Spraying of Herbicides on Mexican Marijuana Backfires on U.S.

In the mountainous, inaccessible regions of Mexico, over an area that comprises more than one-fourth of the national territory, Mexican farmers carefully cultivate fields of opium poppies and marijuana. Each year, more than 2500 tons of that marijuana and 5000 pounds of heroin, an opium derivative, find their way across the border into the hands of pot smokers and heroin addicts in the United States. Customs officials here will admit frankly that they are powerless to prevent it, and authorities in Mexico have fought a notoriously losing battle with farmers who are skillful at locating fertile ground hundreds of miles from highways—and do not hesitate to shoot at soldiers and narcotics agents. In a country where the average yearly income in rural areas is in the range of $200, the modest farmer of opium and marijuana can have an income of $5000.

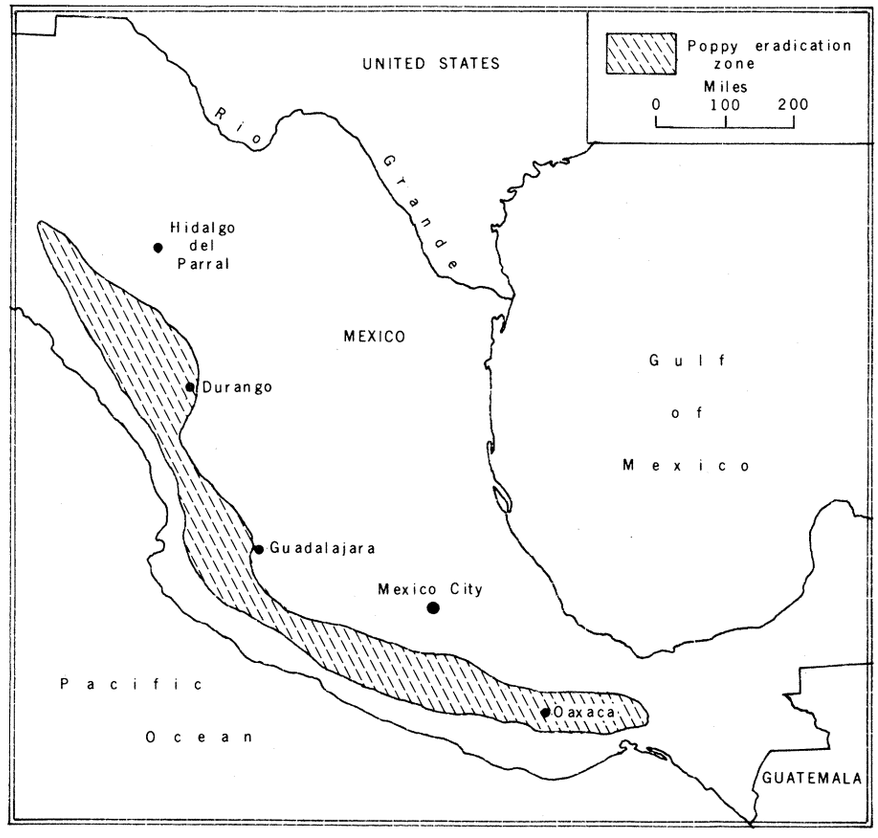
In the spring of 1975, the Mexican government and their advisers in the U.S. drug enforcement establishment came up with a bright idea: Herbicides, which were successfully used to defoliate large portions of the Southeast Asian jungle during the Vietnam war, could be sprayed on the opium and marijuana fields by Mexican pilots in sophisticated American helicopters. Infrared aerial photography, another high-technology development of the Vietnam war, could be used by fixed-wing aircraft to track down and pinpoint the location of the fields. By this method, thousands more acres and thousands more fields could be wiped out than through the older, slower, ground method of search-and-destroy by burning.

After a brief period of trials and demonstrations before a variety of Mexican and American officials, the program began with the use of a variety of agricultural herbicides, including 2,4,5-T, 2,4-D, and paraquat (Gramoxone by its trade name). Later, paraquat was accepted as the most effective herbicide to use on marijuana, and 2,4-D was judged the most effective for use on opium poppies. Last year, according to government officials, poppy fields covering 14,000 acres and marijuana fields covering 9500 acres were destroyed by airborne spraying. This prompted one U.S. official to pronounce it "the most effective and cost efficient means of decreasing the flow of drugs such as heroin into the United States."

