

PARAQUAT

A POTENT WEED KILLER IS KILLING PEOPLE

BY ANDREW C. REVKIN

A typical case: The girl is about 16, thin, weak and very sick. She is rushed down the hospital corridor, beneath the whirling ceiling fans that do nothing but push the hot, steamy Caribbean air around and around. She has been vomiting for hours, her hysterical mother says. The doctors search and probe and test. The father arrives and pulls out a bottle half full of a brown liquid that clings like syrup to the glass. Paraquat.

The course of the girl's poisoning is textbook, says her doctor—just like the 150 he's seen before. For 40 more hours she vomits. Her yellowing eyes say her liver is failing. Her mouth and throat fill with lacerations and sores, and she can no longer swallow. The doctors hear rumbling in her chest. Her urine is brown.

Then, for a couple of days, things look better. She sits up in bed, eats and can talk. But the doctors aren't fooled by her progress, just frustrated. The next day, her breathing becomes labored, her chest heaves. The doctors stand by helpless, able only to kill the pain with morphine. She finally dies of suffocation—her lungs useless sacks of scar tissue.

Against his will, Dr. Rahid Rahaman, at San Fernando General Hospital on the fertile island of Trinidad, is becoming the world's expert on paraquat poisoning. He sees almost a case a week, and almost every patient dies.

There are many sides to paraquat. To most Americans, it is the controversial weed killer used to destroy marijuana fields—first in Mexico, then in Florida and soon, the State Department hopes, in South America.

Farmers know it as one of the most versatile tools in agriculture. Paraquat is used to control weeds and speed the harvest on more than 10 million acres of American crops—everything from soy-

beans to sunflowers, cotton, wheat and corn. But that is just the beginning.

Paraquat is replacing the plow—the centerpiece of agricultural technology since the Bronze Age—as the standard means of preparing a field for planting. By the turn of the century, paraquat, and what is called no-till farming, will have made the plow obsolete on more than half of America's farmland.

And more new uses are promoted every year by paraquat's British manufacturer, Imperial Chemical Industries, and its American partner, Chevron Chemical Company. In fact, an ICI spokesman confidently predicts that there is a use for paraquat "on every hectare of agricultural land in the world."

Paraquat is a paradox: "Paraquat is probably the most effective herbicide that exists right now on the Earth," says Dr. Edward Block, a University of Florida lung specialist who has treated five paraquat victims. But, he is quick to add, "it is also one of the world's worst poisons." Although the lethal doses have not been accurately determined, paraquat can kill if only small amounts are swallowed, inhaled or spilled on the skin.

When asked how many people have died from paraquat poisoning, most medical experts and industry spokesmen recite figures between 600 and 1,000. And about half of those are suicides. Considering the worldwide popularity of the herbicide and its 20-year history, the experts say that is a very small number.

But a review of the available medical literature and personal interviews with physicians and government scientists around the world indicate that the reported death rate is a drastic underestimate.

In Trinidad—with a population of 1.2 million—officials report two deaths a month from paraquat poisoning. (Given a

similar death rate, the United States would lose close to 5,000 people a year.) But Dr. Rahaman's month-by-month tally of deaths at just one hospital, San Fernando, far exceeds the government estimate. And in Western Samoa, in the Pacific, the paraquat death rate for 1980 was four times higher than Trinidad's.

A list of cases reveals a grim picture of this popular pesticide:

A farmer's wife in England made salad dressing, mistakenly using paraquat her husband had stored in an unmarked jar. After several tastes, she decided the salad was no good. Three weeks later she died.

In Papua New Guinea, a plantation worker spraying paraquat slipped and fell. Some of the herbicide spilled out of his backpack canister, saturating his clothing. By afternoon his skin had begun to blister. After a week, he developed a cough. Thirteen days later, he died.

The owner of a citrus grove in Florida borrowed some paraquat from a friend because he was not licensed to buy it himself. He later sipped some from a container he thought held water. Although he told his doctor he had spit it out before swallowing any, he soon died.

The list goes on—victims of circumstance or ignorance, accidents or suicides. Moreover, the risk of acute poisonings has recently been overshadowed by evidence that paraquat may pose a hazard to the long-term health of farmworkers and others who are frequently exposed to it.

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A paraquat brochure promotes a deadly practice (inset). A page reprinted from an ICI leaflet shows a barefoot workman spraying paraquat on a rice paddy—and on his legs. Used correctly, paraquat may halt the ravages of erosion (background).



Paraquat sales have tripled since 1974 in California, one of the only states to keep track of pesticides.

Physicians from coast to coast insist that paraquat must be strictly controlled. Says Sheldon Wagner, a doctor who dealt with a paraquat triple poisoning in Oregon: "The problem I see is that you simply cannot let that chemical be anywhere except in a locked bin and appropriate containers. It should certainly not be put in the hands of the general public—ever." Edward Block agrees, but says we must make some concessions to practicality: "This stuff is used in enormous quantities." Even if it is handled properly, he says, "there will be a minimum acceptable number of accidents that will have incredibly tragic consequences." The risk is acceptable, he concludes, "only as long as we continue to exert control as to who can use it and under what conditions."

