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CHEMICAL AND BACTERIOLOGICAL (BIOLOGICAL) WEAPONS

Letter dated 23 June 1982 from the Permanent Representative of Canada to the United Nations addressed to the Secretary-General

I have the honour to request that the text of a note verbale from the Permanent Mission of Canada, dated 21 June 1982 (annex I), and the report attached thereto containing information regarding the alleged use of chemical weapons in South-East Asia (annex II), submitted in accordance with General Assembly resolution 35/144 C of 12 December 1980, be circulated as an official document of the Assembly under item 54 of the preliminary list.

(Signed) Gérard PELLETIER
Ambassador and
Permanent Representative

* A/37/50/Rev.1.

ANNEX I

Note verbale dated 21 June 1982 from the Permanent Mission of Canada to the Secretary-General

The Permanent Mission of Canada to the United Nations presents its compliments to the Secretary-General of the United Nations and has the honour to refer to the Secretary-General's note dated 26 January 1981, requesting Member States to submit information on alleged use of chemical weapons in accordance with General Assembly resolution 35/144 C of 12 December 1980.

The Government of Canada remains concerned that reports continue to be received regarding the alleged use of chemical weapons in South-East Asia and the possible violation of both the 1925 Geneva Protocol and the 1972 Biological Weapons Treaty. It will be recalled that, in March 1981, Canada submitted to the Secretary-General in accordance with the provisions of General Assembly resolution 35/144 C information volunteered by refugees in Thailand on the alleged use of chemical weapons.

In the continued belief that States have a responsibility to assist the research of the Group of Experts appointed by the Secretary-General, whose mandate to investigate reports on the alleged use of chemical weapons has been extended by General Assembly resolution 36/96 C of 9 December 1981, the Canadian Department of External Affairs invited Dr. Bruno Schiefer, Chairman of the Toxicology Group of the University of Saskatchewan, to undertake an independent study. Dr. Schiefer is one of the foremost Canadian authorities on the study of mycotoxins. The Permanent Mission of Canada, therefore, has the honour to enclose Dr. Schiefer's report. It is hoped that it will provide a useful scientific contribution to the investigation now underway by the Group of Experts.

Dr. Schiefer's report is based on the results of a two-week visit to Thailand in February where he held discussions with Thai Government authorities, Thai scientists and Canadian Embassy officials, in addition to visiting refugee camps on the Laotian and Cambodian borders with Thailand. In these locations, Dr. Schiefer collected control samples and conducted interviews with victims of alleged chemical attacks. His report concludes that events which are reported to have taken place at the time of the alleged chemical weapon attacks cannot be explained on the basis of naturally occurring phenomena. Neither mycotoxins nor diseases naturally occurring in South-East Asia can explain the reported symptoms of victims of the alleged chemical weapons attacks. The symptoms described, however, are consistent with tricothecene mycotoxicosis. The report suggests, furthermore, that although certain types of mycotoxins occur in Thailand, and probably also in surrounding countries, there are no naturally occurring diseases with the symptomatology of trichothecene mycotoxicosis.

Canada believes that it is important that the United Nations investigations carried out in accordance with resolution 36/96 C be as thorough as possible, both

for humanitarian reasons and to maintain the credibility of existing agreements relating to CW/BW use. In this connexion, Dr. Schiefer's report, in its final conclusion, identifies an urgent need to improve the verification and control procedures for chemical and/or biological weapons in order to determine if they are being used.

The Government of Canada supports the conclusions of Dr. Schiefer's report and hopes that the research contained therein will be of use to the Group of Experts in the conduct of their investigations.

ANNEX II

Study of the Possible Use of Chemical Warfare Agents in Southeast Asia

A Report to the
Department of External Affairs
Canada

by
H.B. Schiefer
Toxicology Group
University of Saskatchewan
1982

Study of the Possible Use of Chemical Warfare Agents in Southeast Asia

Executive Summary

1. The events that are reported to take place at the time of alleged chemical warfare attacks cannot be explained on the basis of naturally occurring diseases. Neither mycotoxicoses nor other diseases occur in Southeast Asia which might be able to cause the rapid onset of symptoms or the effects on all sorts of forms of life (human, animal and plant life) that is reported to occur.

2. Judging on the basis of eyewitness reports it appears that three different types of agents have been employed as warfare agents, one of them being "Yellow Rain"

3. Most of the features described with "yellow rain" attacks are consistent with trichothecene mycotoxicosis.

4. The symptoms described are more consistent with Stachybotryotoxicosis, a disease caused by macrocyclic trichothecenes, rather than with symptoms attributed to other trichothecenes.

5. Although certain types of mycotoxins (e.g., aflatoxin, ochratoxin and possibly zearalenone) occur in Thailand and probably also in surrounding countries, there are no naturally occurring diseases with the symptomatology of trichothecene mycotoxicosis.

6. There is an urgent need to improve the verification and control procedures for chemical and/or biological warfare.

Index

1.0 Objectives of Study

1.1 Conduct observations, if possible on-site, to determine whether or not chemical or biological agents have been used.

1.2 If a *prima facie* case is considered to exist, attempt identification as to the possible agent.

1.3 Determine existence or level of natural occurrence of mycotoxicoses in Thailand.

1.3.1 Determine whether *Fusarium* spp. or other fungi capable of producing trichothecenes do occur in Thailand.

1.3.2 Determine which types of mycotoxicoses occur in Southeast Asia.

1.4 Determine occurrence of other epizootic diseases in Thailand and surrounding countries.

1.5 Make any other observations or suggestions deemed necessary.

2.0 Background

2.1 Introduction

There have been reports since May, 1976, of the use of some sort of lethal or incapacitating chemical weapon (CW) in Laos against the Hmong tribesmen. The first allegations of CW use in Kampuchea were received about August, 1979.

In 1980, the United Nations General Assembly passed a resolution (35/144C) authorizing the Secretary General to establish a group of experts to investigate reports of the alleged use of chemical weapons and to report their findings (see Document A/36/613).

2.2 Canadian Aspects

Canada's interest covers the broad spectrum of international and national considerations. The Canadian approach to the problem has been developed on the basis of need for an objective examination of the available evidence. To this end, the principal investigator was asked to conduct this study.

2.3 Details

The principal investigator, Dr. H.B. Schiefer, visited Thailand from February 12 to 28, 1982, and conducted "on-site" inspections close to the Thailand-Kampuchea and Thailand-Laos borders. He interviewed victims and refugees, received reports from various scientists, physicians and Thai authorities, and investigated the general disease pattern in Thailand, with particular reference to mycotoxicoses.

During his stay, the principal investigator gave a lecture on "Mycotoxicosis, With Particular Reference to Trichothecene-Mycotoxicoses" at Chulalongkorn University. This lecture was attended by approximately 50 scientists. The lecture was repeated at Kasetsart University and was attended by 40 Thai veterinary pathologists who were having their regular bimonthly meeting at the time.

The principal investigator distributed about 50 copies of a booklet: "Mycotoxicoses - Summary of Pertinent Facts", which had been written for this purpose, and numerous copies of reprints were made available to Thai scientists and physicians in Ban Vinai Refugee Camp either through the Embassy or by direct mailing.

2.4 Acknowledgements

The principal investigator wishes to express his warm appreciation to the various Thai government and private authorities who extended cooperation to him thereby enabling him to carry out his investigation in the shortest possible time.

3.0 General Situation in Southeast Asia During February, 1982

The month of February is in the middle to later part of the "dry" season in Southeast Asia, and therefore the time for military operations.

3.1 In Kampuchea, the Vietnamese-Kampuchean troops made a concerted effort to break down the remaining Khmer Rouge resistance.

On February 11, 1982, a Vietnamese aircraft crash-landed inside Thailand in the area of Pong Namron[1] (location ① on map, following page). On February 13, 1982, "the Vietnamese forces fired artillery shells with gas canisters into areas around Khao Din (Kampuchea)"[1].

A few days later (Feb. 15, 1982), five Thai border patrol policemen were killed during a clash with about 300-400 intruding Vietnamese soldiers inside Thailand[2]. A spokesman of the Thai Supreme Command said that the Vietnamese were in pursuit of Khmer Rouge. This incident took place at Ban Saptali, which is also in the Pong Namron district (① on map). On February 19, 1982[3], a twin-propellered airplane, coming from Kampuchea, sprayed a light yellow chemical dust over Ban Saptali and four other villages, again in the Pong Namron district[3]. This attack took place 8 km inside Thailand. The villagers were evacuated.

A day later, it was reported[4] that the yellowish chemical "is unlikely to be 'Yellow Rain'". The collection of the substance was carried out without any safety measures, and leaf samples as well as parts of a tin roof were sent to a number of laboratories in Bangkok, including the Department of Clinical Microbiology, Siriraj Hospital, and the Armed Forces Institute of Medical Sciences.

A few miles north of the site of this attack, heavy fighting continued inside Kampuchea, close to Aranj Prathet (Nong Pru) (map location ②), which is the area where a Khmer Rouge camp was visited by the principal investigator on February 19, 1982. During the visit, the distant noise of artillery shelling was very noticeable.

