DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY
HARVARD UNIVERSITY

MEMORANDUM

TO: FILE

RE: INCIDENT AT BAN SA TONG

DATE: 25 APRIL 1986

A) The event. On Friday 19 February 1982, residents of the village of Ban Sa Tong in Thailand, about 10 kilometers from the Cambodian border, reported an unusual event. A village health officer, according to an interview with a UN investigating team, saw a plane circling Ban Sa Tong at 9:00-9:30 in the morning and at about 10:00 was told by villagers that deposits of a yellow material had been noted. He collected samples of it and radioed a report to the authorities. The Thai Border Patrol Police arrived to investigate. They too collected samples and ordered the villagers not to drink the water. Later in the day, Provincial health authorities came to investigate. The District Officer of Pong Nam Ron district, in which Ban Sa Tong is located, said that the plane was white and single-engined and that the two adjacent villages of Ban Sa Tong and Ban Sub Tha Mau both had deposits of the yellow material, with the greater amount at Ban Sa Tong. By coincidence, a television crew from Bangkok channel seven came through both villages on Feb 19 and filmed the deposits. These appear in the film as yellow spots, in agreement with descriptions by local residents (UN General Assembly Document A/37/259, 1 Dec 1982).

According to the Bangkok Post of 21 Feb 82, the yellow deposits resembled "small drops of candle wax". The article also stated that samples were collected by Border Patrol Police and by Thai Marine units, both of whom warned villagers not to drink the water until tests were done, and by U.S. Embassy officials. According to the Bangkok "Nation Review" of 21 Feb, the Provincial Governor came to inspect the area on the 20th and announced that preliminary tests showed the substance to contain "bio-toxin". But the Bangkok Post of 24 Feb reported that on the previous day the Minister of Health said that mice injected with the yellow material showed no symptoms.

On 5 March, two weeks after the incident, a medical team from Canadian National Defense Headquarters in Ottawa, sent to investigate allegations of chemical warfare in Southeast Asia, arrived in Ban Sa Tong ("An Epidemiological Investigation of Alleged CW/BW incidents in SE Asia", Surgeon General Branch, National Defense Headquarters, Ottawa, 11 August 1982).

According to the Canadian report, "On 19 Feb 82, at 0930 hrs, a single-engine unmarked plane circled the Thai village of Ban Sa Tong located 20 kms north of Pong Nam Ron and 10 kms west of the Cambodian border. After five or six circuits it dropped a yellow

substance from a height of about 5,000 feet. Six houses in the south-east sector of the village were liberally covered with a yellow powder which stuck to roofs, walls, foliage and ground."

The Canadian team also reports the village of Ban Sub Tha Mau to have experienced depositions of yellow spots on numerous occasions in February and March, with fresh deposits occurring even during the time the team was investigating. The Canadian report concludes that "The yellow substance is being blown over the border from Cambodia where it is being used in and around Pailin by Vietnamese forces." The distance to Pailin is given as 13 kilometers.

B) Medical investigation. The Canadian team noted that there was no significant increase in visits to the village clinic following the incident of 19 Feb. Daily clinic visits averaged about twenty per day before and after the incident and also during the same period in 1981. The team noted that "The only significant symptom in patients examined at the clinic for the period 19 Feb-28 Feb inclusive when compared with the same period in 1981 was upper respiratory infection/common cold."

On March 5,6,12 and 14 the Canadian team interviewed a total of 33 residents of Ban Sa Tong. The interview form they employed asks respondents where they were and what they were doing "at the time of the attack". The interview form then asks questions regarding symptoms experienced "upon exposure".

The symptoms most often reported in the Canadian interviews at Ban Sa Tong are, in order of decreasing frequency, cough (17 persons), headache, dizziness, dry throat, loss of appetite, fatigue, weakness, and itching (10 persons). The only residual effects actually seen by the Canadian team ascribed to the yellow material were coughing and fear. According to their report, "...grandmothers were extremely apprehensive".

