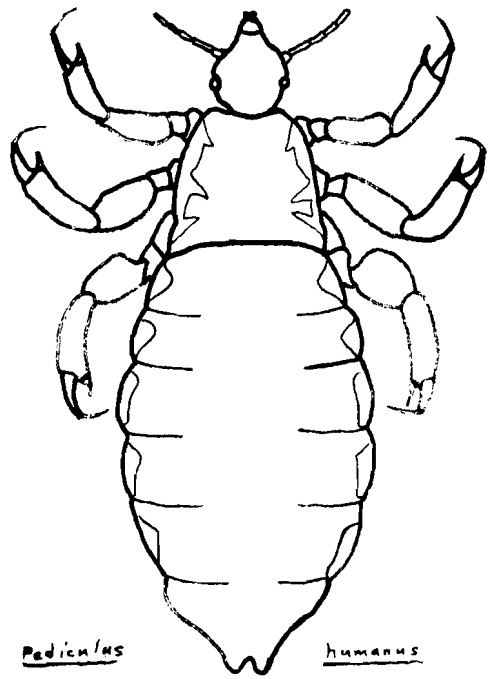
# 5TH PREVENTIVE MEDICINE UNIT

## 65TH MEDICAL GROUP, FASCOM




# ARTHROPOD BORNE DISEASES

## IN SOUTH KOREA

TECHNICAL BULLETIN NO. 3

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# ARTHROPOD BORNE DISEASES IN SOUTH KOREA

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## I. INTRODUCTION

Arthropod borne diseases do not represent the serious health problem in a garrison situation that they represent to an army in the field. The purpose of this bulletin is to review the diseases that mosquitoes, fleas, mites, ticks and lice are capable of transmitting in Korea, so those concerned with the health of the military can estimate the potential health hazards involving arthropods under both garrison and field conditions.

Arthropod borne diseases were significant health problems during the Korean War. Some like malaria had a dramatic increase as the hostilities broke out. Cognizance of the threat arthropods represent may aid in anticipating preventive measures to conserve the fighting strength.

Information for this bulletin has been gathered from the sources mentioned in the selected bibliography and through coordination and consultation with the Eighth Army Surgeon's Office, the Republic of Korea (ROK) Army Surgeon's Office, the Preventive Medicine Section of the Ministry of Health and the World Health Organization (WHO).

## II. THE MAJOR ARTHROPOD BORNE DISEASES IN SOUTH KOREA

### A. Malaria

The principle vector of malaria in Korea is the mosquito Anopheles sinensis, which makes up approximately 30 per cent of the mosquito population of South Korea. The causitive organism of

malaria in Korea is the protozoan parasite Plasmodium vivax. The World Health Organization made a malaria survey of South Korea from 1960 to 1965 and found a large reservoir of malaria in the indigenous population, especially in the northern half of Kyongsang-Pukto. This malaria found in Korea is a mild, seldom-fatal disease, and most of the infected people do not seek medical care. To illustrate this, in 1967 the Ministry of Health reported 1,416 clinical cases of malaria, while the WHO discovered 16,616 cases of malaria in their continuing probe of the disease. While Plasmodium vivax is the only known indigenous malaria parasite in Korea, other Plasmodium strains and species are being found in returnees from Vietnam. Transmission of these imported malarias has not been discovered, but the danger exists and the Korean Government is attempting to screen all returnees and provide chemotherapy to eliminate the parasites.

During the Korean War malaria was a considerable problem to US Forces (USFK) with some 39,000 cases reported. On 8 July 1950 at the beginning of hostilities a drug suppressive program was ordered and supplies of chloroquine were available for the administration of 1/2 gram of chloroquine weekly. The drug program undoubtedly reduced malaria incidence; never-the-less, there was a sharp increase in malaria from less than 3 per 1,000 in July 1950 to over 40 per 1,000 in August and 30 per 1,000 in September 1950. In addition to the above rates it has been estimated that 75 to 90 per cent of the cases of fevers of unknown origin were actually malaria. Figure 1 (OTSG 1953) shows the malaria incidence during the Korean War.