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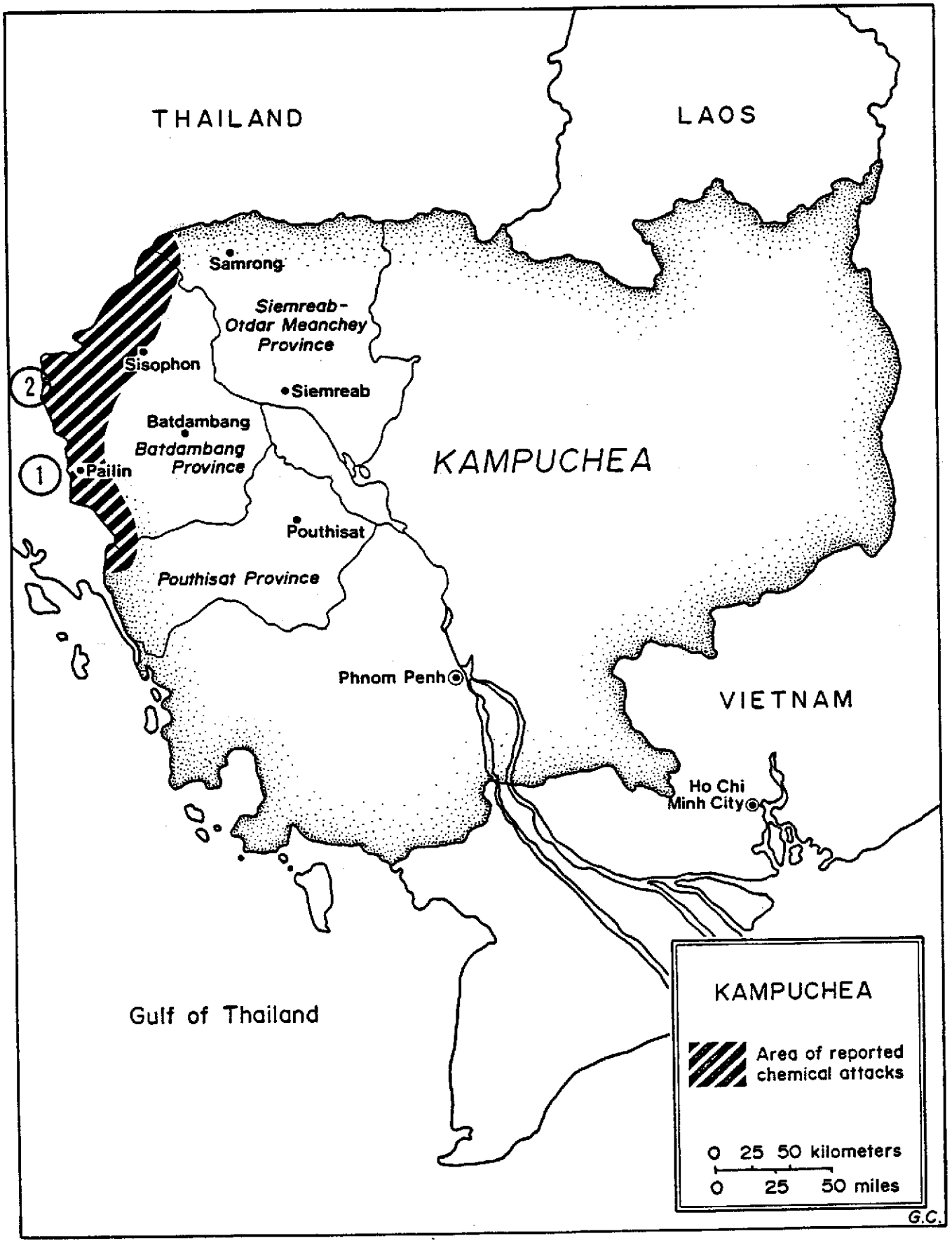
1) The Nation (Bangkok) Feb. 17, 1982
2) The Nation (Bangkok) Feb. 19, 1982
3) Bangkok Post and The Nation, Feb. 21, 1982
4) The Nation (Bangkok) Feb. 22, 1982 and Bangkok Post, Feb. 24, 1982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2
1
KAMPUCHEA
Area of reported
chemical attacks
0 25 50 kilometers
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G.C.

Various leaf and soil samples were collected in the Khmer Rouge camp. These samples were forwarded to laboratories for further investigation.

3.2 With respect to Laos, Thai border patrols were on alert, but no particular noteworthy incidents took place and it appeared that a number of Hmong had gone from their refugee camps into Laos.

Leaf and soil samples were collected from two locations close to the Mekong River. Again, the samples were forwarded to the appropriate laboratories.

3.3 Within Thailand, other military operations were carried out by the Thai army. Heavy fighting broke out in the south of Thailand in an attempt to eradicate the communist insurgents who control a good part of the hills around Surat Thani, approximately 300 km north of the Thai-Malaysian border. Other skirmishes took place in the Thai-Burma-Laos triangle.

4.0 Results

4.1 Evidence Suggesting That Chemical Warfare Agents Were Used

The first- and second-hand eye witness reports (see Appendix I) and the numerous reports on the alleged use of chemical warfare agents[1], attest to the fact that "something is going on". Although one has to take into consideration the possibility of exaggeration in some of the refugee reports, and further that some of the "eye witness" reports may be fabrications under the influence of personal messages or radio broadcasts by the Khmer Rouge or Hmong leaders, one has to give serious attention to the apparently never-ending flow of reported incidents. It appears highly unlikely that the essentials of all the reports are products of imagination, fabrication or propaganda.

There is no indication of occurrence of diseases in Thailand which naturally affect, at the same time, all kinds of species such as humans, other mammals, birds or plants (see Appendix IV). Considering the geographic, climatic and general living conditions, this is probably also true for the surrounding countries. Therefore, it is highly improbable that the events reported by the refugees could be due to natural circumstances.

4.2 Types of Chemical or Biological Warfare Agents That May Have Been Used

4.2.1 Introduction

Although the principal investigator has certain reservations with respect to the categorization of the agents that have allegedly been used, a certain general consensus appears to be developing in that at least three different types of agents may have been employed:

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1) - First Canadian Submission to the Experts' Group through the Secretary General in March, 1981;
- Various US submissions to the UN;
- Report of the Group of Experts to Investigate Reports of the Alleged Use of Chemical Weapons, A/36/613, 36th UN General Assembly, 20 Nov. 1981;
- Seagrave, S. Yellow Rain. A Journey Through the Terror of Chemical Warfare. M. Evans & Co., New York, 1981.

"Yellow" - Apparently causes skin rashes, difficulty of breathing, vomition, hemorrhages and eventually death in humans. Death of animals and plants occurs within 14 days.

"White" - Causes headaches, blurred vision, vomition and very rapid death both in humans and animals.

"Green" - Causes difficulty with vision, numbness and a feeling of general disorientation.

4.2.2 Agents Other Than "Yellow Rain"

The principal investigator is neither experienced nor qualified to comment on the agents that have been described as "white" or "green"; therefore, no judgement is passed on these two types of agents.

The "yellow" agent, however, causes a number of symptoms that have a certain similarity with diseases caused by the mycotoxins of the trichothecene variety.

4.2.3 Evidence Suggesting That Mycotoxins May Have Been Used

Many features of "yellow rain", as described in eye witness reports (see Appendix I), are rather suggestive of trichothecene mycotoxicosis. However, when comparing symptoms and other findings of Alimentary Toxic Aleukia (ATA) and Stachybotryotoxicosis (see Appendix III) with the features described by witnesses of the alleged chemical attacks, it is evident that there are more similarities between Stachybotryotoxicosis and "Yellow Rain" than between ATA and "Yellow Rain".

ATA is a disease due to ingestion of trichothecenes and it takes some time for most symptoms to develop. Stachybotryotoxicosis in man, on the other hand, is associated with inhalation and percutaneous absorption of the toxins. Death, at least in animals, occurs very rapidly due to these mycotoxins.

Inhalation of grain, hay or straw dust containing mycotoxins is also associated with inhalation of proteins acting as antigens, causing an allergic pulmonary reaction known as "intrinsic alveolitis". Repeated exposure to aerosols containing both the macrocyclic trichothecenes and the proteins would enhance the reaction to these substances and lead to chronic pulmonary disease known as intrinsic alveolitis[1)] which eventually leads to chronic lesions known as pulmonary fibrosis. In this

1) See Appendix III (Chapter 4.0).

context it is interesting to note that many alleged victims of "Yellow Rain" complain about respiratory problems many months after the initial attack[1].

The possibility that "Yellow Rain" may contain trichothecenes is further corroborated by reports of the effects on plants. The toxic effects of trichothecenes on plants are well documented[2], and from the interviews (see Appendix I), the principal investigator gained the impression that plants became yellow and died within a period of 10-14 days after a "Yellow Rain" attack. Further, it has been said that pigs which ate these yellow leaves started to vomit, an observation that would support a diagnosis of trichothecene toxicosis (see "Interviews", Appendix I).

The hypothesis that mycotoxins (trichothecenes) have been used in gas attacks is also supported by recently released information from the United States Mission to the United Nations. It was stated[3] that a metabolite of T-2 toxin, the deacetylated T-2 toxin form called HT-2 toxin[4], was found in the blood of two alleged victims.

Another aspect in support of the hypothesis that trichothecenes have been used is the level of mycotoxins found in some samples from foliage which was analyzed by Dr. J. Rosen, Rutgers University[5]. Dr. Rosen found deoxynivalenol (vomitoxin), T-2 toxin and diacetoxyoscirpenol concentrations of 50 ppm; in addition, zearalenone was found. Those levels are unusually high when compared with findings of trichothecenes in mouldy feeds[6].

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1) Verbal communications from various physicians working in refugee camps.

2) Reiss, J. Effects of mycotoxins on higher plants, algae, fungi and bacteria, pp. 119-143 in: Mycotoxic Fungi, Mycotoxins, Mycotoxicoses. An Encyclopedic Handbook, Vol. 3. T.D. Wyllie and L.G. Morehouse, eds. Marcel Dekker, New York and Basel, 1978.

3) United States Department of State, Special Report #98: Chemical Warfare in Southeast Asia and Afghanistan. Report to the Congress from Secretary of State Alexander M. Haig, Jr., March 22, 1982.

4) Ellison, R.A., Kotsonis, F.N. In vitro metabolism of T-2 toxin. Appl. Microbiol., 27, 423-424, 1974.

5) Transcript of ABC-TV News: Rain of Terror, Dec. 21, 1981.

6) Ueno, Y. Trichothecene Mycotoxins: Mycology, Chemistry, and Toxicology. Chapter 10, pp. 301-353 in: Adv. Nutr. Res., Vol. 3. H.H. Draper, ed. Plenum Press, N.Y., 1980; and personal observations during five years of feed testing in Saskatoon.

Not consistent with the assumption of T-2 toxin and similar trichothecenes as principal causative agents are the reports of immediate death after spraying of "Yellow Rain". This group of trichothecenes will not cause immediate death unless one would assume that a vehicle, like DMSO[1)] was used to facilitate the entrance of trichothecenes into the body. As of the day of writing of this evaluation there have been no reports of finding DMSO in any of the samples of alleged chemical warfare attacks. However, in this context it is worthwhile to mention that most victims have stated that the gas "smelled like garlic" or a similar spice. The literature is replete with descriptions of abnormal odor sensations, like garlic, in more than 50 percent of patients who received DMSO-treatments for a variety of diseases[2)]. A smaller percentage of DMSO-treated patients also experienced nausea, vertigo, and difficulties with vision[2)].

4.3 Natural Occurrence of Mycotoxins in Southeast Asia

It follows from Appendix IV, that the only mycotoxicoses known to occur naturally in Southeast Asia up to this time are aflatoxicosis and ochratoxicosis. Other mycotoxins may indeed occur, as they do in other countries of the world, but the same rules of probability would have to be applied to Thailand and Southeast Asia as they are applied in other countries. It is well documented that in Canada, for instance, almost all known mycotoxins can be found in food or feed commodities if one looks for them, but at the same time we do not have any reports of epizootic or enzootic occurrences of mycotoxicosis, save a few incidences of trichothecene-toxicosis in animals. These enzootics are observed on a local basis and, while being a serious threat to the livestock industry, they have never reached epizootic proportions, nor have there ever been reports that various forms of life, such as human, animal and plant life, have succumbed to naturally occurring trichothecenes within a time span of up to 10-14 days.

1) DMSO = Dimethylsulfoxyd.