But many claim that paraquat is already out of control and that the situation is rapidly getting worse. There are strong indications that the agencies charged with regulating paraquat and other pesticides in this country are impotent: inundated by the numbers of chemicals and users; undermined by an ominous lack of basic data on health effects; too understaffed to enforce the regulations they make.

And the situation is far worse overseas, particularly in developing countries where there are no regulations; where paraquat can be bought right off a store

shelf; where workers walk barefoot in freshly sprayed fields and where a warning label (if there is one) is often nothing more than indecipherable gibberish.

Perhaps most disturbing, much of what the U.S. government thought it knew about paraquat has recently been cast into doubt. Last year, the Environmental Protection Agency (EPA) published a review of research on the health effects of this herbicide. In almost every category, from birth defects to its cancer-causing potential, the data on paraquat have been deemed "inadequate." And in certain areas, where the testing was done by a commercial laboratory called IBT, the experiments are reportedly rife with fraud.

The increasing "chemical dependency" of world agriculture is producing record crops and growth now, but may yield a bitter harvest of unforeseen hazards.

Tom Dilworth stands in the mud at the edge of the southwest Virginia cornfield his family has farmed since the Revolution. He leans into a cool spring wind, watching a heavy yellow truck make its way over the cornstalk stubble and sprouting green weeds. A white mist of paraquat flows from nozzles along a 30-foot boom suspended from the truck.

Within hours, the plant residue and weeds will begin to droop and shrivel, compacting down into a layer of protective mulch. This organic carpet will hold the soil and reduce evaporation, providing a fine seedbed and protecting the crop to come.

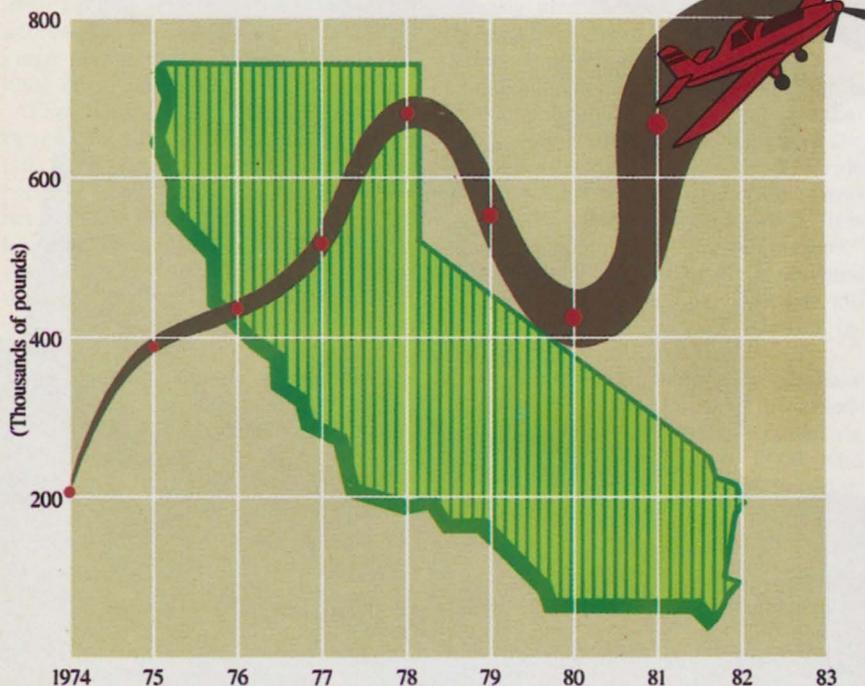
This is the essence of no-till farming. It takes very little labor, does not disturb the soil and requires only a couple of operations—spraying and planting. Dilworth says almost all of the farmers in his corner of Virginia have put away their plows in favor of paraquat.

Paraquat is uniquely suited to no-till because it is the most effective of the so-called "hit and run" herbicides. It is immediately deactivated by clay particles in the soil, with which it forms an almost unbreakable bond. It thus leaves the soil safe for the emerging crop.

According to Scott Hagood, a weed scientist at Virginia Polytechnic Institute in Blacksburg, Virginia, no-till farming caught on first in hilly regions hard-hit by erosion. Sweeping his large hand along a map of the Allegheny Mountains, which separate Virginia and West Virginia, he says, "Right in this area are some of the oldest no-till growers in the world." Any tool that combats erosion is bound to

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Advertisements for paraquat products, like this one in Kenya Farmer, often make no reference to the dangers of the herbicide. And few countries require such warnings.



Chevron and ICI won't release nationwide sales figures for paraquat. But the tripling of paraquat use in California in the past decade is probably typical of other states.

For a note on Andrew C. Revkin, turn to page 11.

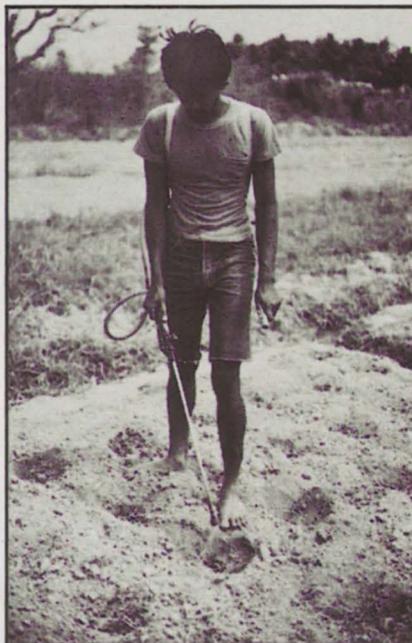
A man spraying paraquat spilled some on his skin. After a week, he began to cough; 13 days later, he died.