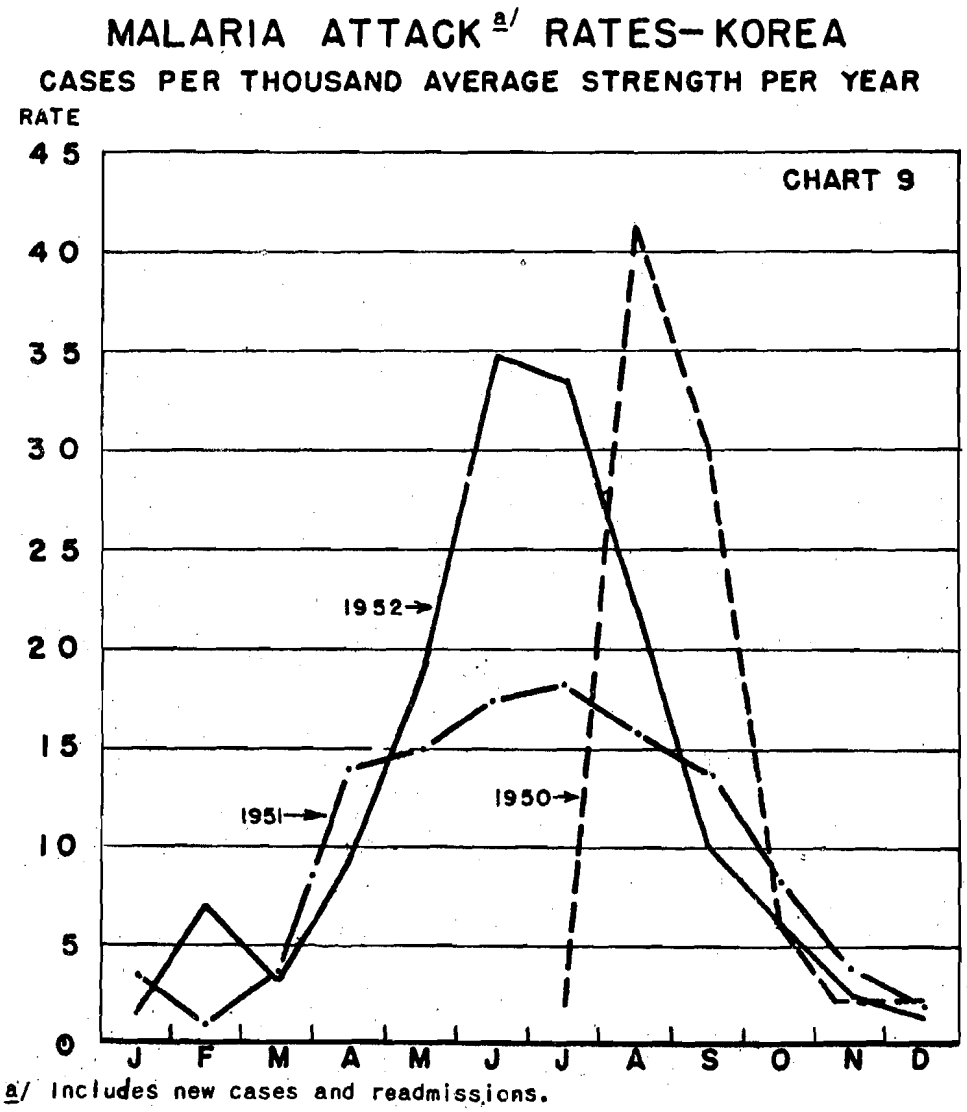


Figure 1. Incidence of malaria among US Forces Korea during Korean War (from OTSG 1953).

Since the end of the war the malaria incidence has dropped to a very low level. The Office of the Surgeon General (OTSG 1967) reported Korea to have the third lowest malaria incidence rate (0.10 per 1,000) of all Army areas, with only Alaska and Europe having lower incidences. This change is probably largely due to the improved living conditions with adequate screening to protect against bites of malaria vectors. Other factors involved in malaria control include mosquito vector control through fogging military compounds regularly with insecticides and reducing mosquito breeding sites. Education of personnel in the use of individual protective measures such as bed nets, mosquito repellents and chemopropholaxis is important.

The fact that much malaria still exists among the Koreans is probably because of a lack of protective screening while sleeping during the mosquito season. Sleeping out-of-doors and in open, unscreened rooms is common practice. This provides the ideal environment for the propagation of the parasite in the human reservoir. In the war time situation where soldiers are exposed to mosquito bites more frequently, malaria could again become a serious tactical problem.

TB MED 164 discusses malaria. AR 40-5 requires malaria chemopropholaxis in all areas of malaria endemnicity, prescribing a dosage of one chloroquine-primaquine tablet per man per week. Figure 2 shows the seasonal distribution of malaria and its vector in Korea. Figure 3 shows the annual total cases of malaria among the Korean