2) Dimethyl-Sulfoxyd: DMSO; Internat. Symp. Nov. 8-19, 1966, Vienna; G. Laudahn and K. Gertich, eds. Saladruck,Berlin, 1966.

4.4 Natural Occurrence of Diseases That Cause Rapid Death in Humans and Animals

As described in Appendix V, anthrax, botulism and rabies are epizootic diseases that occur naturally in Thailand and probably also in surrounding countries. Cattle intoxications due to plant poisons are not uncommon, neither are other diseases that are prevalent in subtropical countries. None of these diseases occur with nearly the rapidity that is reported from the alleged chemical warfare attacks.

4.5 Suggestions for Verification Procedures

Diseases due to mycotoxins are a relatively new field of research and the numerous difficulties that are encountered during the elucidation of natural mycotoxin outbreaks are well documented in the literature.

In order to determine whether mycotoxins might have been used as warfare agents, a thorough knowledge of the naturally occurring mycotoxicoses is the basis from which aimed investigations have to start. Appendix VI provides some suggestions on how one might proceed.

4.6 Comments on the UN Experts' Report

Although the UN experts were of the opinion that their report was inconclusive, one has to admire the thoroughness and objectivity of the approach. However, a number of minor misinformations have found their way into the report which are briefly discussed in Appendix VII.

APPENDIX I

Interviews With Alleged Victims of Chemical Attacks

1.0 Introduction

The UN team, in its report to the Secretary-General[1], described the difficulties with respect to the evaluation of the alleged gas attacks in a very succinct manner. It was pointed out that it is difficult to judge second-hand information; without having access to the site of an alleged attack, without having the opportunity to examine victims or take samples, or having to rely on eyewitness reports.

For obvious reasons, this investigator was hampered by the same conditions when conducting interviews.

2.0 Interviews With Alleged Victims

2.1 Khmer Rouge

Together with an officer from the Canadian Embassy in Bangkok, the principal investigator visited a Khmer Rouge camp on the Thailand-Kampuchea border, close to Nong Pru, on February 19, 1982.

Chemical attacks had been experienced by the Khmer in this region since 1979, we were told. The latest attack occurred on February 13, 1982, at 1800 hrs, about 30 km from the camp. A group of Khmer Rouge was shelled with 105 mm shells, and about 17 soldiers became ill. Symptoms described were "burning in eyes, with tears," vomition, dry throat, shortness of breath, burning sensations in the breast and abdomen, with swelling of the abdomen. The gas was said to smell "like perfume", and to cause "confusion".

The casualties were transported to the base camp hospital, treated with corticosteroids, antibiotics, atropine and fluids by 2200 hrs. Most victims recovered speedily. A group of 7 victims were in the hospital hut and we interviewed them. The Khmer Rouge said that it was too dark to see any color of the gas. Not all shells were gas-releasing ones, but all shells were said to have exploded in the ground. The victims did not have any skin reactions.

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[1] UN General Assembly, 36th Session. Chemical and Bacteriological (Biological) Weapons, Report of the Secretary-General, Nov. 20, 1981. A/36/613, paragraphs 48 & 49.

While most of the patients looked bright and alert, one patient, Cheng Soeur, 20 years old, was obviously suffering. His breathing was labored, his lips swollen and cyanotic. He still had fever and his hospital record showed that he had malaria (Plasmodium falciparum ++). The Khmer took a blood sample from Cheng Soeur on February 14, 1982, at 1100 hrs, and a urine sample on February 15, 1982, at 0700 hrs. Both samples were handed over to the investigator and have been sent to appropriate laboratories for analysis. Cheng Soeur said that this was his first experience with chemicals; six others have had previous exposures (1981), at which time the shells were much closer and some victims "fell into a coma and couldn't walk for an hour". Otherwise, the symptoms were said to be the same.

2.2 Hmong

On February 20 and 21, 1982, the principal investigator visited Ban Vinai Refugee Camp, close to the Thailand-Laos border; Mr. M. Grinius and the investigator interviewed two victims who had been interviewed on earlier occasions by either the physicians in the camp or by Dr. Amos Townsend[1)].

Xia May Wong reported that he had witnessed a gas attack on December 20, 1981, at Phou Ynaw. Xia May Wong was in a rice field about one mile from the village when he heard the noise of a jet plane, which flew over the village twice. Fifteen minutes later, people saw "poison" on trees and rocks; the color of the "poison" was described as yellow to orange. Xia May Wong didn't dare go into the village until the next day. When he returned, he found five dead people. Pigs were said to have died too, and plant leaves had holes in them. Survivors told him that they felt nauseated, that their eyes felt like "falling out of their sockets", and that seizures and diarrhea occurred within five minutes. The final count of dead was 20. Xia May Wong used a bamboo scoop to collect some of the powder in a container, "but people who did so got sick nevertheless". If the powder came into contact with the skin it hurt.

Xia May Wong said that plants were affected by the poison as well. Cabbage, rice and other plants turned yellow in about 10-14 days.

The same person had been seen as a patient by Dr. Derek Bird, one of the

1) Medical Coordinator, International Rescue Committee.

physicians at Ban Vinai. The following is a verbatim copy of the interview on January 7, 1982:

Report: to Dr. Derek Bird, Jan. 7, 1982

Xia May Wong had been in Laos for nine months. The conditions there were very bad indeed. All the crops were dead. There is no rice or vegetables to eat. The Vietnamese are gassing the fields of rice.

He witnessed a gassing attack on December 20, 1981, at Phou Ynaw near Vientianne. The airplane was a Crif. It flew very high and gave off blue and yellow gas at the same time. He and a group of men, five of them altogether, went into the area and collected a sample of the gas. They used bamboo spoons with long handles. Almost immediately, he became affected and had a severe headache. He couldn't open his eyes and they became very red. His eyes felt as though they were falling out and protruded from his head. He started vomiting yellow and blue vomit. Diarrhea began next about ten minutes later. There wasn't any bleeding. His arms and legs were very painful. He felt very foolish and couldn't stand up. Some of his men were also affected.

In the village about 130 people died. All the animals were dead. The people had the same symptoms as he and his men, but were even more ill. They also had convulsions and developed rashes and died. The rashes were yellow in color and broke down and were weeping.

The leaves of the trees died and all the vegetation which had been covered by the gas. The gas was very sticky. They put a sample in a bottle and have now given it to Chief Van Neng.

The chief of the village had given him a letter to give to the authorities on his return. A photocopy and translation is included with this report.

Xia May Wong - Centre 1-3-3-9
Ban Vinai Displaced Persons Camp, Loei Province,
Thailand.

The sample that was carried to Thailand was handed over to Mr. Van Neng, the Hmong leader at Ban Vinai; rumor has it that the sample went to England for analysis.

The second interviewee, Xiong May, Corporal of the Hmong Army, from the village of Ban Pha Ngon, reported that his village had been attacked many times (up to 18) over the last years. The enemy was said to have come to the village every 20 days or so, stayed in the village for a few days, and the troops ate what the villagers had. Sprayings occurred after the Vietnamese troops and the Laotian guides had left.

Xiong May had been interviewed by Dr. Derek Bird on February 4, 1982. The following is a transcript of this interview:

Report on the gassing of Hmong people in Laos - Ban Vinai Refugee Camp
Thursday, February 4, 1982.

1. May Xiong, Corporal in the Hmong army, 2. Lo Xiong, 3. Youa Leng Yang, to Dr. Derek Bird, Physician at Ban Vinai.

Interpreters: Cher Yang, Address, 3.2.2.7, and Khou Chang, Address, 7.1.5. Sp.

May Xiong, aged 29, and 20 other people from his village crossed the Mekong river from Laos on the 26th, January, 1982.

Between 1979 and 25th November 1981, they had witnessed 18 gassings on their village, Phan Meum, north of the Nam Ngeum dam. Three types of gas had been used, yellow 8 times, white 5 times, and green 5 times.

Yellow gas caused a rash which was very itchy and seemed to be deep in origin, coming from the bone. The lungs were swollen and the breathing was very difficult. They had coughs producing blood-stained sputum. Nausea occurred, but there wasn't any vomiting. Diarrhea was severe and the stools were black. Sleep was impossible because of the itching and diarrhea. They felt foolish as though they were drunk and they couldn't stand up. They couldn't eat. People died from coughing and diarrhea. Six people died in the village; 4 were old people and 2 were babies.

White gas caused headaches as though they had been punched. The eyes were swollen and protruded from the sockets as though they were going to fall out. Vision was blurred. They began to vomit blood, and diarrhea, also with blood, occurred at the same time. Three to four people died immediately. Bleeding was more severe than with the yellow gas. Urination was painful and the urine was blood-stained. Breathing was difficult and their breath tasted bitter. The sputum contained considerable amounts of blood. Twenty-five people died in the village and one little girl of 6 years old still has a cough and blood-stained sputum as a result, from the last gassing on 25th November 1981. All the animals died very quickly. They cut them open to see why. They found that the hearts and lungs were ruptured. Leaves and crops died immediately.

Green gas caused difficulty with vision. Bodies were numb and they could not feel anything. Coughs were common, but there wasn't any blood-stained sputum. They were wheezy and faces became swollen. Bowel movements were normal. Hearing was affected. They felt foolish and couldn't walk anywhere for 8 days. Eight people died after 5 days. The vegetables were affected and the people who ate them became flatulent.

The same type of airplane was used on all occasions; it had two wings.

Because there were few animals to eat and all the crops died, they managed to stay alive by eating tapioca and tomatoes for almost two years. The water was contaminated and so they had to dig new wells and keep them covered.

The total population of the village was 54 families, i.e., 384 people altogether. When they left the village 96 were still ill.

During the February 21, 1982, interview, Xiong May said that a green powder and smoke was used from March to May, 1980; from June 6, 1980 to May, 1981, yellow powder was used, and from November, 1981, to January, 1982, white gas was used. (Note: lack of attacks during the summer months coincides with the rainy season).

Xiong May had come into contact with the yellow gas, and he showed scars on his underarms and his inner thigh area. He said he was dressed with a cotton shirt and cotton pants, but the powder went through the fabric when walking through vegetation moist from night dew.

When asked about animals, he said that chickens and dogs died first (10 days plus), pigs a little later (13-14 days) when eating the yellow powder or leaves that had turned yellow. Pigs vomited after eating the leaves, but died immediately when coming into contact with the white gas. Buffaloes ate the powder with leaves, and death occurred rapidly with circular movements, following contact with the white material. When the buffaloes ate the yellow powder they died with blood coming from nose and mouth within 14 days.