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catch on; last year, a staggering 6 billion tons of topsoil washed or blew off America's fields.

The biggest selling point for no-till now, however, is its potential for saving fuel. "We've got farmers with two-dollar [a bushel] corn right now who can't even hope to cover their expenses of the crop," says Hagood. "And they've got to eat and they've got kids running around." Taking a big pinch of Red Man chewing tobacco from a pouch, he adds, "They're continually seeking a way they can put something in their pockets. One way is not to have to drag that plow across the field with the oil it consumes. For that reason, just the economics, you'll continue to see no-till growth."

It is a long way from the 100-acre farms of western Virginia to the plains of the Midwest, where 10,000-acre belts of corn stretch unbroken to the horizon. But even there, scientists are convinced that no-till agriculture and paraquat will eventually predominate. Jerry Mannering, an agronomist at Purdue University in Indiana, says that 40 percent of the land in that state is subject to erosion. Except for flat, poorly drained areas, he says, "what we're telling farmers today is that essentially all of our land [planted in] soybeans is well adapted to no-till. In twenty or



Pesticide sprayers rarely wear protective clothing in hot, humid tropical climates.

thirty years, we might easily have as much as fifty percent or more of all row-crop acreage no-tilled in the corn belt."

What this translates to is a projected fivefold increase in the demand for paraquat in the United States in the next 20 years. The trend has already begun. Neither ICI nor Chevron will release sales figures, but in California, one of the few states to keep close track of pesticide use, paraquat sales have tripled since 1974. And, according to Wood and Mackenzie, a Scottish firm that analyzes the agricultural industry, worldwide paraquat sales have been increasing at around 15 percent a year for the past decade.

30 VARIETIES

ICI markets more than 30 different products containing paraquat, from Attack Pack to Weedrite. But the most common form is the 20 percent solution called Gramoxone. Chevron, which is licensed to sell its version only in the United States, calls its product Ortho Paraquat.

Paraquat kills plants within hours by disrupting photosynthesis and causing individual cells to collapse like deflating balloons. It usually takes weeks for human victims to die.

Late last August, Scott Wilson, a 25-year-old gardener at a Florida condominium, accidentally sprayed paraquat on his face and clothing. He had used the herbicide and others many times in years past without any trouble. That is why Wilson simply washed his face and hands. He went back to work even though his shirt was still wet with the chemical, and he had apparently gotten some in his mouth.

Five days later, Wilson was rushed to the hospital, barely breathing. He underwent a day and a night of testing. Then his wife, Lucille, was led into a small waiting room. "A nurse brought me a Valium and a glass of water, and they told me that he was going to die," she says. "I was in a state of shock because it wasn't 'Let's treat him, maybe he can get better.' It was that cut-and-dried—he was going to die."

Once paraquat enters the human body, it becomes concentrated in the lungs, which rapidly degenerate. In a last-ditch effort, Wilson was flown by chartered jet to New York City where, after a week of waiting for a proper donor, he was given a lung transplant, only the fortieth ever attempted. But even a small army of specialists and their armamentarium of advanced drugs and techniques could not save him. Two and a half months after the spraying accident, Wilson died.

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'LONG POISON SPRAY'

When a very sick young man was brought in from a small island plantation, Sister Ancilla Auer, who ran the medical clinic in that remote part of Papua New Guinea, was mystified. All she was told was that the laborer, named Patrick, had spilled some "long poison spray" around his groin. The spray was paraquat.

She described what followed in a letter to the provincial health officer:

"Patrick wore a laplap. He opened it, he was suffering from pain round the scrotum area—from inside Thighs—terrible hurt and covered with yellowish smear.

"We sponged the area 2 times daily till the skin was clean—some parts of the skin was off and bleeding. We changed the gauze 2 or 3 times daily, till it was really good healing up.

"On his fourth day staying in our Medical Centre, Patrick started short breathing. I was surprised, he was acting like this? I thought he was home-

sick because nobody from his wantoks were around him. He refused to eat.

"Patrick started to be restless, went outside to the beach waiting for a boat or Kanu to bring him over to the island. We forced him to go to bed.

"On the 27th, we found him laying on the Cement floor and we put him back to bed.

"Patrick was quiet the afternoon. The Pulse a bit lower as usual. I left the room to look for the Meal for Patrick. During that time, the Doctor had a good talk with him. He came to me, ordered the injection for the night and said: 'Don't worry, Sister—he will be alright!' He went off by Speedboat. I was looking for Patrick who finished already half of his meal. 10 Minutes later I went to dress his wounds—I was amazed—Patrick was laying with starring eyes, no response, very low pulsation—last breath—he passed away. Oxygen and Circulation Inject, no success!"

—A.C.R.

The lung was full of holes. When squeezed, the blistered tissue made a sound "like crushed Rice Krispies."