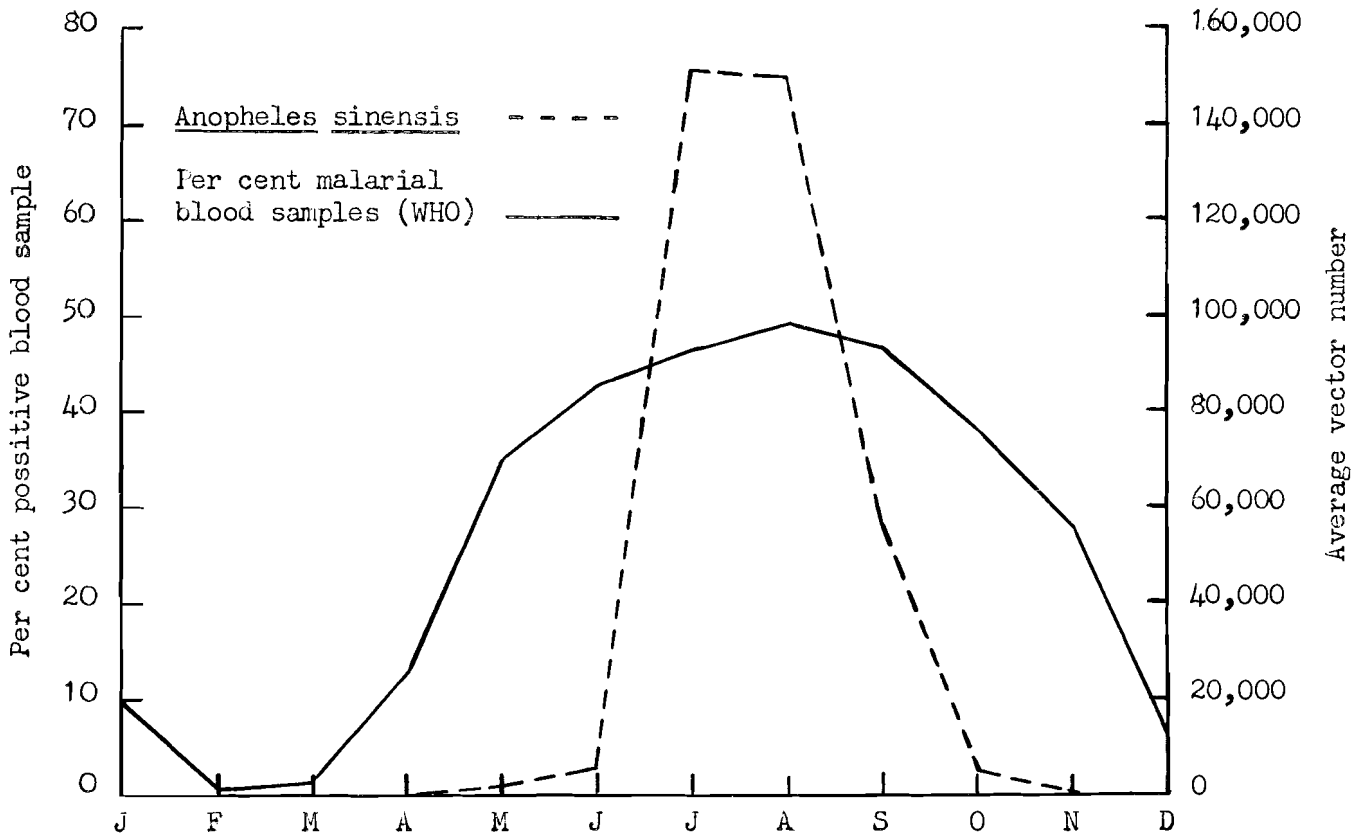


Figure 2. Average (1962-1967) seasonal distribution of Korean malaria and mosquito vector.

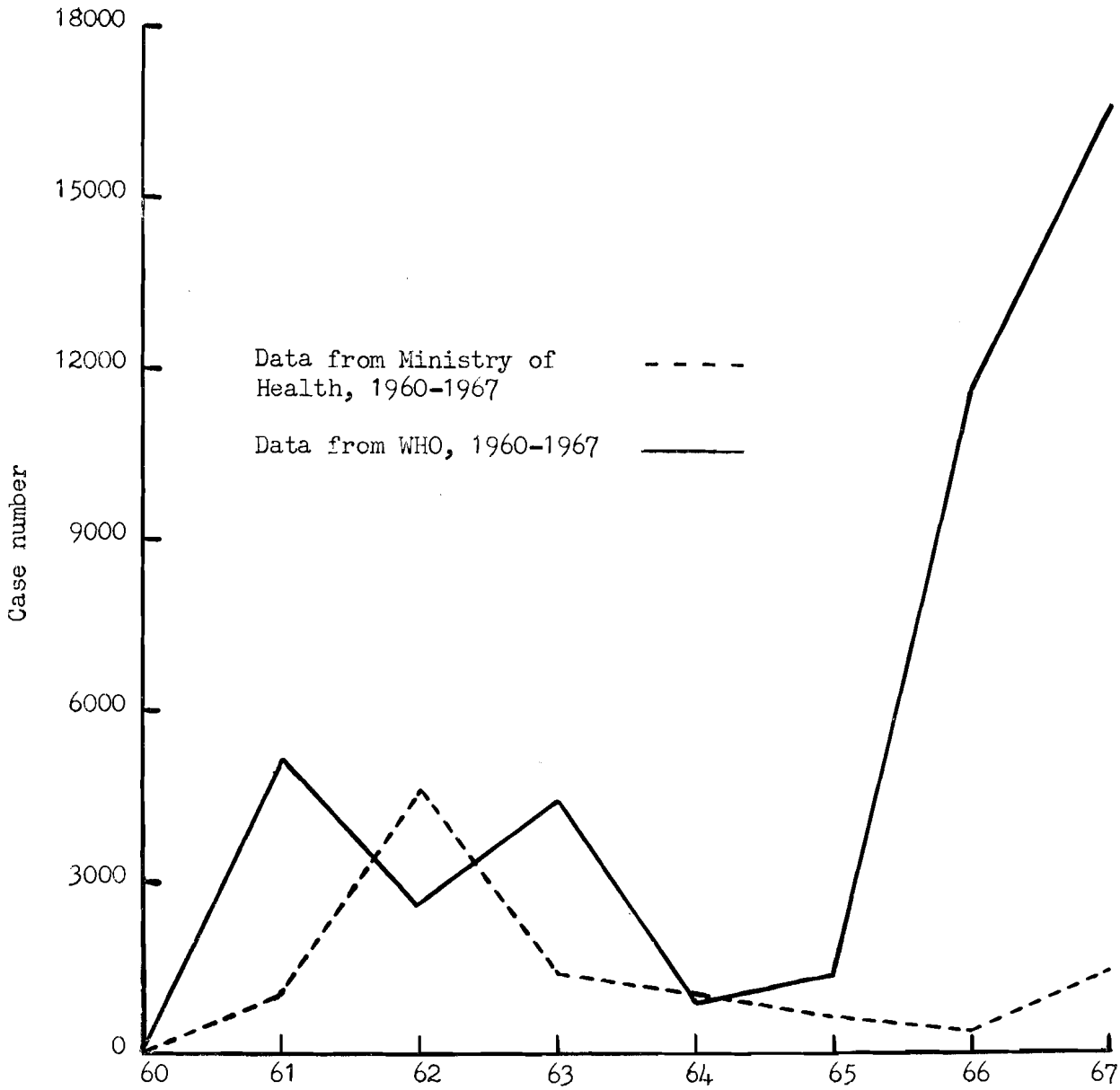


Figure 3. ROK annual total cases of malaria.

population as reported by the WHO and the Korean Ministry of Health. Figure 4 shows the distribution of malaria throughout Korea according to WHO data.

B. Japanese B Encephalitis

An encephalitic disease that occurs during the mosquito season in Korea is assumed to be Japanese B Encephalitis. Because serological tests are not always requested, the frequency of the disease has been questioned.

The vector of the disease in Korea appears to be the mosquito Culex tritaeniorhynchus which is the vector of Japanese B Encephalitis outside of Korea. Culex tritaeniorhynchus accounts for only about 4 per cent of the total mosquito population. Culex pipiens which is known as a vector of encephalitis elsewhere, comprises approximately 30 per cent of Korea's mosquito population. The seasonal distribution of the disease and vectors is shown in Figure 5.

Japanese B Encephalitis is a viral disease and is described in TB MED 181. The incidence among USFK is very low, probably as a result of effective protection against mosquito bites. Among the Korean population the disease averages about 1,700 cases per year with a death rate of about 30 per cent. Figure 6 shows the annual total cases among Koreans. Figure 7 shows the geographical distribution of the disease.