Dr. Amos Townsend interviewed Xiong May on February 16, 1982. The following is a copy of this interview:

Translation

From March, 1980, to May, 1980, there was an airplane (B-8 Choper Bell?) flew 5,000 ft high from northeast through Ban Pha Ngon which spread smoke from both sides of the plane. Fifteen to 20 minutes later it looked like rain, finally I found green spots on the rocks and all over the places as well. Three days later people in that area (villagers) had headaches, dry coughs, chest pains. The cough lasted 10-20 times before they could stop once; they were almost dying of coughing. If someone got these symptoms, it took a month or more for them to go. Some of them died due to no medications. I attached herewith the details, the numbers of people who faced these problems. Nobody died.

Animals: There were 4,200 chickens and 600 pigs. Fifteen hundred chickens and 70 pigs died; no others died.

Crops: Only rice plants died. Before the incidents, they planted one basket and they got 60 baskets. After the green rain, instead of getting 60 they got only 15. The other kind of plants didn't grow up as good as it used to. Some died when they were young.

Forests: Normal.

In April, 1980, Mr. Bounmy, the head of district sent a representative and 20 other members to visit Ban Pha Ngon (couldn't remember the date). They stayed there for 5 days and interrogated the villagers whether there were any Thai, Chinese, or Hmong leader came. Yang Tong, chief of the village, answered that they did not see any. During their 5 days visit, the Pathet Lao collected 10 chickens, 7 dogs, 1 pig and a sheep from the villagers for their meals. After than, they went to Xaysomboun's district office at Ban Xone L.S. 272.

From Nov. '80 to May, '81, there was a bi-plane that flew about 2 km high, from the North through Ban Pha Ngon headed to Vientiane 10 times. While the plane was flying, I was working outside the village. I saw a black smoke spread out from the left wing from time to time. Ten minutes later I heard a sound like rain on the leaves, then I found some yellow spot stuck on all over my body and all over the places. Suddenly there was a bad smell and I felt bitter in my mouth. At the same time I had a runny nose, tears came out from both eyes, the eyes turned yellow and I had a blurred vision. It seemed everything was moving around me. Later on I had a headache, nausea. For the ones who were not strong enough they immediately vomited. Three to four days later we had diarrhea; the color of the stool was normal, but mucus, small amount each time but very often. We were getting worse; after a week we had a chronic cough with white sputum, 10-20 times before we could take a breath. Besides the above symptoms we had a bloody diarrhea, breathing difficulties, vomiting in yellow mucus, pain all over and got into the others very quickly. In the morning the patients couldn't get up by themselves. During their serious condition, they had a strange voice when they spoke.

Urine was light red in color, bad smell, it looked like a horse's urine. Their eyes were red, finally they got a conjunctivitis. We healed these symptoms by our traditional medicine (opium and yellow gluant soil). To resist the disease and to decrease the warmth in the body we

Translation continued (2)

smoke the opium and drank water which we put the soil in.

There were 476 people (60 families) in that village at that time. Twenty-two died, 40 had a serious ill; it took a month to recover from it. The other 454 had the skin disease which would never be healed. Some of them died 25 days to 3 months after the incidents.

Skin disease: itched, rash spread all over the body, seriously blistered. The worst places were on the armpit, thigh and anus. This symptom didn't heal due to no medications.

Yellow Rain

Dead animals: 2,700 chickens and 265 pigs died; 4 of 20 horses; 3 of 18 cows and 6 of 30 sheep died. Ducks, dogs and cats didn't die. No buffalo in that village.

Crops: Rice, before the incident, we planted 1 basket, we got 60. After, instead of getting the same amount we got only 5 baskets. In that 5 we had to pay 3 baskets as taxes to the Pathet and other two to the government's store. We had to find some other things to eat.

Corn: Before the incidents, planted 6 kgs, got 960 kgs.
After the incidents, planted 20 kgs, got 80 kgs.
Other vegetables were planted but didn't grow, except pineapple.

Daily meal: No rice, only tapioca, sweet potato and fish from the stream.

Forest: 30% of the trees died in that area.

On the 3rd Nov., 1981, to 25th Dec., 1981, white rain was spread 4 times in Pha Ngon area. A bi-plane flew about 7,000-8,000 ft high from North through Muong Cha (No. of the airport unknown) and blew the smoke from the left wing.

After 15-20 minutes, it looked like rain, when it hit the ground it became white, wet and sticky. Twenty minutes later it became white dry spots which stuck all on everything. Suddenly the villagers had breathing difficulties, coughing, eye irritations. It seemed the eye balls would fall out. It was really hard to open and close the eyes, burning in the throat through to the lung. Four days later they had bloody coughing, bloody diarrhea; they died 5 days after the white rain. When I was there 25 were dead, 96 were seriously ill, while 20 were in normal condition (not very ill). Others had pain on the body.

Dead animals: 9 cows, 8 horses, 14 sheep, 150 dogs.

Crops: Rice: they could only get the seed for the coming year.
Corn: as above.
Others all died except pineapple.

Forest: 35-40% of trees died.

Translation continued (3)

Villagers' action: 1. Fled to Thailand.

2. Decided to stay and died in the village to mark history and to be a lesson to the youngsters.

3. Expected the death day.

Pray to God to draw his attention to us. Keep asking him who will give us the kind warmth for which we had devoted our life to him.

Speech of the VN and PL:

In Feb., 1980, Mr. Bounxou, district official talked to Lee Mou, official of Houa Pacha in Ban Xone's district office. He said that if the Hmong are still alive they will fight, so the VN and PL must kill them all; otherwise, the war in Laos will never end. We, the Hmong, didn't want to believe this; finally it did happen as they said. Not only the chemical warfare, but we were accused in many ways. They captured 60 well educated Hmong with good character and killed them. The PL claimed that they were guilty of crimes since 1053 to the present. Even if they themselves didn't do anything wrong, but their relatives did or if they themselves did get money from Vangpao and Americans, then the PL and VN must punish them. He said, "We did believe you a million percent but since you are very clever how can be believe you again!"

That's why we only expect the day when the Hmong will disappear from this world!

By Xiong May, Ban Vinai Camp
February 16, 1982

Translation and (original) typing
by Mrs. Sinthy Khounrasaphiphak
for Amos R. Townsend, M.D.
IRC, Bangkok

The following are transcripts of clinical histories and other testimonials given to physicians at Ban Vinai Camp:

Report to Dr. Derek Bird from Doua Yang

January 1, 1982 - Ban Vinai Camp, Hmong Displaced Persons, Loei Province, Thailand

Arrived in Ban Vinai on December 21, 1981.

Eye-witness account of two gassings

1. October, 1979 in Pou Lan. S65 Nr. Pha Phai.

The airplane only had one engine and was small. Red cloudy gas was dropped by rocket. Everyone had diarrhea with blood and coughs (without blood). Doesn't know how many died, but there were more than 10. About 15 babies died. All adults were all right. He was sick for 10-12 days with dizziness and fainting which occurred immediately. He felt very foolish, very tired and had a headache. He eyes were protruding from the sockets as though falling out. Diarrhea and blood occurred immediately to anyone near the rocket, but 6-7 days passed before diarrhea if they were further away. All hens and pigs died. Doesn't know whether water supplies were affected or not because he hadn't a microscope. He took opium and it made him feel better after 2 hours.

2. June, 1981, in Phon Xao.

The second gassing was like rain, like when crops are sprayed. It was white in color and sticky. The people who were near and got the gas straight away died after 3 days. They thought they were all right, but died suddenly doing the job of work at that time. Those who touched the leaves also died after 3 days. Four villages were gassed, about 600 people althogether, but only 50 died. All the animals died as well. This time children and adults died.

He was living in the jungle at the time, but saw the attack and ran away, but he did count 50 dead. There may have been many more. He waited 1 month before returning to the village.

The drops of gas on the leaves burned holes in them and the fields of rice and corn died. After 2-3 days of sunshine the gas disappeared from everything.

Report to Dr. Derek Bird from Lee Shong Moua, 3-2-25-sp., age 37 years

January 8, 1982 - Ban Vinai Camp, Loei Province, Thailand.

Lee Shong Moua witnessed gassings on 3 separate occasions.

No. 1: The plane was a large one with 4 engines and gave off yellow gas. He became dizzy and couldn't see very well. His eyes were very big and swollen. His chest was very tight and he was breathless. He was foolish and his head felt long. He had to lie down.

After 2 days and smoking opium he recovered.

Twenty-two people died in the village, both grown ups and children. They had nausea and diarrhea. They eventually fell asleep and died. All the animals also died.

The date of this attack was June, 1981.

No. 2 and 3: took place in September and October of 1981.

The gas this time was white. People had similar symptoms as above, but coughed up blood. Eighty died altogether. All the corn and rice was killed and all the animals.

Vang May - 22 year old male - arrived in Ban Vinai December 10, 1981.

January 12, 1982.

Date of gassing: 6 times, June-October, 1981.

On all 6 occasions, gas was yellow. Gas was dropped by helicopter on all 6 occasions. Did not notice any numbers or letters on helicopter. Helicopter white in color.

He obtained a sample of yellow powder, which he gave to Hmong chief Van Neng, in Ban Vanai Camp.

Symptoms included vomiting (no blood); diarrhea (no blood); dizziness, headache, dyspnea (no blood), rash which lasted for 1 week. Rash was on chest, hands, legs.

Three people died in his village. Chickens died. One person had hemoptysis.

Physical exam discloses some expiratory wheezes in the lungs. Many 3-5 mm pigmented areas on forearms and legs. No evidence of emphysema.

Josef Vosmek, M.D.

22

Report to Dr. Derek Bird from Chung Neng Chang, aged 40 yrs, address 1.6.3.9

January 15, 1982 - Ban Vinai Camp for Hmong Displaced Persons, Loei Province, Thailand

The patient complained of diarrhea for 3 days with blood. He had pain on passing urine, also with blood and severe pain. These symptoms were very similar to the symptoms which he had when he was gassed in Laos 2 years ago. There were 30 men in his group of soldiers. The plane which dropped the gas had one engine and made 3 flights dropping yellow, green and red gas. Two men died. All the men were dizzy and their vision became black. They could not see. Their eyes were protruding from the sockets. They had diarrhea with blood. Vomiting occurred and was green like bile. The 3 men who died did so very quickly, but became mad before they died. They looked yellow. All the animals died.

The gas smelled very bad and made them feel as though they had been hit inside the head. The yellow gas was very sticky like honey.

Diagnosis for present condition: 1. Probable amoebic dysentery.
2. Urinary tract infection.

Diagnostic tests: stool microscopy, urinary analysis.

Report concerning gassing attack in Laos

Nhia Houa Xiong - age 63, address: 2.3.22.3, Ban Vinai

Interviewed by Dr. Derek Bird - Interpreter: Chia Yang

The patient complained of a chronic cough for 2 years. This began following a gassing attack on his village, Keo Ma Naag, in February, 1979.