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The visible effects of acute paraquat poisoning are grisly. Dr. Stephan Kamholz, a pulmonary specialist at Montefiore Medical Center in New York City, was on the lung transplant team that tried to save Scott Wilson's life. He says it was the first time he had seen lungs that had been poisoned by paraquat; they were unlike anything he had seen before. According to Kamholz, human lungs are usually a "pleasant pink." Wilson's were "the color of calves' liver—brick red to dusky red, with some yellowish amber patches." When the surgeons removed Wilson's left lung to make way for the transplant, they found that it was heavy—one and a half times the normal one-pound weight. The bread-loaf-size organ was riddled with holes and covered with blisters. And when Kamholz squeezed it between thumb and forefinger, the normally spongy tissue made "a sound like crushed Rice Krispies."

Paraquat also poisons the liver and kidneys, but does so much more slowly. For reasons largely unknown, says Kamholz,

certain cells in the lungs of mammals actively collect any paraquat molecules that are floating around in the circulatory system. As the rest of the body slowly rids itself of the poison, these cells, called type-two pneumocytes, accumulate it in ever increasing amounts. The paraquat molecule is apparently similar in structure to some compound that is needed for the normal function of pneumocytes—possibly the vitamin niacin—and the cell is "fooled" into destroying itself. Once it is absorbed, paraquat interferes with normal metabolism, giving rise to deadly by-products that further disrupt the lungs. Recent work by Dr. William Ross and Dr. Block at the University of Florida indicates that DNA damage may also occur.

Whatever the cause, the effects are

clear. The lungs fill with fibrous tissue, producing a condition called pulmonary fibrosis. The passage of oxygen is blocked. Slow suffocation is inevitable. According to his doctors, Scott Wilson would have died within hours without the lung transplant.

The lethal dose for humans varies, depending on how paraquat enters the body. The chemical can be absorbed by inhalation or through the skin, says Block, but no one knows how much is too much. If swallowed, however, as little as a teaspoonful of the liquid form can kill.

NO KNOWN ANTIDOTE

There is no known antidote for paraquat poisoning. The closest thing to one is a slurry of fine clay—either fuller's earth or bentonite—a sort of clay milkshake. As they do in the field, the paraquat molecules still in the gut form nearly unbreakable bonds with the clay particles and cannot be absorbed into the body. One Chevron promotional brochure, called "Paraquat CL: facts about its use," claims that the clay treatment is an "antidote":

"... Paraquat gained a certain amount of notoriety as a 'poison without an antidote.' This reputation was probably never justified, but is certainly no longer the case," says the pamphlet. "The treatment for Paraquat poisoning incorporates the use of an antidote, bentonite clay. . . ."

Not one out of half a dozen doctors and EPA scientists queried agrees with that use of the term "antidote," and several say it is misleading. But the EPA does not routinely monitor promotional literature, only product labels.

Dr. John Liddle, chief of toxicology of the environmental health division of the federal Centers for Disease Control in Atlanta, says paraquat's affinity for clay could provide an effective first-aid treatment. "A person who was poisoned in the field," he says, "could reach over and grab a handful of dirt and start eating. You might get salmonella from the dirt, but it would probably save your life."

Any clay treatment, whether improvised on the spot or applied in a hospital, is useless once paraquat has entered the victim's bloodstream. And because tell-tale symptoms often do not appear for days, a correct diagnosis—as in Scott Wilson's case—often comes too late. "It starts out looking like something totally different from what it is," Block says. "First comes gastric distress, then kidney failure and then the lung pops up. Any reasonable internist should be thinking paraquat, but by that time, you're almost

POT-SPRAYING PLANS

The use of paraquat against marijuana plants has gone in and out of style for the past decade. In the mid-1970s, encouraged and largely funded by the U.S. Department of State, Mexico started a spraying operation.

When paraquat residues began showing up in marijuana north of the border, NORML, the National Organization for the Reform of Marijuana Laws, sued to stop the program. Government studies found that heavy smoking of contaminated marijuana could cause lung damage. In 1979, Congress prohibited U.S. funding for paraquat spraying overseas.

But in 1981 that decision was reversed. The Department of State is now offering to assist any Western Hemisphere nation that initiates a paraquat spraying program. According to a report issued last December, up to \$19 million will be provided to a participating country to pay for the equipment, training and personnel.

Colombia is one of the countries most actively courted by the State Department. Colombian officials, however, have reportedly indicated that they would be willing to use paraquat only after the United States began using it

on its own marijuana fields.

Indeed, such efforts have begun. Florida sprayed several fields last summer.

But there is a difference between domestic efforts and those planned for the rugged, inaccessible jungles of Colombia. Here, the paraquat was sprayed from trucks and backpacks. The marijuana was guarded until it had withered, then carted away.

The spraying proposed for overseas will be done from the air, with the risk of drift, and it will be nearly impossible to prevent the tainted plants from being salvaged.

In a letter to the federal Drug Enforcement Agency last year, a Chevron vice-president protested the use of paraquat, claiming there is not enough data on smoking sprayed marijuana. "The label bears the words 'POISON' and the skull and crossbones," the letter read. "Terrifying people in order to modify their social behavior is not a registered use [of paraquat]. . . . When used as a weed killer, paraquat is accomplishing by chemical means what can be done with a hoe and bonfire. . . . The hoe, in this instance, would be the preferred means."—A.C.R.