What has followed this comparative success, however, has been a growing criticism of the program by American environmentalists, an exacerbation of existing tensions between the United States and Mexico, and in the words of an American senator, outrage over the fact that no steps were taken to ensure the health of millions of Americans who might be using marijuana harvested immediately after it had been dosed with herbicide. Concerns about the safety of the paraquat-sprayed marijuana—first expressed in the underground press—have led to a federally funded study of the safety. A warning about paraquat-contaminated pot has been issued by the Office of Drug Abuse Policy in the White House. Dogging the whole affair has been a series of contradictory statements by the State Department, which has tried at nearly every opportunity to minimize the ecological and health risks associated with the program, as well as the American involvement in it.

"What we're dealing with here is a very sensitive issue within the framework of relations between the United States and Mexico," a State Department official told *Science*. "Right now, they are spending an inordinate amount of their resources on a project [the spraying] that essentially benefits the United States. We don't want to disturb that. Moreover, anything that makes it appear that the United States is in any way controlling or directing the program is damaging to the stability of the Mexican political environment. The closer their government is to the United States, the worse it looks in the eyes of the Mexican people and press."

When the office of Senator Charles Percy (R-Ill.) began inquiring about the herbicide-spraying program in May 1977, after a member of his staff saw references to it in the underground press, the State Department was mindful of the diplomatic problem. In its responses to Percy and to the later inquiries of the National Organization for the Reform of Marijuana Laws (NORML), department



Most of the marijuana and opium poppy fields are in the mountainous regions. The map shows the principal area of the herbicide-spraying program.

0036-8075/78/0224-0861$01.00/0 Copyright © 1978 AAAS

officials pointed out that "the Mexican narcotics control effort is directed and controlled by the Mexican government." The State Department also asserted that the herbicides used in Mexico—after having been selected by the Mexicans with complete independence—do not pose any environmental or human health risks: "Reports from the [American] embassy indicate that marihuana sprayed with herbicide disintegrates quickly into a fine powder rendering it useless for smoking." Even the White House drug abuse office, in a statement released on 9 December 1977, asserted that "while the U.S. has provided both equipment and technical assistance to the Mexican government for the eradication of illegal poppy fields, it is not participating in the marihuana eradication program."

However, these claims appear to be contradicted by the scope of U.S. assistance to the program and by the contents of several State Department documents relating to the herbicide spraying. Although the U.S. claims, for example, that the herbicide program is Mexican-directed and controlled, it seems clear it could not function as it does without American approval: Since 1973, this country has provided $40 million in direct funding for the program, most of which has been used to purchase 41 American-made Bell & Howell helicopters and 35 Cessna single- and twin-engined fixed-wing airplanes. Mexican personnel are trained by flight instructors, maintenance and repair instructors, and aviation systems advisers under contract to the United States. Employees of the Drug Enforcement Administration accompany the Mexicans on flights to identify the fields and assure that they have been destroyed. Four government agencies oversee the operation: the State Department, through the U.S. Embassy in Mexico, and its Office of International Narcotics; the Drug Enforcement Administration; the General Accounting Office; and the Agency for International Development.

This participation and oversight, moreover, clearly has extended to the marijuana eradication program: A report filed by John Ford, an employee of the State Department who was sent to help set up the spraying program, contains several references dated October 1975 to observations he made and advice he provided on the spraying of paraquat on marijuana fields.

The importance of the contradictions in the activities and public statements of the government lies in the influence that the State Department's denial of a U.S. role had in delaying an investigation of the environmental and human health effects of the herbicide-spraying program. Concern over those effects first arose simply because of paraquat's inherent toxicity to humans and plants. As the label on it states, "one swallow can kill," and there is no known antidote. Ingestion or inhalation of one-tenth of an ounce is sufficient to damage major internal organs and result in a painful death after 24 hours. In fact, more than 100 persons in the United States have died from ingesting paraquat by accident or to commit suicide. Most of the deaths have occurred in Texas and California, where paraquat has been used to kill weeds and clear land, according to a scientist at the National Institute of Drug Abuse.