The gas was dropped by a bi-plane and was yellow in color and sticky like honey. The plane also dropped white gas. He experienced a burning sensation in the mouth and throat. His nose also felt as though it was burnt. This lasted 3 weeks and he then developed a cough with white sputum. After the gas was dropped he felt as though he couldn't move and his eyes became very swollen and protruded from his head. He didn't get diarrhea, but other people did. Three people died in the village from diarrhea and bleeding from the rectum.

Since that time he has had a chronic cough with sometimes white and sometimes green sputum. He was treated for tuberculosis, but there has never been a positive skin test and he has never had any positive sputum tests for tuberculosis. The treatment has not made him feel any better and his breathing has not improved.

Examination reveals signs of chronic bronchitis and emphysema. Chest x-ray shows diffuse mottling and increased lung markings consistent with a diagnosis of chronic bronchitis. Hematocrit was 38 on 18 Feb. 1982, WBC 800, P44,L 48, E8. Urine normal.

Patient: Ghia Pao Chang - 37 year-old male, married-
Hmong from C8Q1B2R12, Ban Vanai Refugee Camp

Date of consultation: December 1, 1981.

History: Had gassing encounter three times:

1st incident - March, 1979 - with bluish gray smoke
2nd incident - May, 1980 - with yellowish smoke/rain
3rd incident - October 17, 1981 - with yellow rain

Consulted because of slight difficulty of breathing since October, 1981, with stuffy nose accompanied by headache, anorexia, insomnia, inability to walk long distances before getting tired. He has been brought to Udorn last November 10, 1981, for screening of gassing.

Physical examination: Throat - congested
Vision - complains of hazy and semi-yellow vision
Chest - clear CVS - no murmur
Abdomen - benign No hepatosplenomegaly

Diagnosis: 1. Alleged gassing encounter
2. Acute pharyngitis

Plan of management: 1. Ampicillin 500 mgm p.o. QID x 7 days
2. Decolgen tab. 1 TID x 7 days
3. Multivitamins tab. 1 TID x 7 days
4. To come back after 7 days for follow-up

Gideon D. Regalado, M.D.
Medical Coordinator, Ban Vinai Health Care Program

Chong Mona Yang - 23 year old male, address: 4.1.32.sp.
Arrival in Ban Vinai: 11-15-81

Date of gassing: April, 1981.

Events around the gassing: Took bath in river from which people had developed diarrhea from drinking. Noticed "yellow dust" on rock in river where he sat. Immediately became dizzy and passed out and was carried to house nearby and vomited profusely; had severe chest pain and dry cough. Cough began to have white sputum, not yellow sputum x 4 months; worse at night, right-sided chest pain worse with cough. Still has dizziness.

Symptoms: dizziness, vomiting, loss of consciousness, chest pain, slight h/a; thinks his memory is poor (?).

Three people in his village died from this same incident. He brought sample of this dust to Nang Chia.

Lynn Ridge, MSN, PNP
Ban Vinai Refugee Camp
Loei Province, Thailand
January, 1982.

3.0 Evaluation

3.1 Khmer Rouge

The symptoms described from this particular attack (see 2.1) are not suggestive of known mycotoxicoses, but may be consistent with tear-gas or a similar agent. The patient, Cheng Soeur, may have been suffering from malignant tertian malaria.

3.2 Hmong

From the descriptions, one gets the impression that at least three different types of "gases" have been used:.

"Yellow" - causes skin rashes, difficult breathing, vomiting and death in humans. Death of animals and plants occurs within 14 days.

"White" - causes headaches, blurred vision, vomition and very rapid death both in humans and animals.

"Green" - causes difficult vision, numbness and "a feeling of foolishness", like being drunk.

Dr. Amos Townsend, in a private interview, was inclined to use a similar sub-classification, based on the information he had obtained during the course of his investigations.

The skin lesions on the arms and legs of May Xiong are scars which could have been caused by a variety of conditions. At this stage, no specific cause can be determined.

3.3 Other Aspects

When comparing the reports given at different dates by one and the same witness, one cannot help but notice many inconsistencies. This could be due to difficulties arising through the interpreter(s), due to different emphasis on questions by the interviewer(s), plus failure of memory and/or a tendency to make a story more impressive. Thus, these testimonies appear to be less reliable than is desirable. On the other hand, it should not be overlooked that the principal facts, i.e., attack by either artillery shelling or airplanes, distribution of some sort of material that causes some degree of suffering, disease and/or death of a variety of forms of life (man, animal, plant) are always represented.

The principal investigator was told that there is a good to very good correlation, with respect to time and location of attacks, between reports from victims and defecting pilots who have given accounts of their targets and missions.

APPENDIX II

Evaluation of Samples of Attacks

1.0 Blood and Urine Sample Received from Khmer Rouge Victim

As described in Appendix I (2.1), a blood and urine sample was received. An initial analyses for traditional CW agents was carried out at DRES in Suffield. Nothing unusual has been found. The samples are waiting for further analysis for mycotoxin metabolites.

2.0 Samples from Attack in Thailand

The principal investigator received a leaf sample from one of the Thai scientific institutions, and had a chance to see the other samples, after cultures had been made. The yellow material appeared to be sticky, and smear marks (from taking the samples) on the tin roof looked like some sort of yellow glue had been spread.

Dr. Samaniya Sukroongreung at Siriraj Hospital started cultures from the yellow spots and other places on other leaves. At the time of the last visit (Feb. 26, '82), she had tentatively identified F. sporotrichioides from a yellow spot and Aspergillus and Penicillium spp. from the other spots. Cultures from a further five yellow spots had not been determined, but the following tentative diagnoses were made:

Fusarium sp., most likely sporotrichioides x 1,
Fusarium sp., not yet determined, x 1,
Aspergillus sp. x 3.

Dr. Samaniya Sukroongreun said that Fusarium spp. were a very rare finding in Thailand, and that she had never isolated F. sporotrichioides before.

Subsequently, she forwarded two cultures to Canada: one, a Fusarium sp. (probably F. sporotrichioides var. chlamydosporum) and the second a Penicillium sp. Dr. Neish from the Biosystematics Research Institute in Ottawa identified the Fusarium sp. as Fusarium semitectum Berk & Rav. var. semitectum, the suspected Penicillum sp. as Cladosporium cladosporioides (Fresen.) de Vries. For future reference, the fungi have been assigned BRI lot no. 82M-66.

Dr. Neish found the same type of fungi on the leaf that the principal investigator had received.

Dr. Neish also confirmed Dr. Samaniya Sukroongreung's earlier findings that most of the yellow material was pollen from so far

unidentified sources.

It should be remembered that two newspapers[1] had already reported, on February 22 and February 24, 1982, that the yellow material was not "Yellow Rain". Public Health Minister, Dr. Sem Pring Paung Kaew, said that doctors had injected distilled water containing the dust into mice. After 15 hours, the mice were still alive and showed no signs of damage to their nervous systems, according to the laboratory report.

The results of the analyses for mycotoxins are not known yet at the time of writing of this report.

3.0 Discussion

Because of the incompleteness of the investigation at the time of writing of this report, it is premature to come to any conclusions. However, from the findings so far, one might regard the "Yellow Rain" incidence in Thailand as a diversionary tactic.

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1) The Nation (Bangkok), Feb. 22, 1982, and Bangkok Post, Feb. 24, 1982.

APPENDIX III

A Review of Mycotoxicoses Caused by Trichothecene Mycotoxins

1.0 Introduction

Trichothecene mycotoxins are now known to be the cause of a number of diseases, such as "Staggering Toxicosis", Alimentary Toxic Aleukia, Red-Mold Disease (Akakabi-byo) in Japan, "Moldy Corn or Hemorrhagic Disease", Vomiting and Feed Refusal problems, Stachybotryotoxicosis, Dendrochiotoxicosis, and "Bean-Hulls Poisoning" in Japan.

The trichothecenes have been classified into four groups according to their structural and fungal characteristics[1]:

Group A: 25 members, amongst them Verrucarol, Diacetoxyscirpenol (DAS), Neosolaniol, HT-2 toxin, and T-2 toxin.

Group B: 9 members, amongst them Dioxynivalenol and Nivalenol.

Group C: 2 members, including Crotocin.

Group D: So-called macrocyclic trichothecenes; 12 members, amongst them Verrucarin A, B and J; Roridin A, D, E and H; Satratoxins; Vertisporin.

The main substrates on which trichothecenes are produced are cereals, leguminous crops, sweet potatoes, cabbage and hay. Naturally occurring levels of trichothecenes are around 2 ppm, the largest quantity found to occur spontaneously was 71.5 ppm[2]. Under laboratory conditions, up to 2,250 ppm T-2 toxin have been produced[3].

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1) For a most recent review of the trichothecene mycotoxins, see: Y. Ueno, Trichothecene Mycotoxins, Mycology, Chemistry and Toxicology. Chapter 10, pp. 301-353, in: Adv. Nutr. Res., Vol. 3. H.H. Draper, ed. Plenum Publ., New York, 1980.

2) Gedek, B. p. 333, Kompendium der medizinischen Mykologie. Pareys Studientexte #24, Parey Berlin, 1980.

3) Davis, G.R.F., N.D. Westcott, J.D. Smith, G.A. Neish and H.B. Schiefer. Toxigenic isolates of Fusarium sporotrichioides obtained from hay in Saskatchewan. Can. J. Microbiol., 28, 259-261, 1982.

Extensive research[1] has demonstrated that the fungi capable of producing trichothecenes give better yields of toxin when cultured at low temperatures (0-5°C) than at higher temperatures (23-25°C), however, the type of toxin produced may vary. Fusarium tricinctum, for instance, was found to produce DAS and T-2 toxin at 8°C and HT-2 toxin at 25°C[2].

2.0 Alimentary Toxic Aleukia

In 1943, Russian scientists determined that a disease known as "septic angina" was caused by the ingestion of mouldy cereals and the name "Alimentary Toxic Aleukia" (ATA) was used henceforth. The clinical course of ATA in people can be divided into four recognizable stages:[3] Stage 1 (0-9 days): shortly after ingestion of contaminated food, a burning sensation in the mouth, tongue, throat and palate is experienced. Within days, gingivitis, stomatitis, glossitis, esophagitis, vomition and diarrhea develop. Abdominal pain, headache, dizziness, weakness, fatigue, tachycardia, fever and sweating are other symptoms. The white blood cell count may decrease to 2,000. Stage 2 (2-8 weeks): is a latent phase in which leukopenia persists. Weakness, headache, and mild asthmatic symptoms occur. A low blood pressure, diarrhea or constipation are seen as well. Stage 3 (6-8 weeks): appears suddenly. Hemorrhages in the skin and in internal organs are observed, and a necrotic angina and bronchopneumonia lead to death. The leukocyte count may be as low as 100. Stage 4: is known as the convalescence stage which may require up to two months and more until all blood parameters are normal.

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1) Ueno, Y. op. cit.

