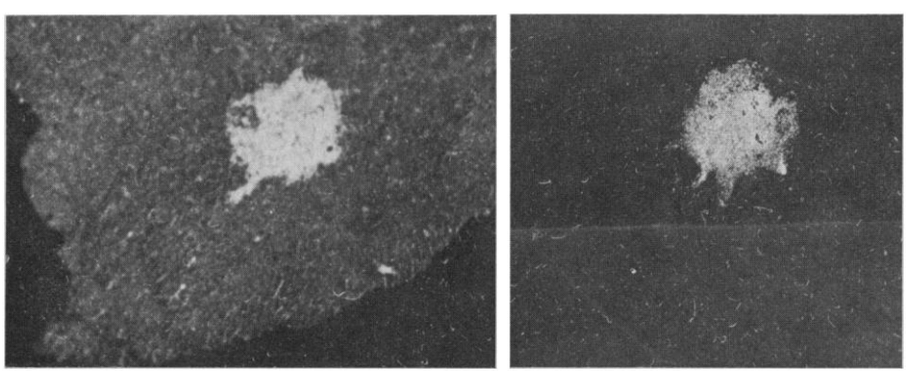
Yellow Rain Evidence Slowly Whittled Away

Recently disclosed data from British and Canadian defense laboratories make the U.S. case seem ever more doubtful

THE evidence against the Soviets as promoters of biowarfare in Asia, never strong, grows steadily weaker as scientists continue to probe its credibility.

Since the issue arose in 1980, British scientists have examined "50 odd" biomedical and environmental samples taken from battle areas in Southeast Asia, says an official in London. They have not been able to find the high levels of biotoxins reported by the United States. In fact, they have found no biotoxins at all. The British have not published the data, but the facts have been confirmed by the Chemical Defense Research Establishment at Porton Down.

For their part, the Canadians did find the toxin T-2, not in battlefield samples, but in the blood and urine of Thai people. These



Distinction without a difference? *The Meselson theory holds that the only way to distinguish a yellow rain sample (left) from bee droppings (right) is to ask what the State Department calls it.*

individuals had never been in battle zones, suggesting that T-2 may be present in food. The Canadian data were collected in 1984 in a study for the United Nations on methods for investigating claims of chemical warfare. According to Ian Mundell of Canada's External Affairs Ministry, five out of 270 people tested had some level of T-2 in their system.

The U.S. State Department does not acknowledge that any of this has damaged its own case on yellow rain. Speaking on background, an official said "We continue to be concerned with the violation of the Biological Weapons Convention," the 1972 agreement that outlaws even the possession of bioweapons. "We never argued that trichothecenes [toxins] don't occur naturally; what we said was that they do not occur in the high concentrations and in the unusual combinations we've seen" in Southeast Asia. The skeptics put too much emphasis on field samples, he added. "The evidence goes way beyond sample analysis" and includes "other intelligence."

Five years ago, the State Department claimed it had "conclusive" proof that yellow rain was a manufactured biotoxin supplied by the Soviets and used by Communist troops in Kampuchea and Laos. The lethal agent was said to be T-2, a trichothecene produced by the mold *Fusarium*. The toxin was found in six yellow-spotted samples of leaves and rocks and in water collected near battle sites. These samples, along with refugee reports and blood and urine samples containing toxin, became the core of the case for Soviet complicity. Today, the value of this evidence has been whittled away to very little.

Although Southeast Asians were the victims of aerial attack, it seems unlikely that the weapon used was T-2 suspended in yellow rain. Instead, Matthew Meselson, a Harvard biochemist, argues persuasively that most of what has been collected and studied as yellow rain is really bee feces. The poison used against the Hmong people, if there was one, may have been a conventional gas or some other substance not yet identified.

Meselson laid out his case and evidence last fall in *The Scientific American* (September 1985, p. 128). He thinks the government mistakenly lumped together two or three unrelated phenomena. The mistake may have begun with the Hmong refugees in Thailand, who linked yellow rain with air attacks and diseases afflicting their people. U.S. investigators adopted these explanations, for they were trying to establish that Communist troops were using chemical weapons. When T-2 turned up in environmental and blood samples, it was taken as clinching the case.

Meselson does not attempt to explain the refugees' war experiences. But he does take issue with the official explanation for yellow rain and the spotted leaves.

With the help of bee and pollen experts in the United States and Thailand, Meselson has shown that the Asian honeybee (*Apis dorsata*) swarms in "cleansing flights" from its hive, leaving a swath of defecation nearby. The resulting spots are remarkably like those collected by official yellow rain sleuths. They are the same size (2 to 6 millimeters in diameter); the same color (yellow, yellow-brown, red-brown); they contain the same material (pollen grains which have been digested or stripped of protein); they have the same relative concentration of grains (roughly 1 million per milligram); and contain the same pollen types.

A State Department official insists it is "just an allegation" that all yellow rain samples contain pollen. Not all have been turned over to Meselson for analysis. But neither has the State Department issued any analysis of its own giving the pollen content of its samples.

Although U.S. officials learned 4 years ago that yellow rain contained pollen, they have not explained it. Some theorized that the grains may have been used to carry a toxin. Meselson found this far-fetched. A more credible explanation, he now argues, is that bee feces were simply mistaken for bioweapons. To believe otherwise, Meselson writes, "one would have to imagine an enemy so devious that its chemical weapon is prepared by gathering pollen predigested by honeybees."