During most of the Korean War Japanese B Encephalitis was not a serious problem in terms of incidence (0.1 - 0.7 cases per 1,000). However this disease intensified the medical difficulties encountered in the early stages of the conflict. In the eleventh week of conflict

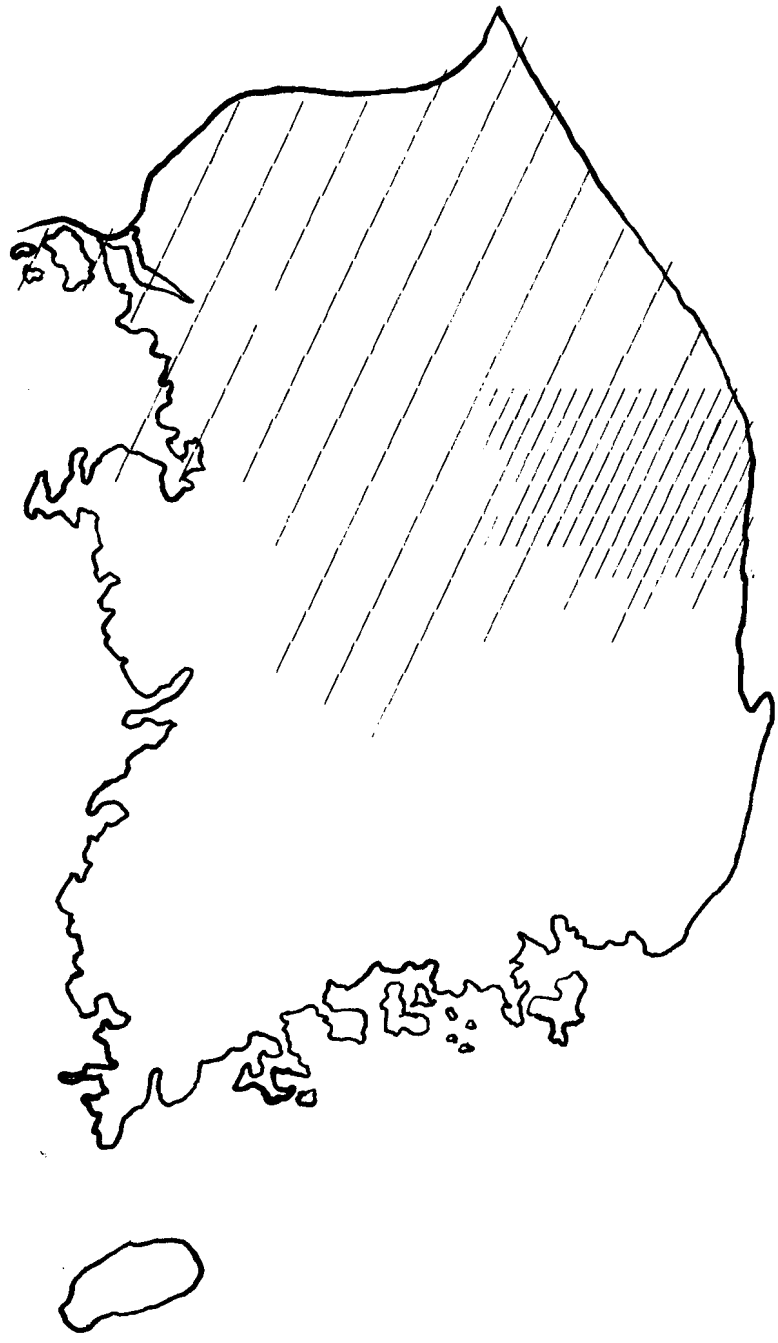

Figure 4. Geographical distribution of malaria in Korea.