Davis, G.R.F. and J.D. Smith. Effect of temperature on production of fungal metabolites toxic to larvae of Tenebrio molitor. J. Invert. Path., 30, 325-329, 1977.

Davis, G.R.F. and J.D. Smith. Effect of light and incubation temperature on production by species of Fusarium of metabolites toxic to larvae of Tenebrio molitor L. Arch. Intern. Phys. Biochem., 89, 81-84, 1981.

2) Bamburg, J.R., N.V. Riggs and F.M. Strong. The structure of toxin from two strains of Fusarium tricinctum. Tetrahydron., 24, 3329-3336, 1968.

3) Joffe, A.Z. Fusarium poae and F. sporotrichioides as principal causal agents of Alimentary Toxic Aleukia, pp. 21-80 in: Mycotoxic Fungi, Mycotoxins, Mycotoxicoses, Vol. 3. T.D. Wyllie and G.L. Morehouse, eds. Marcel Dekker, 1978.

ATA is caused by ingestion of cereal grains affected mainly with Fusarium poae or F. sporotrichioides and the toxic principle has been recognized as belonging to the trichothecene group, mainly T-2 toxin. Other Fusarium spp. are also capable of producing these trichothecenes, but only very occasionally. F. poae and F. sporotrichioides produce the largest quantities when maintained at low temperatures (-2 to -7°C or from 0 to +5°C), but little or no toxin is produced by these fungi at temperatures of 23°-25°C. USSR strains of the said species of fungi produce several times as much toxin as those from other countries.

Experimental feeding of pure T-2 toxin to cats resulted in a pancytopenic disease similar to ATA in man[1)], and monkeys died between days 8 and 15 of treatment with T-2 toxin, due to leucocytopenia and pneumonia[2)].

In contrast to these findings in cats and monkeys, it is well documented that it is not possible to reproduce all the symptoms of ATA in other animal species[3)].

Rats have been reported to die within 48 hours of consuming grain on which Fusarium sporotrichioides was grown[4)], but this feed resembled probably more the naturally occurring "cocktails", containing T-2 toxin and other trichothecenes, than a diet containing one type of trichothecene only.

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1) Lutsky, I. et al. (3 co-authors). The role of T-2 toxin in experimental alimentary toxic aleukia: a toxicity study in cats. Toxicol. Appl. Pharmacol., 43, 111-124, 1978.

2) Rukmini, C., J.S. Prasad and K. Rao. Effects of feeding T-2 toxin to rats and monkeys. Fd. Cosmet. Toxicol., 18, 267-269, 1980.

3) Patterson, D.S.P. et al. (5 co-authors). The failure of trichothecene mycotoxins and whole cultures of Fusarium tricinctum to cause experimental haemorrhagic syndromes in calves and pigs. Vet. Rec., 105, 252-255, 1979.

Hayes, M.A., J.E.C. Bellamy and H.B. Schiefer. Subacute toxicity of dietary T-2 toxin in mice: Morphological and hematological effects. Can. J. Comp. Med., 44, 203-218, 1980.

4) Davis, G.R.F. et al. (4 co-authors). Toxigenic isolates of Fusarium sporotrichioides obtained from hay in Saskatchewan. Can. J. Microbiol., 28, 259-261, 1982.

The relative resistance of some experimental animal species (mice, rats, pigs, sheep, cattle) to pure T-2 toxin could be explained by natural resistance or alternatively these species may have developed, during thousands of years of evolution, specific enzymes capable of detoxifying trichothecenes because their natural foods have probably contained such toxins on occasion. Other species, such as humans, monkeys or cats are more selective or different in their food habits and therefore may not have had the chance to develop natural resistance. This hypothesis is further strengthened by a recent observation of the effects of T-2 toxin on invertebrates[1]. Bertha Army worms which feed on green leaves are highly sensitive to T-2 toxin, whereas yellow mealworm larvae which feed naturally on cereal grains are less sensitive.

3.0 Metabolic and Toxicokinetic Fate of T-2 Toxin

Animal experiments have shown that T-2 toxin is relatively rapidly excreted. After four days of observation, 68 percent of radioactive-labelled T-2 toxin was excreted[2]. Most of the T-2 toxin is excreted as HT-2 toxin, suggesting that the liver may have been able to transform T-2 toxin into the deacytelated HT-2 toxin[2,3].

4.0 Stachybotryotoxicosis

Principally, Stachybotryotoxicosis is a mycotoxicosis of horses and other livestock caused by the toxins of the saprophytic fungus, Stachybotrys alternans or S. atra. In animals, which ingest infested hay or straw, the symptoms are rather similar to ATA in man. The toxic principles, Verrucarin, Roridin and Satratoxins, have been identified as belonging to the group of macrocyclic trichothecenes. Such macrocyclic trichothecenes are also produced by Myrothecium sp., and cause diseases in livestock known as Myrotheciotoxicosis or Dendrodochiotoxicosis.

1) Moore, K.C. and G.R.F. Davis. Bertha Army worm (Mamestra configurata), a sensitive bioassay organism for mycotoxin research. J. Invert. Path., 1982, in press.

2) Matsumoto, H., T. Ito and Y. Ueno. Toxicological approaches to the metabolites of Fusaria. XII: Fate and distribution of T-2 toxin in mice. Jap. J. Exp. Med., 48, 393-399, 1978.

3) Chi, M.S., T.S. Robison, C.J. Mirocha, S.P. Swanson and W. Shimoda. Excretion and tissue distribution of radioactivity from tritium-labelled T-2 toxin in chicks. Toxicol. Appl. Pharmacol., 45, 391-402, 1978.

Human Stachybotryotoxicosis occurs by handling S. alternans-contaminated hay or stray, or when such material is used for bedding or as fuel to heat homes. After inhalation or by skin contact, the symptoms in man are first described as a rash at points with heavy perspiration, such as armpits, scrotal or inner thigh area, etc. Moist dermatitis follows[1]. Dyspnoea, shortness of breath, sore throat, nose bleeding, burning sensation in the eyes, weakness, exhaustion and perspiration are other symptoms reported[2].

Occasionally, a general toxicosis is brought about by absorption of toxins through skin or inhalation[3]. Immunosuppression plays a major role in this disease[4].

While most of the symptoms are ascribed to the inhaled mycotoxins, one has to consider the possibility of induction of "intrinsic alveolitis" due to inhalation of proteins, originating from the grain and hay or straw dust. Intrinsic alveolitis, essentially, is a hypersensitivity reaction[5] which occurs after repeated inhalation of antigenic proteins.

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1) Ozegovic, L., R. Pavlovic and I. Milosev. Toxic dermatitis, conjunctivitis, rhinitis, pharyngitis and laryngitis in fattening cattle and farm workers caused by molds from contaminated straw (Stachybotryotoxicosis?). Veterinaria (Sarejevo), 20, 263-267, 1971.

2) Andrassy, K., I. Horvath, T. Lakos and Zs. Toke. Mass incidence of mycotoxins in Hadju-Bihar county. Mykosen, 23, 130-133, 1979.

3) Hintikka, E.L. Human stachybotryotoxicosis, pp. 87-89 in: Mycotoxic Fungi, Mycotoxins, Mycotoxicoses, Vol. 3. T.D. Wyllie and L.G. Morehouse, eds. Marcel Dekker, 1978.

4) Danko, G. Stachybotryotoxicosis and immunosuppression. Intern. J. Environ. Studies, 8, 209-211, 1975.

5) Keogh, B.A. and R.A. Crystal. Alveolitis: The key to the interstitial lung disorders. Thorax, 37, 1-10, 1982.

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4.0 Stachybotryotoxicosis

Principally, Stachybotryotoxicosis is a mycotoxicosis of horses and other livestock caused by the toxins of the saprophytic fungus, Stachybotrys alternans or S. atra. In animals, which ingest infested hay or straw, the symptoms are rather similar to ATA in man. The toxic principles, Verrucarin, Roridin and Satratoxins, have been identified as belonging to the group of macrocyclic trichothecenes. Such macrocyclic trichothecenes are also produced by Myrothecium sp., and cause diseases in livestock known as Myrotheciotoxicosis or Dendrodochiotoxicosis.

1) Moore, K.C. and G.R.F. Davis. Bertha Army worm (Mamestra configurata), a sensitive bioassay organism for mycotoxin research. J. Invert. Path., 1982, in press.

2) Matsumoto, H., T. Ito and Y. Ueno. Toxicological approaches to the metabolites of Fusaria. XII: Fate and distribution of T-2 toxin in mice. Jap. J. Exp. Med., 48, 393-399, 1978.

3) Chi, M.S., T.S. Robison, C.J. Mirocha, S.P. Swanson and W. Shimoda. Excretion and tissue distribution of radioactivity from tritium-labelled T-2 toxin in chicks. Toxicol. Appl. Pharmacol., 45, 391-402, 1978.

Human Stachybotryotoxicosis occurs by handling S. alternans-contaminated hay or stray, or when such material is used for bedding or as fuel to heat homes. After inhalation or by skin contact, the symptoms in man are first described as a rash at points with heavy perspiration, such as armpits, scrotal or inner thigh area, etc. Moist dermatitis follows[1]. Dyspnoea, shortness of breath, sore throat, nose bleeding, burning sensation in the eyes, weakness, exhaustion and perspiration are other symptoms reported[2].

Occasionally, a general toxicosis is brought about by absorption of toxins through skin or inhalation[3]. Immunosuppression plays a major role in this disease[4].

While most of the symptoms are ascribed to the inhaled mycotoxins, one has to consider the possibility of induction of "intrinsic alveolitis" due to inhalation of proteins, originating from the grain and hay or straw dust. Intrinsic alveolitis, essentially, is a hypersensitivity reaction[5] which occurs after repeated inhalation of antigenic proteins.

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1) Ozegovic, L., R. Pavlovic and I. Milosev. Toxic dermatitis, conjunctivitis, rhinitis, pharyngitis and laryngitis in fattening cattle and farm workers caused by molds from contaminated straw (Stachybotryotoxicosis?). Veterinaria (Sarejevo), 20, 263-267, 1971.

2) Andrassy, K., I. Horvath, T. Lakos and Zs. Toke. Mass incidence of mycotoxins in Hadju-Bihar county. Mykosen, 23, 130-133, 1979.

3) Hintikka, E.L. Human stachybotryotoxicosis, pp. 87-89 in: Mycotoxic Fungi, Mycotoxins, Mycotoxicoses, Vol. 3. T.D. Wyllie and L.G. Morehouse, eds. Marcel Dekker, 1978.

4) Danko, G. Stachybotryotoxicosis and immunosuppression. Intern. J. Environ. Studies, 8, 209-211, 1975.

5) Keogh, B.A. and R.A. Crystal. Alveolitis: The key to the interstitial lung disorders. Thorax, 37, 1-10, 1982.