P A R A Q U A T

**For the equivalent of
eight American dollars
I buy enough paraquat
to spray an acre or
kill a hundred people.**

week into the illness; you've lost it."

Chevron spokesmen say they are doing whatever possible to reduce the number of poisonings. In this country and England, there are 24-hour hot lines listed on each product label. Chevron has its own analytical laboratory in Richmond, California—the only laboratory in the country capable of measuring minute tissue levels of the herbicide. And one salesman in each of Chevron's sales districts has a clay treatment package ready to airlift to any hospital that reports a case. But Milt Wilson, Scott's father and a nursery owner who used to use paraquat, says that is not enough. "The main thing I see," he says, "is the doctors being so unaware of what to look for with it, how to treat it, what it is, how bad it is. A run-of-the-mill doctor just don't even know what he's looking at." As for Chevron, he says, "Hell, they make a lot of money; they could afford to put pamphlets in every doctor's hands in this country every three months if they had to."

Both Chevron and ICI are adding an emetic—a chemical that induces vomiting—to their American formulas this year; ICI's British batches already contain the additive. But their effort seems soured by the fact that it is not an across-the-board policy. According to Dr. Peter Slade, product manager for paraquat at ICI, they are assessing the need on a "country by country" basis. Paraquat shipped to many Third World nations is not getting the emetic.

Many doctors consider the emetic useless to begin with. An article in the *Medical Journal of Malaysia* last September reviewed 30 cases of paraquat poisoning



Paraquat is often sold in whiskey bottles.

reported at one hospital there. Of those, 24 reportedly had vomited within 15 minutes of ingesting the paraquat. Yet only 3 patients survived.

Directly across the street from San Fernando General Hospital in Trinidad, I walk into Chunilal Seebaran Agri-

cultural Service and Supplies, Ltd., a small open-air shop. On the wall to the left are shelves lined with old whiskey bottles filled with Gramoxone. The simple labels have no warnings. The bottles are sealed with loose-fitting corks. For the equivalent of eight American dollars I buy one bottle—enough paraquat to spray an acre or kill a hundred people. Visits to a variety of hardware and grocery stores on the island turn up paraquat in bottles with different shapes and different labels, always freely available.

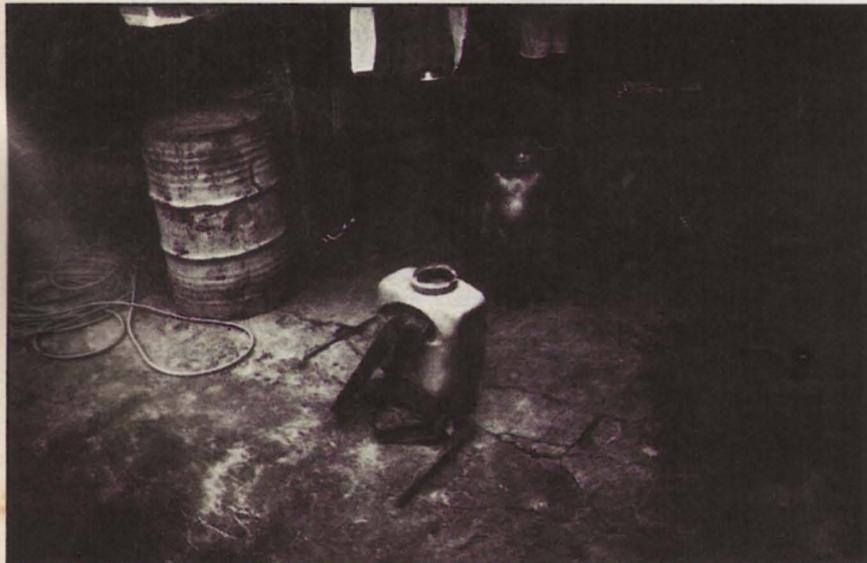
In fields along the roadside, I see several workers using backpack sprayers, although clad only in shorts and barefoot.

I meet the Maharaj family, who run a watermelon stand near the country's only drive-in theater. One son, Sudeshing, killed himself by drinking paraquat several years ago. His father says Sudeshing had had a terrible argument with his wife. It took the 29-year-old man four days to die. Paraquat is such a popular means of suicide among Trinidad's large Indian population that it has acquired the name "Indian tonic." Dr. Rahaman says that most of the suicides he sees begin as rash attempts to gain attention and that fewer would occur if the paraquat bottle were not so readily available.

Sudeshing's older brother takes out the backpack sprayer the family uses around the house. His naked infant son looks on as he fills the sprayer with water from a washtub and demonstrates its use in a corner of the yard. He also uses paraquat in his job with the government fisheries department. The spray men are provided with boots, but nothing else.

Developing nations have often suffered from embracing Western technology before they have the capacity to manage it. Dr. Rohit Doone, a medical officer with the Ministry of Health in Trinidad, says paraquat is totally unregulated in his country. "In the Caribbean region by far and large," he says, "the laws are quite inadequate."