This is not the first or the only time bee feces have confused people. Long after he solved the puzzle to his own satisfaction, Meselson says, he came across a fascinating article in Harvard's Yenching Library. In a 1977 volume of *Kexue Tongbao*, four Chinese scientists described how they had been summoned to the northern province of Jiangsu in 1976 to solve a problem. The local people were baffled and upset by something they called "yellow rain." It had fallen mysteriously on several occasions in 9 to 13 different places. The team investigated, dis-

covered that the rain contained pollen, and in due course concluded that it "is not a mysterious material," but "the feces of bees excreted while they are flying." Their description of the spots is consistent with Meselson's, and with the U.S. samples of yellow rain.

Meselson reports that in his experience, bee feces are just as confusing to Hmong refugees in Thailand as to Chinese peasants. He writes that he showed bee spots to "16 groups" of refugees in the Ban Vinai camp in Thailand, where the reports of yellow rain originated. He asked people to describe what they saw. Thirteen groups did not know what the spots were; two groups said they were *kemi*, a term for chemical weapon; and one man in the final group said they were insect feces, but later agreed with the rest of his peers, who claimed the spots were *kemi*.

If this response seems confused, it is no more so than Western expert opinion. ■

ELIOT MARSHALL

The UCLA-Occidental-Gorbachev Connection

Putting together the bone-marrow transplant team to treat Chernobyl victims involved private philanthropy, high-level connections, and sophisticated technology

Los Angeles

IT is the end of a long afternoon for Robert Peter Gale, head of the bone-marrow transplant unit at the University of California at Los Angeles. On 7 June, he returned from Moscow where he performed 19 bone-marrow transplants on victims of the Chernobyl nuclear accident. Now he is caring for 30 "horrendously ill" patients at UCLA Medical Center and is trying to juggle the press. The afternoon of 18 June began with a long photo session for *People* magazine. Then *Life* came in. Next it was the turn of a crew from Japanese television, who had waited patiently in the hall for hours. Then *Life* called to complain that they had been promised exclusive photos, so what was *People* doing there?

Gale, a thin and intense man who pads around the building in clogs, seems exhausted yet stimulated by the constant tugs for his attention from the press, patients, physicians, and the hospital staff. And he is understandably excited by the story he has to tell. For he is the one who organized and carried out the bone-marrow transplant operations in the Soviet Union—an undertaking so complex that it rivals any battle plan. Now he is planning to enlist the help of the scientific community to follow, for the rest of their lives, as many as 100,000 to 200,000 Soviets who received doses of radiation that may result in cancer or birth defects in years to come.

Even before the nuclear reactor exploded at Chernobyl, Gale had thought about what he would do if such an accident occurred. So, in a sense, he was mentally prepared.

Gale's first thought on hearing of the accident was to offer help. As chairman of the advisory committee of the International Bone Marrow Transplant Registry, he called other committee members and suggested the group contact the Soviets. Then he devised a plan to transmit their offer of aid.

"That morning, Reagan's offer of humanitarian aid was declined, so I thought of two other channels," says Gale. One was to go through the National Cancer Institute, which had an inactive exchange program with Soviet scientists. The other, which was the plan that worked, was to go through Armand Hammer, the head of Occidental Petroleum, whose headquarters are just a few blocks from the UCLA Medical Center. Gale and Hammer have known each other for years, and Hammer has a relationship with the Soviets that goes back 65 years.

In an interview at his office at Occidental Petroleum, Hammer told *Science* the story of his involvement with the Soviets. He first visited Russia in 1921, just after he graduated from New York University Medical School. He had a 6-month hiatus before he was scheduled to begin an internship at Bellevue Hospital and decided to go to Moscow to help with a typhus epidemic. "When I got to the area where the typhus epidemic was, I found that the principal problem was famine. I said, 'Why don't you buy grain?' They were burning grain in America because they had too much," Hammer says. But the Soviets explained that they had no means to buy it.

Hammer, who was already a self-made millionaire, bought the grain for them. It was the beginning of a long and virtually unbroken trade relationship between him and the Soviets. So, on 6 May, when Gale called Hammer, Hammer sent a telegram to Mikhail Gorbachev, relaying Gale's offer of help. "The answer came back, 'Please send him immediately,' " Hammer recalls. "I told him not to worry about a visa, just go. And I told him to phone me when he got there and tell me what he needs."

Gale left on 8 May. He had, he says, booked reservations on every flight to Moscow that week in order to be ready to go as soon as he got word that the Soviets wanted him. Just before he left, he "mobilized resources." Specifically, he arranged for Mortimer Bortin of the Medical College of Wisconsin, who is scientific director of the International Bone Marrow Transplant Registry, to coordinate transplant centers in case there was a need for donors—and transplant centers—outside the Soviet Union. He also contacted John Hansen of the University of Washington and arranged for him to coordinate computer data from a North American registry of potential bone-marrow donors and for John Goldman of Hammersmith Hospital in England to do the same for a European directory. Although there is only a 1 in 10,000 chance that marrow from an unrelated person will completely match any particular patient, Gale wanted to have the registry donors available. It turned out, however, that he did not need to use them.

In addition, Gale called Paul Terasaki of UCLA, a tissue-typing expert, and asked him to assemble all that he needed for tissue typing as many as 200 people. He also contacted his UCLA colleague Richard Champlin, asking him to put together antibiotics, needles, and other supplies to take care of the Chernobyl victims clinically. And he got in touch with Israeli scientist Yair Reisner, whose specialty is using plant lectins to remove T cells from bone marrow before it is transplanted. In this way, it is possible to overcome some of the difficulties of tissue mismatches. Hammer flew Terasaki, Champlin, and Reisner to Moscow.

The technology that the physicians used was first discussed in 1945, when American researchers began laboratory investigations