Despite its toxicity to humans, paraquat does not persist in the environment—it breaks down when it contacts soil—which made it initially attractive to the Mexicans. To the American critics of its use on marijuana, however, that major attribute is more than offset by the way it acts to destroy plants. When sprayed in the air, paraquat sticks to the leaves of plants, desiccating them through a chemical reaction with the leaves' surfaces, with sunlight as the catalyst. Thus, for the plant to be completely destroyed, it must sit for a day and probably two in bright sunlight. The potential hazard to users of marijuana is created whenever the crop is harvested by the farmer on the same day it is sprayed. Once harvested and pressed into bricks for shipment across the border, the leaves are out of the sun, the plant stops its deterioration, and the herbicide remains largely intact on the marijuana.

State Department Denial

Initial inquiries from Percy and NORML about the possibility of this occurring or having occurred were deflected by the State Department with a denial of any responsibility for the program. Eventually, in response to persistent inquiries by Percy, the White House drug abuse office convened a meeting in May 1977 of representatives of eight federal drug enforcement and health agencies to discuss the issue. Then a different obstacle arose. Several of the officials balked at the idea of investigating potential risks associated with use of a contraband substance. According to Percy, they said in effect: "So who cares, what responsibility does our government have for dope smokers who might be poisoned by paraquat?" Although Percy himself had carefully expressed his disapproval of "the use of illegal drugs under any circumstance," he firmly expressed his belief that "the United States government has a responsibility to ensure that its actions do not foreseeably endanger the health and safety of *any* of its citizens, drug users included."

This view was shared by presidential assistant Peter Bourne, the director of the Office of Drug Abuse Policy, who pointed out that any intake of paraquat-treated marijuana by U.S. citizens would be a direct result of the U.S.-supplied spraying operation. Following the meeting, Bourne directed the National Institute on Drug Abuse (NIDA) to conduct a $35,000 study to determine if marijuana contaminated with paraquat actually was being imported, and if so, whether it could cause injury to those who used it.

To answer the first question, NIDA obtained 71 samples of marijuana confiscated during major drug busts in the southwestern region of the United States and had them analyzed by researchers at the University of Mississippi. Richard Hawks, a chemist at NIDA who is directing the research, makes no claims that the samples are representative of all the marijuana that comes across the border, but he said that researchers found paraquat on 10 percent of the samples, and "by itself, that was positive proof that paraquat-laden marijuana is being imported."

For the second portion of the study, marijuana plants were grown by the Department of Agriculture at a laboratory in Beltsville, Maryland, where they also were treated with paraquat. Scientists at the Research Triangle Institute in North Carolina then burned the marijuana and subjected the smoke condensate to chemical analysis. The researchers already knew that a hazardous amount of the herbicide was unlikely to be inhaled by the user as a part of the smoke, but it was unclear whether or not the heat of the burning converted paraquat into another toxic substance. Tests of the smoke condensate using mass spectrometry have yet to be carried out, but the preliminary results of tests using a slightly less accurate method indicate that the herbicide is broken down into bipyridine, which commonly exists in tobacco smoke and will not hurt the user, according to Hawks.

According to NORML, however, the government cannot be sure that paraquat-laden marijuana poses no health hazard unless a study is made of the effects of eating small amounts of it baked in cookies or brownies—a means of administration employed by a small but essentially unknown proportion of the estimated 15 million regular marijuana users in the United States. Using several rather arbitrary statistical measures of

the concentration of the herbicide in imported marijuana and the distribution of marijuana in a batch of brownies, NIDA has calculated that a person would have to consume 32 pounds of brownies—containing 1 pound of the sprayed marijuana—over a short period of time to ingest a lethal dose of paraquat. But the agency does not know whether eating a portion of that amount would have less than fatal but still toxic results, according to Hawks. "We have no plans whatever to look at the effects of ingesting a sublethal dose," Hawks added.

One indication of the potential toxicity of ingesting it may be the fact that the concentrations of paraquat found on the imported samples analyzed by NIDA were between 3 and 650 parts per million. These concentrations uniformly exceed the tolerance levels set by the Environmental Protection Agency for paraquat on foodstuffs, which are in the range of 0.05 to 0.10 part per million. Moreover, "because of paraquat's inherent toxicity and studies that indicate it can cause birth defects," the EPA has placed it on a list of candidates for hearings that may lead to those tolerance levels being reduced, or to a removal of the herbicide from the U.S. market for use in connection with agricultural commodities, an EPA spokesman told *Science*.