The problem goes far beyond the Caribbean. On the other side of the world, in Papua New Guinea, Dr. Damien Wohlfahrt says there is an endless series of poisonings. While working in the isolated western highlands, he documented more than a case a month, and he says there were many more that went unreported. The reports are often bizarre. Two coffee plantation workers applied paraquat to their skin to get rid of lice infestations; both died. Four people died when paraquat was somehow mistaken for Communion wine. A warden at a local prison al-



Despite the dangers, a paraquat spray rig is commonplace in many Trinidadian households.

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"The paraquat people think that nobody should stand up and fight against a big giant like them."

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legedly poisoned an inmate who had gotten off a murder charge on a technicality. A woman drank paraquat because she heard it was a potion that could stop the arguments she had been having with her husband. In a way, it worked. Wohlfahrt, who is the medical superintendent of the largest hospital in Papua New Guinea, has been lobbying for a pesticides act for several years, but paraquat can still be bought over the counter in his country.

SUICIDE THREAT

At one point, he says, "ICI sent up a rep from Australia to quiet me down. I found out subsequently that they spread the story around that I was *irresponsible* for publicizing that it was dangerous—that I would encourage people to commit suicide with it." Ironically, according to Wohlfahrt, besides ICI, his main opposition has been the villagers themselves. They are convinced that paraquat is crucial to their crops. "I found that the villagers were very reluctant to give me any information about poisonings because they knew I was urging restrictions."

In Papua New Guinea and Malaysia, the herbicide is commonly sold in whatever container is at hand—usually, according to a variety of officials, in soft-drink bottles. In fact, paraquat is so pervasive in Malaysia that it has acquired the nickname *kopi oh*, which means "black coffee."

In Thailand, the situation is no better. "Anybody can buy it, even five-year-olds," says Dr. Prayoon Deema, who directs the Toxic Substances Division of the Thai Department of Agriculture. He says paraquat is the "number-one herbicide" in Thailand now, used "for almost every crop, even in rice paddies."

In January, reports spread in Thailand that millions of fish were dying in freshwater ponds, paddies and streams. Tests of some of the ponds turned up high concentrations of paraquat and another herbicide called atrazine. Thai officials speculate that the herbicides are toxic to the fish and also lower the oxygen content of the water by producing rotting vegetation.

If paraquat is dissolved in water that is undisturbed, there is evidence that it can stay active for up to 14 days. Although it is actively promoted for aquatic weed control overseas, it cannot be used to clear waterways or ponds in the United States.

"I try to get the high authorities in Thailand to [restrict] paraquat, and the paraquat people [get] really mad at me,"



Lucille Wilson moved to New York to stay with her husband, Scott, for his transplant.

Prayoon says. "They think that in these developing countries nobody should stand up and fight against a big giant like them." But, he concludes, "it is my duty to prevent my people from getting injury from this kind of thing."

In the United States, the Environmental Protection Agency has the responsibility for weighing the agricultural benefits of toxic chemicals like paraquat against the human and environmental risks. The system of registration, review and regulation has grown so complex that even 10-year veterans of the agency complain that they get "lost and confused."

Paraquat, because of its acute toxicity, is a so-called "restricted-use" pesticide. Only one form is available without a permit—an aerosol spray marketed by Chevron called Ortho Spot Weed and Grass Control. The EPA requires that the users of all the other varieties be certified and licensed by the states and that paraquat be used only for approved purposes.

But officials from Florida to California concede that these laws are all but unenforceable. Technically, the "certified applicator" does not have to be present during application of the pesticide; the

spraying is often done by untrained laborers. Scott Wilson, for example, was not licensed to use paraquat.

According to Bruce Miller, administrator of pesticide enforcement for the state of Florida, there is no way he can keep track of violators. "You try to trace them back, but you can just do so much," he says. "There are approximately twenty-two thousand registered users in Florida; we have eight people in our enforcement section here."

And Miller says there appears to be a black market developing for paraquat and other restricted-use pesticides: "Sometimes that dollar bill is more important than a license. Someone tells you, 'Hey, get some paraquat to put on your potatoes, boy, that's the best thing in the world.' They go out and they'll shop around until they find someone that'll give it to them."

Even licensed users often shun the required protective clothing and face masks, according to Miller. The liquid is easily mishandled or spilled, and during spraying operations, particularly aerial crop-dusting, the paraquat can drift. The EPA has listed many such incidents that resulted in human illness, the death of cattle and destruction of adjacent crops.

DEADLY DRIFT

In 1978, wheat growers around Walla Walla, Washington, switched for the first time to a no-till system, spraying paraquat by airplane before planting winter wheat. Soon, neighboring vegetable farmers began noticing dead, shriveled spots on spinach leaves, lettuce and turnips. A study by the Washington State Department of Agriculture (WSDA) confirmed that paraquat had drifted and done damage as far as 15 to 20 miles from the sprayed fields. "Pretty near every grower in here has had the problem," says Art Fanciullo, a farmer whose spinach has been damaged almost every year. "You can't escape it." The WSDA study indicated that even with drift-control equipment that sprays larger droplets, the herbicide can turn up eight miles away. And much of the spinach still reaches the market—sent at a discount to canneries to which leaf appearance is unimportant.