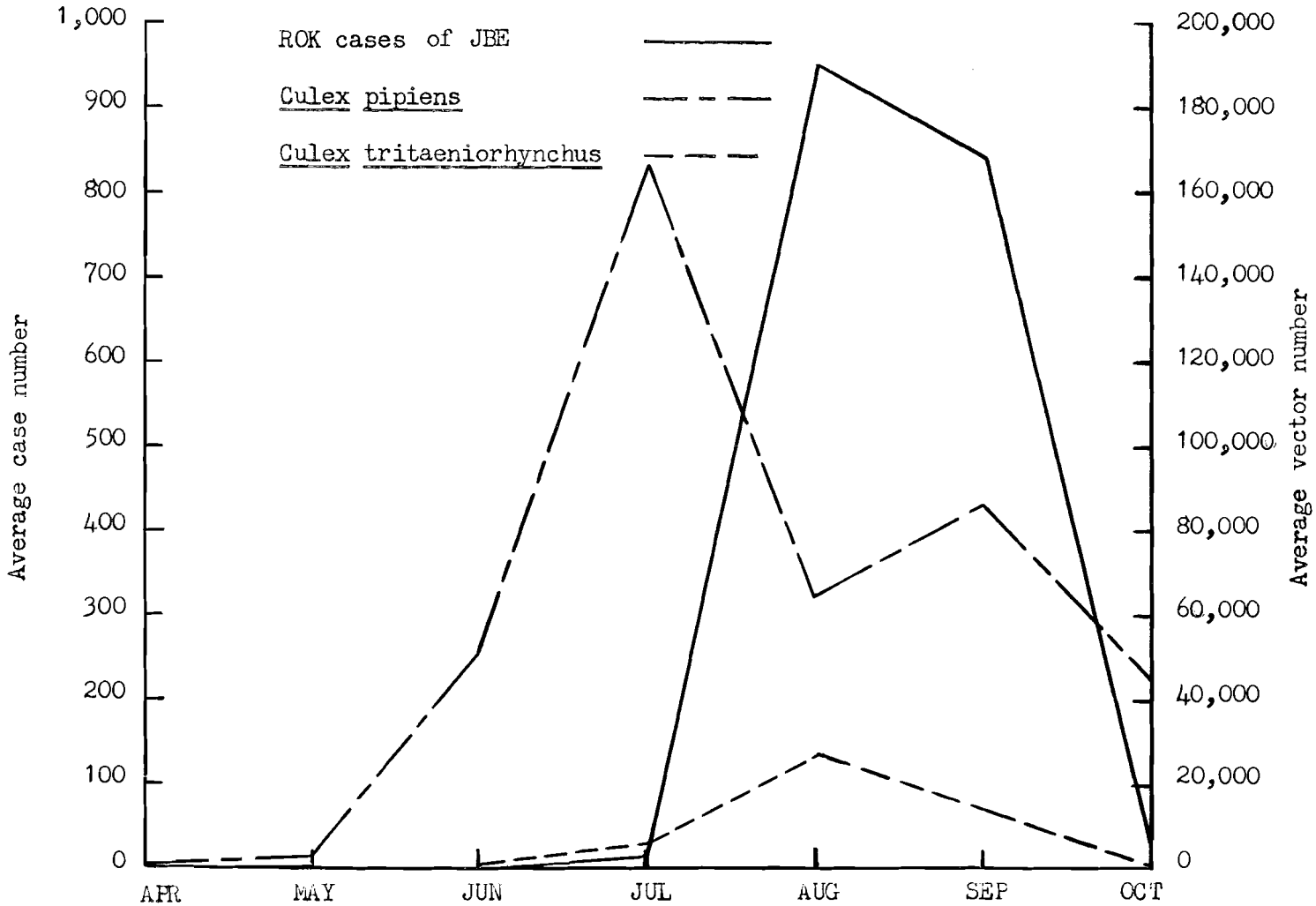


Figure 5. Average (1962-1967) seasonal distribution of ROK Japanese B encephalitis and mosquito vectors.

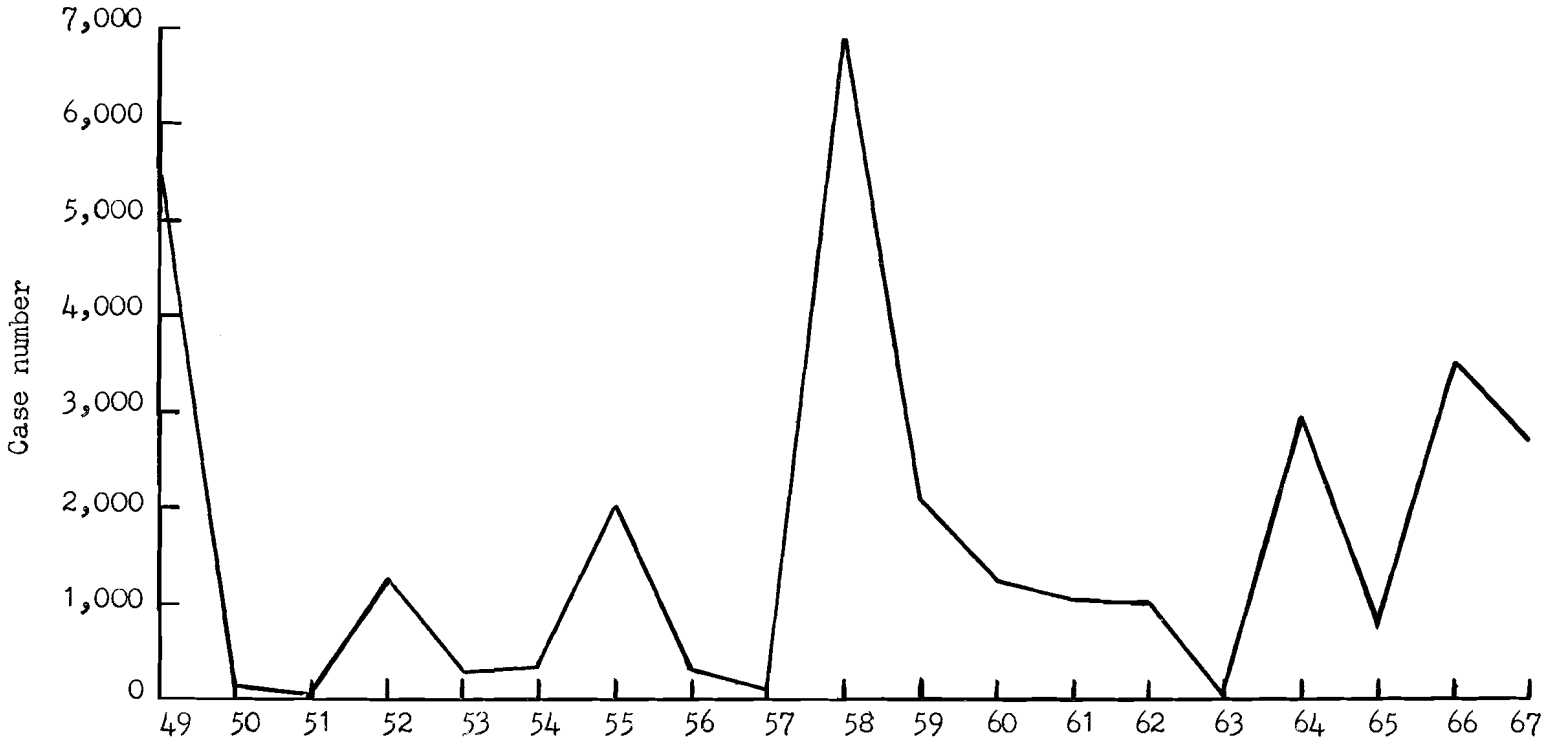


Figure 6. ROK annual total cases of Japanese B encephalitis (1949-1967).