On 14 March, the Canadians interviewed 57 residents of Ban Mai, chosen as a control village because it reported no yellow rain incidents. Ban Mai is 8-9 kilometers west of Ban Sa Tong. Since there was no presumption of chemical attack in Ban Mai, interviews there could not have asked about the effects of exposure to presumed toxic materials. The Canadian report does not specify how this problem was dealt with in the control interviews. Except for headache (22 persons), none of the symptoms cited by villagers in Ban Sa Tong were cited by more than a few of the persons in the control group.

The conclusion of the Canadian report regarding the incident at Ban Sa Tong is that " The team could not identify any possible causal mechanisms common to all those affected except the yellow substance dropped on the village at 0930 hours, 19 Feb 82". They also concluded the yellow substance was responsible for health effects cited by villagers in Ban Sub Tha Mau, 3 kilometers east of Ban Sa Tong, where they conducted 23 interviews, with results generally similar to those in Ban Sa Tong.

A completely different explanation of the health effects reported by villagers was given by a Ban Sa Tong health officer appearing on a BBC "Horizon" television documentary (# H 71202). According to the BBC translation, he stated that a few days after the incident, villagers reported "A few slight headaches and fevers, common complaints". The village health officer considered the affair a "mild hysteria" and said that "It was probably some kind of neurosis...because they were already afraid."

The Canadian team do not discuss the liklihood that affirmative responses to interview questions about illness following appearance of the yellow substance resulted not from any toxicity but rather from common maladies and from psychological and psychosomatic effects of the highly unusual attention and apprehension provoked by the suspicion of chemical warfare attack. This would certainly focus the attention of those being interviewed on common symptoms which they might otherwise dismiss.

CONCLUSION. There were no significant clinical manifestations. The recollection of mild effects by villagers in interviews is unremarkable, considering the likely effects of psychological and psychosomatic factors in a population apprehensive that it may have been exposed to chemical attack. There is no significant evidence for any exposure to toxic substances.

C) The yellow material. All available photographs and samples of the yellow deposits from Ban Sa Tong and Ban Sub Tha Mao show them to be indistinguishable in size, color and general appearance from the feces of wild honeybees from the same region. Microscopic examination of the material by Thai, Canadian, US and French laboratories has without exception shown it to be mainly pollen.

Photomicrographs of the pollen are published in a 1982 Thai scientific report ("Examination of the Yellow Spot Samples Collected from Thailand Border Close to Cambodia", Sukroongreung, et al., Siriraj Hospital Gazette 34, 643-647) and in a recent Canadian report (Final Summary Report on the Investigation of "Yellow Rain Samples from Southeast Asia", Defense Research

Establishment Ottawa, February, 1986). The pollen is diverse, with several different morphotypes particularly abundant. These appear to be the same types found in samples of known honeybee feces from Thailand.

Showers of feces from wild honeybees flying too high to be seen or heard are now known to occur in the region. They may last several minutes, covering areas up to an acre or more with hundreds of thousands of yellow fecal spots. The distribution of spots on leaves collected at Ban Sa Tong suggests that there were 10-100 spots per meter on exposed surfaces in the affected area. This is well within the range observed for honeybee fecal showers in China and Thailand (Zhong Zhangying et al. (1977), Keksue Tongbao 22, 409-412; Seeley et al. (1985) Scientific American Sept., 128-137. Questioning of numerous Thai villagers has shown that they are generally unable to identify spots of bee feces shown to them on vegetation.

The limited area of deposition of yellow spots in Ban Sa Tong (six adjacent houses) is quite consistent with a shower of bee feces. However, being ignorant of the defecation behavior of Southeast Asian honeybees, the Canadian team hypothesized that "...a container had been used that would drop to a relatively low height where it would explode, releasing the substance." The Canadian team was correct to believe that a spray released from high altitude cannot be targeted on a limited area. But they failed to address the inconsistency of their scenario of low-altitude release for targeting effectiveness with their conclusion that yellow spots were carried several kilometers from Cambodia to Thailand by the wind. Low altitude release is irreconcilable with any significant degree of long distance wind dispersal. In fact, even if released from 5,000 feet, drops the size of those observed could not travel the requisite distance without there being wind speeds of hundreds of kilometers per hour.

According to the 1986 Canadian report, some samples of the yellow spots cut out from leaves contained minute amounts of trichothecene mycotoxins near the limit of reliable detection but these were judged "...comparable to the levels reported worldwide for natural occurrences of trichothecenes on stored cereal..."

