Toxin Warfare Charges May Be Premature

On the basis of a single sample, the State Department says mycotoxins are being used in chemical warfare

The State Department's recent charges that mycotoxins have been used as warfare agents in Southeast Asia are based in part on scientific evidence that seems to be seriously incomplete.

"We now have firm evidence of utilization of such weapons in Southeast Asia," Secretary of State Alexander Haig declared at a press conference in Berlin on 13 September. He promised that the evidence would be produced in Washington the next day, but the case presented at a State Department press conference on 14 September was indicative rather than compelling and a long way short of the "firm evidence" claimed by Haig.

Since 1976 there have been numerous reports that chemical warfare agents have been used in Southeast Asia, chiefly by Vietnamese forces in Laos and Campuchea. Despite intensive efforts the agent in "yellow rain," as a major form of the weapon is known, has long resisted identification by United States authorities.

According to Sterling Seagrave, a writer who has spent several years studying the alleged use of chemical weapons in the area, the samples previously returned to the United States for analysis were examined without success because no one knew what to look for. Seagrave, whose book on chemical warfare is to appear this month,* suggested that mycotoxins might be the agent. And indeed a sample of yellow rain sent for analysis to a Minnesota testing laboratory came back last month with a report that there were anomalously high levels of three mycotoxins in the foliage.

Such a result was clearly of great interest and worth following up by obtaining more and better samples. But instead of doing that, the State Department went public with its accusation.

"We believe we have obtained good evidence that rather than a traditional lethal chemical agent, three potent mycotoxins of the trichothecene group have been used," states a fact sheet handed out at the 14 September briefing.

This position, to which the Secretary of State has publicly committed himself, is based on a single sample of material, collected without any controls. Moreover, the sample could have become moldy prior to analysis, raising the possibility that the mycotoxins might have arisen from natural sources.

On the basis of analysis of a single leaf and stem exposed to yellow rain, the State Department is almost directly accusing the Soviet Union of breaking various treaties. Facilities for producing the quantities of mycotoxin and yellow rain reportedly used "do not exist in Southeast Asia. . . . The Soviet Union, on the other hand, does have the necessary facilities to easily produce the quantitites reported," says the State Department fact sheet. The possession and use of toxins, it notes, "is a violation of both the 1925 Geneva Protocol and the 1972 Biological Weapons Convention, as well as the rules of customary international law of armed conflict."

The three mycotoxins found in the sample, nivalenol, deoxynivalenol, and T2, are members of a group known as the trichothecene toxins. Trichothecenes are produced by some but not all species of *Fusarium*, an extremely common fungus. The State Department believes the mycotoxins in the acquired sample must have been applied because, "In point of fact, these mycotoxins do not occur naturally in Southeast Asia."

Two *Fusarium* experts consulted by *Science* expressed surprise at this conclusion, noting that *Fusarium* is found almost everywhere and that one would expect the same to be true of its member species that produce mycotoxins.

Asked the reason for the statement in the fact sheet, Frederick Celic of the State Department's Office of Theater Military Policy says that a search of 3000 literature references to mycotoxins revealed that none had been reported from Southeast Asia. But the failure to find any literature references is obviously a less than conclusive basis for asserting that "mycotoxins do not not occur naturally in Southeast Asia."

The State Department refuses to specify the amounts of mycotoxin found in the sample except to say that they "were up to 20 times greater than any recorded natural outbreak." Seagrave, however, who has maintained close contact with the interagency group's investigation, says that 160 parts per million of one of the toxins was reported.

Such a level would certainly be very high, but it is not "20 times greater than any recorded natural outbreak." A barley sample in the United States produced 25 parts per million of a trichothecene toxin. Reported levels more typically lie between 0.1 and 10 parts per million, but in ideal laboratory conditions up to 900 parts per million of toxin can be obtained, notes James R. Bamburg of Colorado State University. Bamburg studied (and named) T2 toxin as part of the work for a Ph.D. thesis. In short, a level of toxin as high as 160 parts per million would certainly favor an applied origin over natural sources but is probably short of being decisive evidence.

The possibility of a natural source prompts the question of whether the sample of leaf and stem could have been contaminated with fungus at the time of its collection. If so, the fungus might have produced a certain amount of toxin before the sample was analyzed.

Celic declines to specify for how long the sample was in transit but says it was kept at room temperature at all times. (Putting it in a refrigerator would have enhanced toxin production which occurs optimally at 8°C, according to Bamburg.) Asked if the sample had contained fungus before analysis, Celic stated it did not, but quoted a laboratory report saying that the samples "were not heavily molded" but that they carried a "white material resembling mold" which under a microscope "appeared to be powder." If the sample was molded to any extent, however, the mold would be the most likely source of the mycotoxins.

The sheer volume of refugee reports from Southeast Asia builds an impressive circumstantial case that chemical agents of some kind are being used in the area. Those agents may well turn out to include mycotoxins and if so, would represent the first known occasion on which mycotoxins have been used in human warfare. Further investigation is clearly warranted. But it is something else again for the State Department to tell the world it already has "good evidence" for the use of mycotoxins when what it apparently has is a single sample, collected without controls, which was possibly contaminated naturally with mold, and whose significance rests largely on the negatively based inference that mycotoxins do not occur naturally in the area.—NICHOLAS WADE

*Sterling Seagrave, *Yellow Rain* (Evans, New York, 1981).

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