APPENDIX IV

Natural Occurrence of Mycotoxicoses in Thailand

1.0 Introduction

Mycotoxins are toxic metabolites of fungi and may contaminate food of people or animals and thereby may cause diseases called mycotoxicoses. Several mycotoxicoses of humans and livestock have been recognized for many decades, or even centuries. Mycotoxins occur worldwide, but the climatic-geographic variables determine whether certain types of mycotoxins occur more frequently in one region than in another[1)].

2.0 Mycotoxins and Mycotoxicoses in Thailand

The Thai's are quite aware of the potential natural existence of mycotoxins in their country. The occurrence of aflatoxin is well documented since Udorn Encephalopathy[2)] in Thailand was associated with aflatoxin in 1971. Outbreaks of aflatoxin-poisoning in pigs in particular are a common experience[3)], and a vast number of Thai foods

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1) For a comprehensive review of the topic of mycotoxins and mycotoxicoses, see "Mycotoxic Fungi, Mycotoxins, Mycotoxicoses. An Encyclopedic Handbook" 3 vols. T.D. Wyllie and L.G. Morehouse, eds. Marcel Dekker, New York and Basel, 1978.

2) Shank, R.C. et al. (3 co-authors). Aflatoxin in autopsy specimens from Thai children with an acute disease of unknown etiology. Food Cosmet. Toxicol., 9, 501-507, 1971.

3) Somboon Sutherat, Luckhana Naha and Chatuporu Smitanon. Aflatoxicosis in swine (Abstract) 20th Ann. Conf. Kasetsart University, Feb. 4-5, 1982, page 56.

Thirayudh Glinsukon. Mycotoxins as a veterinary problem. Kasetsart Veterinarians, 2, (#3, Oct.) 211-223, 1981 - a general review article that also includes descriptions of trichothecene mycotoxins.

have been sampled regularly for determination of aflatoxin levels[1].

The analytical method used is Thin-Layer Chromatography. In addition to toxin assays, foods were regularly cultured. The fungi that have been found are Aspergillus flavus and A. ochraceous (see below), but Fusarium spp. are nearly never found[2]. Ochratoxin, produced by Aspergillus ochraceous, is another mycotoxin that appears to be fairly well studied[3] and occurs regularly in Thai food and feed. Veterinarians suspect that the estrogenic mycotoxin, zearalenone, produced by Fusarium spp. on corn, may occur[4]. This is based on clinical observations only. No follow-up studies have been done.

1) Thirayudh Glinsukon. Aflatoxin B_1-producing strain of Aspergillus flavus var. Columnaris. J. Natl. Res. Council of Thailand, 11(2), 1-10, 1979.

Thirayudh Glinsukon et al. (3 co-authors). Studies on the population of toxigenic fungi in market foods and foodstuffs. II. Occurrence of Aflatoxins and Ochratoxin A. J. Nutr. Assoc. Thailand, 14(1), 27-40, 1980.

Kanda Romruen, Thirayudh Glinsukon and Chaivat Toskulkao. III. Toxicological evaluation of the crude toxins produced by the representative strains of Aspergillus niger. J. Natl. Res. Council of Thailand, 13(1), 1-18, 1981.

Thirayudh Glinsukon and Kanda Romruen. IV. Toxicological evaluation of crude toxins produced by certain strains of Aspergillus and Penicillium. J. Natl. Res. Council of Thailand, 13(2), 1-25, 1981.

Thirayudh Glinsukon et al. (5 co-authors). V. Screening tests of the antibacterial activity of the crude toxins produced by certain strains of Aspergillus and Penicillium. J. Natl. Res. Council of Thailand, 14(1), 1-8, 1982.

Prisnar Hemsuki et al. (2 co-authors). Incidence of aflatoxin in pre- and post-harvested corn. Regional Grains Post-Harvest Workshop, Jan. 19-21, 1982, Chiang Mai.

2) Dr. Thirayudh Glinsukon, Dept. of Physiology, Mahidol Univ., personal communication, Feb. 23, 1982.

3) Somchai Pongjunyakul and Nisit Muangsri. Hematological aspect of chronic ochratoxicosis A in mice (Abstract) 19th Ann. Conf. Kasetsart Univ., Feb. 3-5, 1981, page 68.

Somchai Pongjunyakul and Nisit Muangsri. Tumorigenicity and long-term toxicity of ochratoxin A in mice (Abstract) 19th Ann. Conf. Kasetsart Univ., Feb. 3-5, 1981, page 70 - this work was supported by FAO/SIDA and done in Thailand.

Somchai Pongjunyakul and R.G. Arora. Oral toxicity of ochratoxin in mice, pathology and pathogenesis. Kasetsart Veterinarians, 1, 70-83, 1980 - this work was done in Sweden.

4) Personal communication. Veterinary pathologists at Kasetsart University.

3.0 Occurrence of Trichothecenes in Thailand

There are no indications that the Thai regulatory agencies or scientists in the universities have been looking for trichothecenes in particular, therefore one cannot say with certainty that these mycotoxins do not occur in Thailand. The same holds with respect to occurrence of fungi capable of producing trichothecenes, although Thai mycologists have repeatedly stated that Fusarium spp. are very rarely, if ever, isolated[1]. However, there appears to be no indication that anyone has ever seen a case that may be classified as Alimentary Toxic Aleukia in man[2], nor is there any indication that cattle, pigs or fowl, the more susceptible domestic species, have suffered from diseases or symptoms caused by these mycotoxins[3].

4.0 Evaluation of Samples Collected in Thailand

4.1 Plant and Soil Samples from Thailand-Kampuchea Border

These samples have been cultured for fungi by Dr. G.A. Neish, Mycologist, Biosystematics Research Institute, Agriculture Canada, Ottawa. Most samples showed growth of Fusarium semitectum Berk & Rav. var. semitectum, which is sometimes referred to as F. sporotrichioides. F. moniliforme was found on a banana plant.

A chemical analysis of the samples by Plant Products Division, Canada Agriculture, for T-2 toxin, HT-2 toxin, DAS, Vomitoxin and Zearalenone showed no presence of these mycotoxins (sensitivity of procedure: less than 1 ppm).

4.2 Plant and Soil Samples from Thailand-Laos Border

The findings are the same as 4.1.

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1) Various personal communications from mycologists at Chulalongkorn, Kasetsart and Mahidol Universities.

2) Personal communication, Professor Mongkol, Siriraj Hospital.

3) Various interviews with Thai veterinary pathologists, most of whom are basically familiar with diseases due to mycotoxins, although nobody has worked on trichothecenes.

4.3 Discussion

In a review of Stachybotryotoxicosis[1], F. semitectum is listed as a potential producer of mycotoxins. Out of 31 samples infested with F. semitectum, 26 fungal isolates were found to be non-toxic, 3 were mildly toxic, and 2 were toxic. For comparison, one should consider the observations made on F. poae and F. sporotrichioides. The respective findings for "non-toxic", "mildly toxic" and "toxic" were: 2, 17 and 44 for F. poae and 4, 15 and 42 for F. sporotrichioides.

It is documented in the literature that F. semitectum is capable of producing T-2 toxin[2], diacetoxyscirpenol and neosolaniol[3].

Therefore, the findings of this report indicate that potential producers of trichothecenes exist in Southeast Asia, but that neither naturally occurring diseases due to these toxins occur, nor that there are any detectable levels of mycotoxins in the natural environment.

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1) Joffe, A.Z. In: Mycotoxic Fungi, Mycotoxins, Mycotoxicoses, Vol. 3, p. 34, T.D. Wyllie and L.G. Morehouse, eds., Marcel Dekker, New York and Basel, 1978

2) Burmeister, H.R., J.J. Ellis and S. Yates. Correlation of biological to chromatographic data for two mycotoxins elaborated by Fusarium. Appl. Microbiol., 21, 673-675, 1971.

3) Tanaka, T., K. Ogawa, N. Toyasaki, Y. Matsuda, Y. Matsuki and Y. Ueno. Identification of trichothecenes produced by Fusarium species from river sediments. Proc. Jap. Assoc. Mycotoxicol., 8, 16-19, 1978.

APPENDIX V

Occurrence of Diseases in Thailand
Due to Toxins and Diseases Causing Rapid
Death in Humans and Animals

1.0 Introduction

Considering the fact that trichothecene mycotoxicoses (see Appendix III) cause a variety of symptoms and lesions which may be caused by other agents or circumstances, a review of the general disease pattern in humans and animals in Thailand is indicated.

2.0 Anthrax

Anthrax, caused by B. anthracis, is a bacterial disease that is characterized by septicemia, and typical findings on autopsy/necropsy are: hemorrhages in all organs and failure of blood to clot, with blood "coming from the orifices". Anthrax occurs in the rural areas at a frightening frequency[1]. In a typical case history, a buffalo or cow dies first. The carcass is "butchered" and the meat consumed by people which may become infected either during the process of butchering or after ingestion of not well-cooked meat. Left-over parts of the animal are eaten by other animals (pigs, dogs) which then contact the disease as well. Finally, further cattle die due to ingestion of spores. The epidemiology is characteristic of a cascade-like event. From one bovine death in the beginning, the disease spreads in a fan-like pattern, but never do all species become affected at the very same time.

3.0 Botulism, due to the toxin of the bacterium, Cl. botulinum, occurs occasionally. Again, the typical cascade of events takes place either in members of one family only, or in animals eating from a carcass. Never is the whole population affected at once.

4.0 Rabies, a viral disease, is rampant in Thailand, and it has been said that even in Bangkok there are approximately 200 deaths per year due to rabies. The association with bites from a rabid animal is established in most cases.

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[1] Chit Sirivan, Chaowana Makgamol and Somchai Chabbang. Report on the outbreak of anthrax in Rajaburi Province in 1981. (Abstract) 20th Ann. Conf. Kasetsart Univ., Feb. 4-5, 1982, p. 18.

Note: Rajaburi is west of Bangkok. Deaths of 16 cattle, 9 buffaloes and 46 people is reported.

5.0 Cattle intoxications due to various plant poisons, particularly those containing cyanide[1] are not uncommon, but other species are not affected.

6.0 The remaining (prevalent) diseases are characteristic of the subtropical location of Thailand: malaria, fungal diseases of the skin, tuberculosis, malnutrition, leprosy in man, and bacterial and parasitic infections in animals are prevalent. Fusarium spp. fungi are not recovered from any of the mycotic infections.

7.0 A number of scientists[2] suspect that pesticide poisoning is much more common than is officially known, because of the rather indiscriminate use of these substances.

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[1] S. Sarataphan, M. Limpoka et al. (5 more co-authors). Mimosa invisa (Inermis Adelb) poisoning in cattle. 20th Ann. Conf. Kasetsart Univ. Feb. 4-5, 1982, p. 78.