CONCLUSION. There is no basis for concluding that the yellow material deposited on Ban Sa Tong and Ban Sub Tha Mau was anything other than honeybee feces.

D) The plastic bag. In its 1982 report, the Canadian team noted that "During a subsequent visit to Ban Sa Tong, one of the

villagers produced a plastic bag which he claimed had fallen from the plane at the same time as the yellow rain. This bag was forwarded to Canada although the team was skeptical that it was the real container."

The February 1986 report of the Canadian Defense Research Establishment Ottawa cited above shows photographs of the bag in question. In the photographs it appears partly crumpled up and torn but otherwise largely intact. It resembles the thin polyethylene bags sold for kitchen use and might be 6 to 12 inches on a side if flattened out. Some brown material and a few small yellowish spots are visible. The 1986 Canadian report states that "The bag was burst and had yellow spots on the outside surface."

Sections of the bag were cut out and extracted with solvents. After centrifugation to remove debris, the solvent was evaporated, giving a solid residue. The residue from one section of the bag is reported by one laboratory to have a concentration of trichothecenes T-2 and HT-2 of 85-230 and 52-117 parts per million, respectively. Residue from another section of the bag, analysed by a different laboratory, using a more discriminating analytical technique, is reported to have a concentration of 6.3 and 6.0 parts per million of these mycotoxins. The residue weights on which these concentrations are based are not reported, making it impossible to estimate the amount of trichothecenes that may have been associated with the bag. Pollen grains are not evident in scanning electron micrographs of a yellow spot. The samples were evidently not subjected to acetolysis before microscopy, as is sometimes necessary to reveal pollen grains.

It has been speculated that the bag may have been a weapon for explosively disseminating toxins. Among the difficulties confronting this speculation are the following:

1) Only one villager claimed that a bag was dropped by the plane.
2) No one, not even the provider of the plastic bag, reported hearing any explosion.
3) The provider of the plastic bag apparently did not see fit to come forward for more than two weeks after the incident, during which time he could have informed the resident village officials, the numerous Thai District, Provincial and National investigators, the TV film crew or the Canadian team during their first visit, starting March 5.
4) There is no significant medical evidence that villagers were exposed to any toxic material.
5) The bag resembles those commonly used in the kitchen and for other ordinary purposes.
6) The bag is largely intact and no evidence is presented for powder burns.

7) There is no evidence for the presence of an altimeter, a timer or any release mechanism.

8) Samples of the substance that the villagers said fell from the sky on the morning of 19 February all contained copious amounts of pollen and are clearly honeybee feces. If anything else was deposited, it apparently was not noticed and not sampled.

9) A coincidence in place and time of a shower of honeybee feces with a chemical attack is exceedingly unlikely, indicating that only the former actually occurred.

10) The parts-per-million values given in the Canadian report refer only to laboratory residues and not to the actual amount of toxin that was in or on the bag. It is therefor not evident that the amounts associated with the bag were sufficient to be of any toxicological significance.

11) Fusarium semitectum was isolated from both of two pollen-containing yellow spots received from the Pong Nam Ron area by Sukroongreung et al. on 22 Feb, 1982, as reported in their publication cited above. One isolate was tested in mice and found to be toxic. Workers at Agriculture Canada isolated Fusarium semitectum and Fusarium equiseti from a leaf collected at Ban Sa Tong after the 19 Feb 82 incident. An isolate of the latter produced approximately 1,000 parts per million (dry weight basis) of the trichothecene deoxynivalenol in laboratory culture (Greenhalgh, et al. "Toxigenic Potential of Some Fusarium Isolates From Southeast Asia", Applied and Environmental Microbiology, 50 550-552, 1985). These and other recent studies of trichthecene mycotoxins in the natural environment of the Asian tropics indicate the need for caution in assigning any particular significance to the findings of trace amounts of trichothecenes in the unknown materials associated with the plastic bag.

CONCLUSION. The plastic bag is not a device for releasing chemical warfare agents.

OVERALL CONCLUSION. The incidents at Ban Sa Tong and Ban Sub Tha Mau resulted from harmless showers of honeybee feces, mis-interpreted by some as a chemical warfare attack.