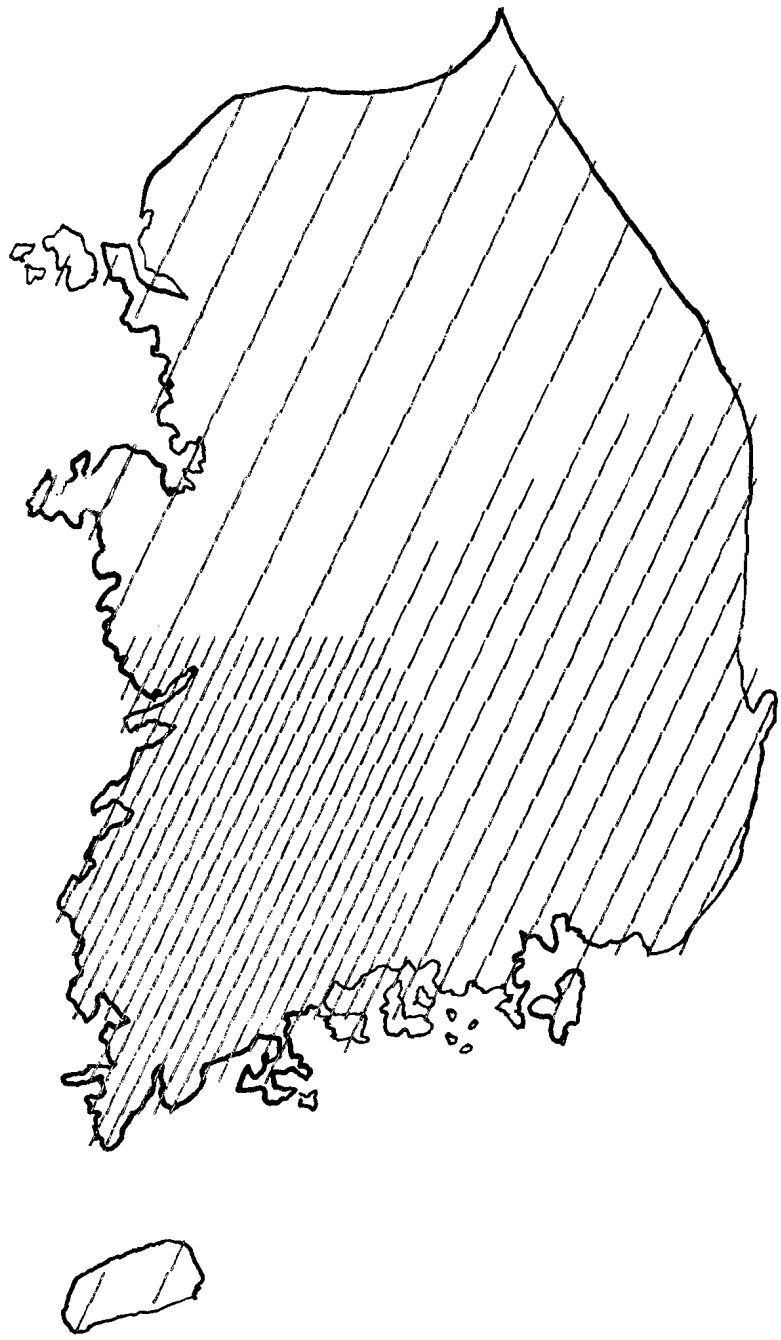

Figure 7. Geographical distribution of Japanese B encephalitis in Korea.

the encephalitis rates reached approximately 28 per 1,000. By the end of 1950 the case rate had dropped to 0.1 per 1,000. The sudden rise in this disease was probably caused by greatly increased exposure of troops to mosquito bites during battlefield conditions.

C. Epidemic Hemorrhagic Fever (EHF)

Epidemic hemorrhagic fever (EHF) has been a puzzling disease for many years. The causitive agent, reservoir and vector have not yet been discovered. The causitive agent is presumed to be a virus. Much attention has been given to rodents as possible reservoirs and mites as possible vectors. Researchers during the Korean War (DA 1953) pointed out three species of trombiculid mites that have seasonal population fluctuations corresponding to the EHF seasonal fluctuation, suggesting possible roles as EHF vectors.

Control recommendations are geared to mite control. Uniform impregnation with M-1960 insect repellent or benzyl-benzoate miticide is recommended in endemic areas. Efforts to reduce mite populations by land clearing and pesticide spraying are thought to be helpful. Rodent control for possible reservoir elimination is also recommended. TB MED 240 discusses EHF.

Occurrence of EHF has two peak periods per year, one in the spring and one in the fall. The case incidence (see Figure 8) among USFK is similar to that of the ROK Army. Figure 9 shows the annual total cases of EHF. Geographical distribution of the disease (see Figure 10) coincidently parallels the DMZ between North and South Korea. The extent of the disease's presence in North Korea is unknown.