Dave Pechan was a crop duster for five years around Stockton, California, before he quit in 1980. He says paraquat was particularly difficult to work with: "That darned stuff would drift downwind even in extremely calm winds. I quit using it because you'd put that stuff on and for the next two or three days you'd walk around with an upset stomach, wonder-

Two transplanted lungs were not enough to save James Franzen; the paraquat still in his body poisoned them.

ing whether you did any damage." Pechan says local weather conditions sometimes made paraquat drift a huge problem. "We get fog here a lot in this valley. They were winding up with minor damage showing all over the whole county." Officials put two and two together, he says, and "realized they were spraying up there, and it was attaching itself to the fog. [Paraquat dissolves very easily in water.] And sometimes the fog hangs here for twenty or thirty days."

As for health problems, Pechan says he spilled paraquat on his leg once and had headaches, diarrhea and dizziness. "You breathe it all the time. In calm air, on your next pass, you fly through the overspray. If you've ever been around crop dusters, they all stink of chemical." He says few of the people he worked with seemed concerned with health effects.

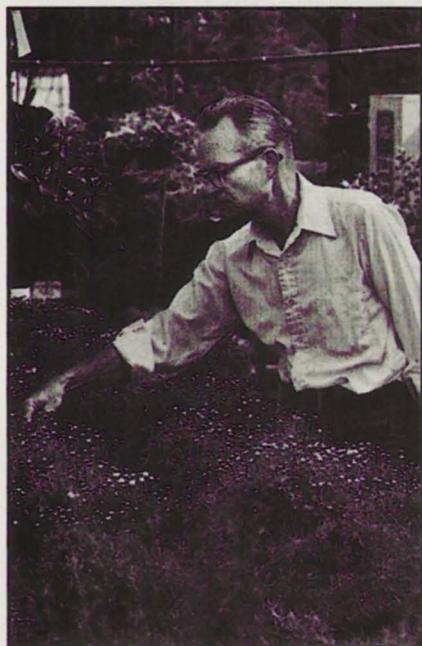
The disregard for unseen effects seems pervasive. "The thing that we have the most problems with," says Bruce Miller in Florida, "is that people will not read the labels before they use a pesticide—and that goes from the most innocuous compound to the most toxic."

Even a weed scientist at a large university, who does not want his name used, says that he rarely suits up before mixing paraquat and spraying it on his experimental fields. "Now just being drenched in paraquat solution, running down your leg or your stomach, isn't going to hurt you," he says, shrugging. "I've never had any problems. Of course, I'm only thirty. I may not make it to thirty-one."

LONG-TERM EFFECTS

Recent work in South Africa, however, indicates that working with paraquat regularly may have cumulative effects that can lead to death. A team of researchers at the University of Cape Town reported in the journal *Thorax* that upon investigating the death of a vineyard worker, they found that he had died of paraquat poisoning and that six of his co-workers had difficulty breathing. Tissue samples were taken from the lungs of the two who were most ill; their lungs were rife with small blood clots, and the small pulmonary arteries had thickened walls and constricted passages. According to Leslie Klaff, one of the doctors who worked on the study, the researchers tried to reproduce in rats the conditions to which the men had been exposed. Rats' backs were painted with paraquat over a nine-week span. "The effects at the end of the period," says Klaff, "looked very similar to those found in the human subjects."

The study was cited in a landmark



James Franzen's father, Ralph, at work in his nursery. The family may sue Chevron.

court case in Washington, D.C. Last November, a jury awarded \$137,500 to the family of an agricultural worker who used paraquat frequently at the Beltsville Agricultural Research Center in Maryland. Richard Ferebee was 52 when he died of pulmonary fibrosis, several years after retiring on disability with chronic severe chest congestion. Dr. Ronald Crystal, chief of the pulmonary branch of the National Heart, Lung and Blood Institute, had testified that Ferebee's death was almost certainly caused by paraquat.

Chevron has appealed the case. "Our side of the story," says Gerald Doppelt, general counsel for Chevron, "was that paraquat could not have caused the illness that Mr. Ferebee died from."

But more lawsuits are piling up. Lucille Wilson has sued Chevron for a total of \$25 million, claiming that the company was aware of the skin-exposure hazard and did nothing to warn of it. The survivors of James Franzen, a young Georgian whose case is remarkably similar to Scott Wilson's, are considering filing suit, according to his father, Ralph. Franzen had been poisoned by paraquat while applying it on a tree farm in Tennessee. He under-

went a lung transplant in Toronto just two weeks before Wilson's New York operation. But residual paraquat in his muscles poisoned the transplanted lung. He then had an unprecedented second lung transplant, but his body had been so severely poisoned that he couldn't breathe on his own. He died 90 days after the first transplant.

Chevron spokesmen cite flaws in all the cases. But regardless of whether the company is legally liable, the medical evidence weighs against paraquat. Dr. Block in Florida, Dr. Kamholz in New York and a host of lung specialists all agree with Dr. Crystal: Paraquat can cause lung damage if sufficient amounts are inhaled or applied to the skin, and it can cause long-term damage. They also agree on another point: There has not been enough research on the subject.

The EPA has traditionally required that the company applying to register a new pesticide must come up with the health data to support that product. Most of what is known about paraquat comes from data produced by Chevron and ICI and by commercial laboratories that have performed tests under contract to these companies.

