defense Secretary Caspar Weinberger that the purpose of the present U.S. military buildup is to "catch up to the Soviets" or "to restore the military balance."

DeLauer does, however, state that the United States leads the Soviets in virtually every basic technology that influences military capabilities, including sensors, optics, life sciences, materials, micro-electronics, propulsion, radar, robotics, signal processing, guidance, navigation, manufacturing, and telecommunications. He also says that most U.S. weapons systems are superior to those of the Soviet Union, and suggests that the distance between the two countries is widening, not narrowing.

Since last year, for example, the Soviets have lost their lead in conventional warheads, and the United States has improved its lead in computers, software, and submarine detection. Despite having spent double what the United States did for strategic weapons over the last decade, the Soviets remain inferior in bombers, submarines, and submarine-launched missiles, equal in land-based missiles and superior only in antiaircraft missiles. According to the report, the Soviets spent $100 billion more than the United States in the last decade on weapons procurement for its conventional forces, yet the United States remains equal or superior to the Soviets in 17 of 18 tactical weapons systems.

Responsibility for these deficiencies may lie in what DeLauer calls some "inherent weaknesses" in the Soviet Union's weapons research effort. "Equipment and instrumentation shortages plague most Soviet R & D efforts and R & D organizations are often compelled to design and manufacture their own instruments," he says. "Computer services are in especially short supply. The U.S.S.R. also tends to follow the United States in technology because Soviet rewards are for maintaining schedule rather than technical innovations that win contracts. Although the Soviet Union annually graduates around three times the number of engineers graduated in the United States, there is widespread underemployment. Soviet engineering manpower is used inefficiently and is frequently overspecialized."

Elsewhere in the report, DeLauer documents the continuing movement of defense research away from universities, in-house laboratories, and contract research centers and into private industry. Despite considerable publicity regarding the militarization of academic campuses, only 3.2 percent of the Pentagon's research is now conducted at universities, down from 3.9 percent 2 years ago.

—R. JEFFREY SMITH

## Better Living Through Chemistry?

An exhaustive study by a committee of the National Research Council has concluded that although the number and uses of chemicals are voluminous, very little is known about their hazards.

Of the 53,500 commercially important chemicals, "only a few have been subjected to extensive toxicity testing and most have scarcely been tested at all," stated the committee.*

The committee found that no toxicity data are available for about 80 percent of 49,000 chemicals in commerce, a category which included thousands of industrial chemicals but excluded pesticides, cosmetic ingredients, drugs, and food additives. Toxicity information about chemicals in these latter categories is lacking as well even though they are more heavily regulated. Toxicity data were either inadequate or nonexistent for 64 percent of the 3400 pesticides and inert ingredients examined in the survey, 74 percent of 3400 cosmetic ingredients, 61 percent of 1800 drugs, and 80 percent of 8600 food additives. (Proprietary information from industry was not included in the study.)

The committee found that even when testing was performed, the

**Toxicity Testing: Strategies to Determine Needs and Priorities* (National Academy of Sciences, Washington, D.C., 1984). $22.50.