Keith Stroup, the director of NORML, believes that NIDA should study not only the hazards of eating paraquat-laden marijuana, but that it should also look into the possibility that heroin may be coming across the border laden with toxic amounts of the herbicide 2,4-D. The chemical works by interfering with the normal growth cycle of a plant, causing it to wither in 36 to 48 hours. Although it is not considered to be as toxic as paraquat, it also has been placed on a list of candidates for hearings that may lead to use restrictions or to its removal from the market; studies have indicated that it may cause mutations and cancer. So far, NORML has been the only group to express any interest in the possibility that it has contaminated imported heroin; ensuring that addicts do not face such a hazard does not seem to be a popular cause. The State Department responds confidently that "because heroin is already injurious to health, we don't consider that [the possibility of herbicide-laden heroin reaching users in this country] to be a problem."

NORML believes that a first step toward changing State Department support of the herbicide-spraying program would be to force the department in federal court to file an environmental impact statement, placing the ramifications of the spraying program on the public record. Impact statements are required under the National Environmental Policy Act (NEPA) for "major federal actions significantly affecting the quality of the human environment" in the United States. The State Department contends that no statement is required for the herbicide program because it is outside the U.S., under the formal control of the Mexicans, and bereft of any direct U.S. subsidy for the herbicides themselves.

Marijuana plants that have been sprayed with paraquat, on the left, turn yellow and begin to dry out after 24 hours. Healthy plant is at right.

Many Washington environmentalists, on the other hand, believe that such a statement is required. Their view is based partly on a 1975 suit by the Environmental Defense Fund that forced the Agency for International Development to file the statements on its pesticide programs in foreign countries because of their potential impact here. Moreover, the herbicide-spraying program in Mexico appears to be a prime example of the type of issue that impact statements are designed to illuminate. The State Department from the start knew, for example, that marijuana treated with paraquat was likely to be harvested quickly by the Mexicans; reports filed by John Ford noted that some of the plots that had been selected for the initial trials were harvested on the same day they were sprayed. The State Department also knew that paraquat is an extremely hazardous herbicide with which to work. In early 1975, an official of the Agricultural Research Service in the Department of Agriculture wrote to the State Department to express his concern over the intention of the Mexicans to use the herbicide, because of the hazards present for those who administered it. If a statement had been filed at the inception of the program, the State Department would have been forced to consider these ramifications and explain them in a public document, critics have pointed out.

Despite the apparent strength that these arguments would have in court, there is some reluctance by the environmentalists to take the case there. Currently, they are engaged in a running battle with agencies of the federal government that oppose a proposal by the Council on Environmental Quality, a White House office, to extend the NEPA requirements for filing impact statements to U.S.-supported actions that will have an effect only *within* the environment of a foreign country. Bringing a federal agency to court over an existing NEPA requirement in a case that hinges primarily on concern for the welfare of U.S. pot smokers and heroin addicts, at the same time a battle is taking place over proposals to extend those requirements, apparently is not considered sound strategy. Some groups also feel that the two issues—concern for U.S. pot smokers and the need for broader use of impact statements—should be kept apart.

Whatever the reason, this lack of action leaves unsolved several confusing mysteries that surround the affair. One is whether or not the State Department actually has exerted any pressure on the Mexicans to substitute another herbicide for paraquat. Richard Dugstad, a policy officer in the State Department's Office of International Narcotics, was quoted recently in the *Washington Post* as saying, "We have done nothing to discourage the use of paraquat by the Mexican government." But this contradicts

what the State Department, in a letter to Senator Percy dated 13 May 1977, said: "We have supported informally the reported decision of the Mexican government to use in the future only 2,4-D" on marijuana plants. Dugstad now states that he was quoted out of context by the *Post*. The letter to Percy also states that "we have been advised that in the future, only 2,4-D will be used against both poppies and marihuana because tests showed it was more effective and safer to handle." Dugstad recently told *Science*, however, that "the Mexicans are staying with the present system of using paraquat on marijuana and 2,4-D only on opium poppies," because of continuing experience that shows each herbicide to be most effective on the plants that are sprayed with it now. He added a rhetorical question that prompts greater uncertainty: "Is it really appropriate for the U.S. to direct another government to use one chemical instead of another?"