Note: 5 cattle died within 24 hours in the northeast of Thailand (Khon Kaen area). Toxic cyanide and nitrate levels were found in all tissues, after ingestion of the mimosa plant.

[2] Personal communications: Dr. B.E. Grimwood, Post-Harvest Advisor, British Embassy; Dr. M. Limpoka, Kasetsart University, and others.

APPENDIX VI

Suggestions for Verification Procedures

1.0 Diagnosis and verification of alleged cases of chemical warfare are always difficult, but the following avenues of approach could be applied to facilitate these tasks:

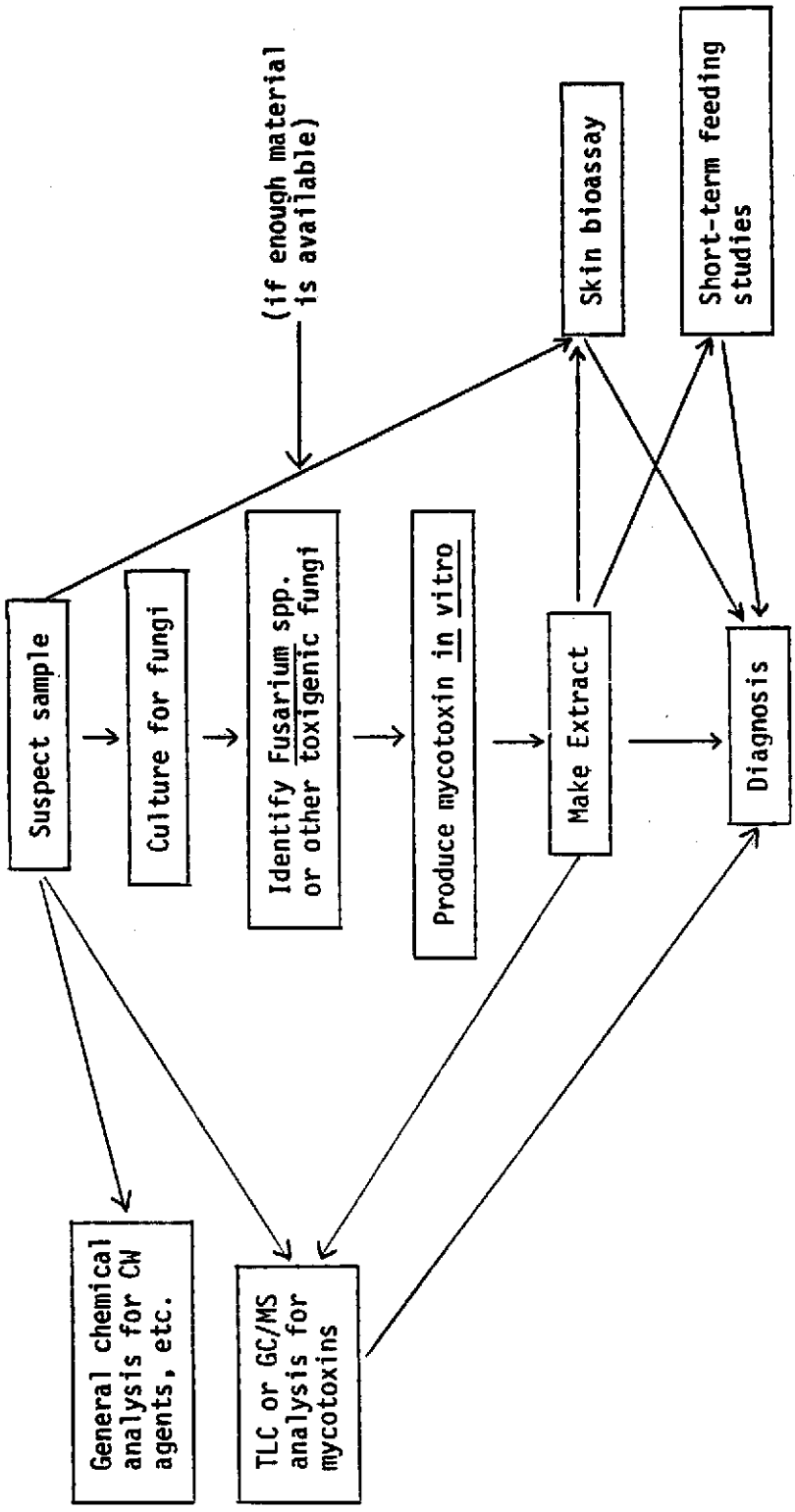
- Establish, in each country with a certain level of scientific expertise, a task-force that could activate existing manpower and facilities according to a master plan. In the case of Thailand, the Chemical Department of the Army could play the role of the coordinator. This department has the basic field test kits for conventional chemical warfare agents, and could activate other departments with respect to further laboratory investigations, provided there is access to Mass Spectrometer data books, current literature, etc.
- Establish, in highly developed countries, mobile test units which are equipped with some basic essential instruments and are staffed by trained scientists and technicians. These units could be flown into countries when needed, and they could utilize existing facilities whenever possible, using much the same approach as the first option.
- The least satisfactory option is to send specialists on reconnaissance missions and have them obtain samples which are shipped into their home countries. This may cause friction with local authorities, feed-back may be slow, and international doubts as to the impartiality of the specialists may be hard to squelch.

The flow-chart on the following page could be used as a guide on how to proceed from a given sample if mycotoxins are suspected.

2.0 Suggestions for Improvement of Interview Techniques

The writer of this report is not a professionally-trained interviewer, but believes that the interview techniques could be improved by the following methods:

Approach for Verification of Mycotoxins



- Adopt standard method of questioning, which goes through every aspect, i.e., from military weapons/delivery system, time/ circumstances, etc., to symptoms in humans, animals, etc.
- Have two interpreters present at the time.
- Due to unfamiliarity of either interviewee or interpreter with different forms of animal and plant life, it may be useful to have pictures or schematic drawings at hand in order to be able to locate and identify exactly what species or area of the body or plant is affected.
- Following are some suggestions for questions dealing with animals, plants and water:

Re: Animals

1. Species (buffalo, pig, chicken, dog, cat, etc.)
2. Which ones died?
3. When did they die? (same time? hours/days apart?)
4. How did they die? (struggling? convulsions? vomiting? diarrhea? and other signs?)
5. Did you or anyone else eat from the animals?
6. Did other animals eat these dead animals? What happened?
7. Did you cut open any animals? What did you think was different from slaughtered animals?
8. What did animals which did not die do afterwards? Were they normal? Sick for some time?

Re: Plants

1. What vegetables/crops do you normally plant in your village?
2. What plants/vegetables were affected after the attack?
3. What did you see on vegetables?
4. What did you see on trees?
5. How long did it take for the plants/leaves to become yellow or whatever color they assumed?
6. Did you or anyone else eat vegetables after the attack?
7. Did animals eat such plants/vegetables? What happened?

Re: Water

1. What is your usual water supply? (well? creek? pond?)
2. Did you drink/use water after the attack? What happened?

3. Did you see animals drink water after the attack? What happened?

4. Did the water have any abnormal color/odor?

3.0 Are Mycotoxins Chemical or Biological Agents?

Introduction. The 1925 protocol for the "Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases"[1], known as the 1925 Geneva Protocol, was meant mainly for chemical weapons and has no verification provision. The 1972 "Biological Treaty" includes a consultation, cooperation and complaint mechanism.

Ambiguity of Existing Treaties. Usually, chemical agents are thought of as synthetic chemicals, whereas biological warfare agents are thought of as living organisms that cause disease and/or death due to the reproduction and spread of organisms. Toxins produced by living organisms occupy a vacuum between treaties on chemical and biological warfare, because the toxins cannot reproduce.

According to Seagrave[2], the Soviet Union considers toxins to be chemicals rather than biologicals, because they are secretions or products of living organisms.

Mycotoxins and "Yellow Rain". Mycotoxins are chemicals produced by living organisms, thus they would have to be classified as chemicals, unless one chooses to introduce a new category, the "biotoxins". As far as "Yellow Rain" is concerned, there is a possibility that the so-called "Yellow Rain" contains both mycotoxins (=chemicals) and living spores of fungi. Conclusive studies are not available yet on this subject; however, should it be possible to prove that samples of "Yellow Rain" contain both mycotoxins and fungal elements and/or spores, the use of "Yellow Rain" would be covered by both treaties.

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1) League of Nations, Treaty Series XCIV, N. 2138, p. 65, 1929.

2) Seagrave, S. p. 196, Yellow Rain; A Journey Through the Terror of Chemical Warfare. M. Evans & Co., New York, 1981.

APPENDIX VII

Comments on the UN Experts' Report

The UN Report, by and large, is a respectable piece of work. The team has done, at least in the opinion of the writer of this report, what could be done under the circumstances. However, a number of minor misinformations have crept into the report which cannot go unchallenged.

It is incorrect to list cobalt cardiomyopathy as a mycotoxicosis (paragraph 2, page 38). This disease is due to a combination of malnutrition and cobalt that was used as a foaming agent.

Paragraph 5 (page 40) contains several typing errors which could be misinterpreted. The natural levels of occurrence of trichothecenes were reported in the literature in µg/kg, not g/kg. Further, it is not correct to say that fungi produce, under laboratory culture conditions, toxins which are different from those in field crops. The quantitative ratio of the various toxins produced may be different, but not the quality as such.

The statement with respect to a particular plant that takes up and modifies trichothecenes is not pertinent. There are no known reports of animals ever having been poisoned by such plants or any other plant that may have assimilated trichothecenes from the soil.

Paragraph 69 (page 28) of the report, which states that it is necessary to prove whether mycotoxin-producing fungi are present in a sample, or in the environment, is a well-aimed criticism of previously carried out investigations. Thai and other authorities should be encouraged to establish a data bank of occurrence of fungi and mycotoxins, and it is hoped that the samples taken by this investigator will help to shed some light on the questions. This author's preliminary impressions are that decay of organic matter occurs in Thailand in much the same fashion as everywhere else in the world[1)].

The point raised in paragraph 73d (page 29), i.e., that many scientific publications report production of these mycotoxins at

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1) Many decaying plant materials were observed to be covered by grey or black "rusts", suggestive of fungal infestation which may include Fusarium species. Also, the bamboo fences and walls in Ban Vinai Camp were "black", indicating fungal growth, but no untowards effects in people living in Ban Vinai are known to occur.

temperatures of 20-30°C is a moot one. It is correct that fungi have the capability to produce trichothecenes at warmer temperatures, but there is no doubt that the greatest amounts of trichothecenes are produced under temperate to cold conditions[1]. How else would one be able to explain the complete absence of reports on Alimentary Toxic Aleukia-like conditions in man and animals in the warmer climates? However, these warmer areas are "blessed" by other mycotoxin problems. This variation is most likely due to the ecologic interaction of various fungi under the given climatic conditions.

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1) See Appendix III.