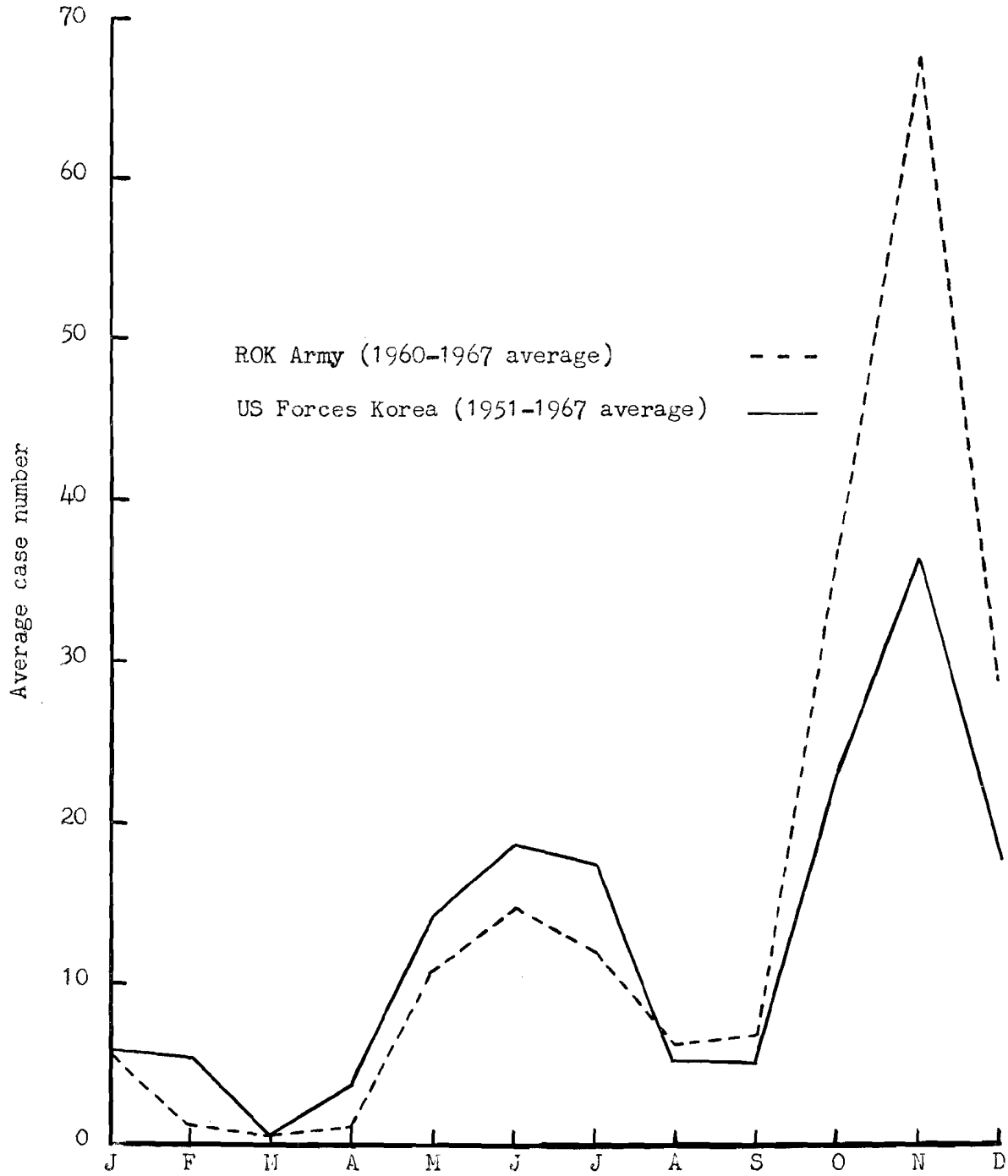


Figure 8. Seasonal distribution of epidemic hemorrhagic fever for ROK Army and US Forces Korea.

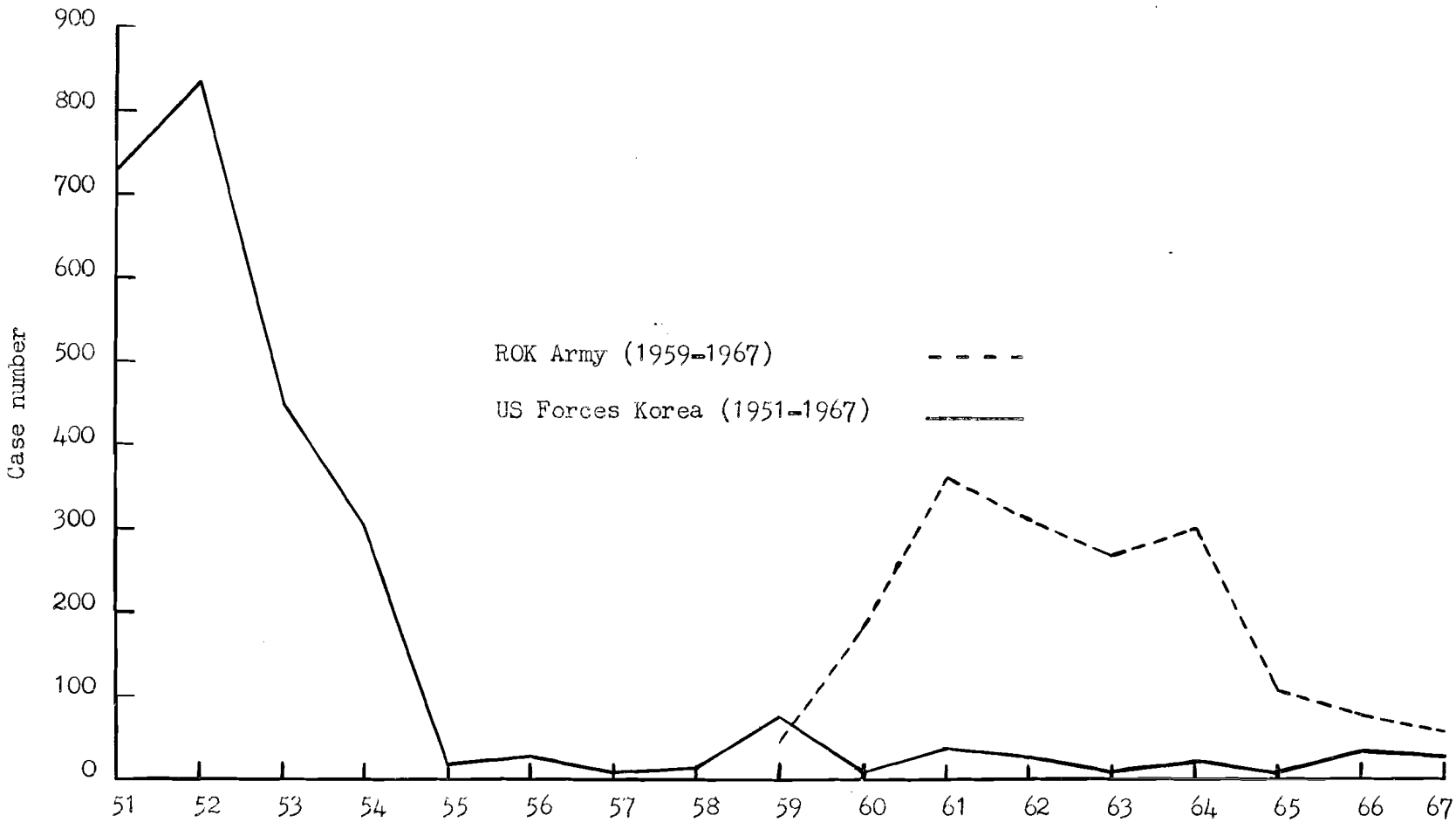


Figure 9. Annual total cases of epidemic hemorrhagic fever for ROK Army and US Forces Korea.