Another unanswered question is whether the Mexicans are using herbicides besides paraquat and 2,4-D on opium poppies and marijuana. A report filed in 1976 by Walter Gentner, an employee of the U.S. Agriculture Department who went to Mexico to observe the operation, states that he saw the herbicide 2,4,5-T, a toxic chemical that may cause cancer, in a shed where other herbicides were stored. He suggested then that a special investigation be initiated, but up to now none has been conducted. Dugstad said that "to the best of our knowledge, no herbicides besides paraquat and 2,4-D are being used by the Mexicans."

In a sense, the uncertainty of this statement is understandable. The State Department has been caught between the proverbial rock and hard place in this affair, which is fraught with international political complications and the potential for exposure of an error in U.S. policy. To admit at the start that paraquat-laden marijuana posed a health hazard for users in the United States would have been to admit that the Mexicans had not made the wisest choice of chemicals and, moreover, that despite the best application of American ingenuity and good intentions, heroin and marijuana are continuing to flow across the border in quantities that pose a hazard to U.S. citizens. What seems clear now, however, is that unless the State Department immediately places all of its cards on the table for everyone to see, its own credibility and wisdom, and possibly its good intentions, will remain in question.

—R. JEFFREY SMITH

New York Puts Together Its Own State Energy Policy and Plan

Albany, New York. The seemingly endless debate over national energy policy is centered in Washington, but a lot of the action is going on in the state capitals, this one being a good case in point.

The vitality of state government is especially evident here. The designers of the gleaming new complex of state office buildings known as the Empire State Plaza apparently never dreamed there would ever be an energy crisis, and its five huge vertical slabs of glass, concrete, and marble can be regarded as a monument to energy inefficiency. But, in light of the initiatives being taken by New York with respect to energy, the plaza and its massive edifices—"instant Stonehenge" some call it—also can be viewed as symbolic of the increasing assertiveness of one major state in a critically important field of national policy.

Although New York may not yet have accomplished as much as certain other states such as Minnesota and California, it has come a long way since the Arab oil embargo 4 years ago in building the legislative and institutional base for a significant state energy policy and program. Its leaders seem convinced that, while the opportunities for a constructive state role in the energy field are limited and constrained, they are nevertheless very real.

To put New York's efforts in a true perspective at the outset, a word about the limits and constraints is in order. For one thing, the federal government is necessarily preempting the leading if not the sole governmental role in a wide range of activities, such as regulating the price and distribution of energy, fostering development of new energy supplies through a large R & D program and the leasing of federal lands containing energy resources, and establishing energy efficiency standards (as in the case of the automobile). Then, on top of this, for New York, and indeed for any state, there can be some fairly tight limits to what the public will accept in the way of conservation measures, especially if most other states are making lesser demands on their citizens and commercial and industrial enterprises.

But, as New York is trying to demonstrate, there is a great deal that a state can do by acting on the special opportunities arising from its own particular circumstances; by trying to influence or shape federal policies to suit its own needs; and by proceeding boldly in cases where federal policy has been laggard or needlessly cautious. Among this state's first positive actions was to establish two new state energy agencies.

First, in late 1975, the Atomic and Space Development Authority, which had been established in the early 1960's as essentially a promotional agency for nuclear power, was abolished and replaced with the New York State Energy Research and Development Authority (NYSERDA). This agency, which has been spending up to $7 million a year on R & D, has the mission of supporting and encouraging projects of particular relevance to New York. Its recently completed survey of technologies that might be used to convert much of New York City's vast outpouring of solid wastes (25,000 tons a day) into fuel for electric power generation is a good example.

A key part of NYSERDA's strategy is to encourage the U.S. Department of Energy (DOE) to undertake or support R & D work that has a New York orientation or application. One of its ways of doing this is to review DOE project proposals and offer to participate in those that meet its criteria. For instance, the two agencies jointly sponsor a current demonstration of heat-recovery and heat-pump technologies that can help restaurants conserve energy. All told, NYSERDA claims to have had a part in bringing some $8 million in federal R & D funds to New York over the past 2 years. While its achievements to date appear modest, NYSERDA has the op-

0036-8075/78/0224-0864$00.75/0 Copyright © 1978 AAAS