FAULTY RESEARCH

Several long-term studies of paraquat's health effects were performed in the 1960s by Industrial Bio-Test Laboratories (IBT) of Northbrook, Illinois, which was then the largest commercial laboratory in the country, having run more than 22,000 tests on hundreds of pesticides and drugs. In 1976, several government audits of IBT research opened up a Pandora's box of possible fraud. All of IBT's tests were invalidated, including those done on paraquat.

Government scientists found fictitious data, such as a mouse dying and springing back to life (actually replaced by a new mouse). Results had been shredded, samples improperly preserved, experiments poorly conceived. IBT is now out of business, and its top executives and scientists are on trial in federal court in Chicago.

The legacy of IBT persists: A mountain of bad data has provided the basis for dozens of EPA regulatory decisions. But paraquat will remain on the market. According to David Gettman, until recently a spokesman for the EPA's office of pesticide programs, "Under our law, once a pesticide is registered, the burden of proof is on the agency to come up with a positive indication of unreasonable adverse effects."

Continued

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PARAQUAT

Continued from page 97

The EPA released a report last fall that summarized the data on paraquat:

- **Teratogenicity** (the tendency to cause birth defects): Research in the medical literature is "inadequate."

- **Mutagenicity** (the tendency to cause gene mutations): "The Agency could not come to any conclusion."

- **Reproductive effects**: "The Agency [found] that the available studies relating to reproductive effects are inadequate."

- **Oncogenicity** (potential for causing cancer): Tests were inadequate and invalid. Of the four tests reviewed, one performed by ICI in 1972 was found to be deficient. The remaining three were performed by IBT.

Despite the data gaps, a pesticide on the market is innocent until proved guilty. Until paraquat is clearly shown to be a danger to humans or the environment, its use will persist.

BUDGET CUTS

Budget cuts have reduced the EPA's ability to study paraquat. Ralph Wright, who coordinated the review of paraquat data published last year, says his section, the special pesticides review division, has been cut from 140 to 36 people. He says most of the hundreds of pesticides that came on the market in the 1960s, like paraquat, were poorly tested. And all have been slated for a systematic review like the one just completed for paraquat. But EPA has run out of money.

The IBT scandal, the jury decision against Chevron and a recent wave of bad publicity following the use of paraquat on domestic marijuana fields don't sit well with proponents of paraquat. "Every time something like that happens, it gives you a very significant black eye," says Jack Early, president of the National Agricultural Chemicals Association. According to Scott Hagood at Virginia Polytechnic, "The loss of paraquat would eliminate practical no-till corn production." And that could eliminate a lot of farmers. Hagood says there is no suitable replacement for paraquat.

There is another "hit and run" herbicide called Roundup on the market that reportedly can do everything paraquat can do—and do it more safely. But, according to industry experts, it is three to four times more expensive. (Incidentally, almost all of the toxicity testing in support of Roundup was done by IBT.)

"There's a lot of people that literally believe that we can do this organically," Hagood says. "Unh-unh! Not and eat. There has to be a core of these products to maintain the level of productivity we have now."

In the past decade, agriculture has become agribusiness. The high cost of rented land (today, more than half of Ameri-

ca's farmland is rented) and the price of new technology are both creating an unprecedented push for productivity—and for new tools like paraquat.

According to Norman Berg, the former head of the U.S. Soil Conservation Service, the higher productivity feeds a self-destructive cycle: By depressing prices, overproduction forces farmers with big debts to produce even more—or perish.

SAFETY VS. SURVIVAL

And in the less developed countries, the pressures for using pesticides are even more immediate. There, says Dr. James Boland, a health scientist with the EPA pesticide hazard evaluation division, "you're dealing with a mind set that is based on subsistence and survival. It's hard to convince a guy who's worried about producing maybe five hundred pounds of rice that he ought to wear a respirator and not get exposed to this stuff, when he says, 'Well, if I don't get the rice, I die and everybody dies.'"

"Everything that's being utilized on these very intensively cultivated acres is being pushed to the maximum," says Berg. "And that's a fragile operation that we do not fully understand." He warns that this vicious cycle can break down. "We are in an increasingly unnatural type of production. We have moved heavily with the chemicals. So many of the decisions that we make are very short range. We're looking into a very cloudy crystal ball. In this work, you need to look beyond this century and even fifty years into the future."

Scott Hagood sees problems that are a good deal less than 50 years away: "If we get too much pressure from the environmental groups, and we start to lose too many of these [pesticides], you're going to see a backlash in the agricultural industry. Now we could go back to having your little twenty-acre patch of corn and plowing it with your tractor and you could keep it weed-free. But we couldn't feed ourselves doing that anymore." Leaning back with a sigh, he says, "When it gets to where people are hungry, they're not going to care."

A sea breeze pushes in over the searing hot tin roofs of Trinidad's capital, Port of Spain. The sweat on my neck chills as I step from the balcony into my air-conditioned hotel room.

I stare at the dark bottle of paraquat that sits impassively on the Formica-topped dresser. Having purchased it so simply, I now wonder what the hell to do with it. Then I think of the similar bottles and jars and cans of paraquat that sit in homes and farms from Trinidad to Texas to Thailand—some labeled, some not, some in knowledgeable hands, some not—and I wonder who will be the next victim of this blessed-cursed chemical age.