Figure 10. Geographical distribution of epidemic hemorrhagic fever in Korea.

During the Korean War EHF was relatively unknown until the battle lines began to focus in the endemic area. EHF incidence rates reported during 1951 were admittedly too low because of unfamiliarity with this disease; however, in November 1951 the incidence rate for EHF reached its peak of 18 cases per 1,000. In 1952, EHF was the leading cause of deaths from disease in Korea — almost three times higher than the next highest category.

Although EHF has had a relatively low incidence rate since the Korean War, it continues to be a morale problem due to its reputation of high mortality. Research is continuing into the cause of this disease.

D. Epidemic Typhus

Epidemic typhus is endemic in Korea. The vector is the body louse, Pediculus humanus and the causitive agent is Rickettsia prowazekii. No cases of epidemic typhus were reported among USFK during the Korean War but the civilian population had an average of 3,228 cases with 473 deaths per month during 1951. After the war the case rate gradually dropped until no cases were reported in 1967 (see Figure 11).

Body lice are still found on Koreans who do not maintain a high degree of personal hygiene. Outbreaks of the disease occur typically during the colder portions of the year when maximum clothing is worn and minimum baths are taken. Epidemic typhus has been reported from each province except Cheju Island.

Lice can be controlled by a program of personal hygiene together

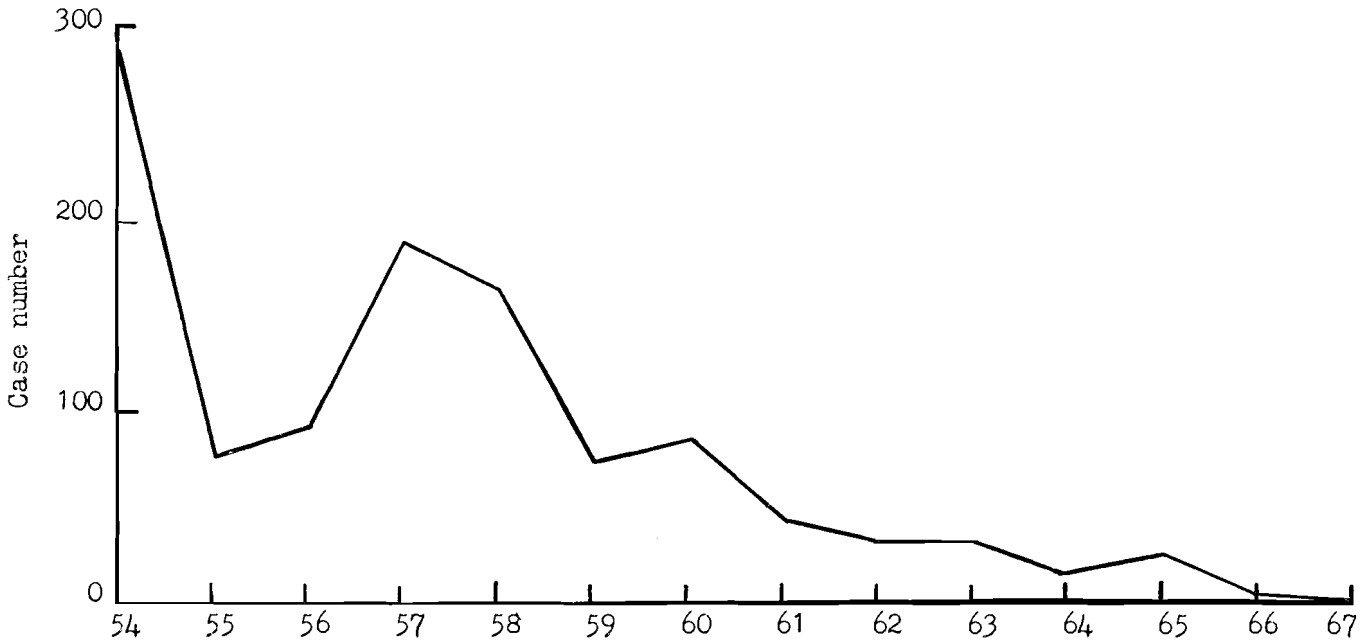


Figure 11. ROK annual total cases of epidemic typhus (1954-1967).

with the use of insecticide powder (1 per cent lindane or 1 per cent malathion dusting powder). Mass delousing operations with lindane during 1952 proved to be very effective in reducing the epidemic typhus rate. TB MED 218 discusses epidemic typhus.

## III. ARTHROPOD BORNE DISEASES OF LOW OR POTENTIAL INCIDENCE

There are several other arthropod borne diseases present in South Korea; however, they have not been considered major diseases even though they may be potentially important.

### A. Relapsing Fever

During the Korean War 69 cases of louse-borne relapsing fever were reported among USFK. This disease can be either louse-borne or tick-borne. Whether or not ticks are involved in disease transmission is not known. The causitive organism is a spirochete, probably Borrelia recurrentis. No cases of relapsing fever have been reported in the ROK since 1961.

More cases of the disease have been reported from South Cholla Province than elsewhere in Korea. Figure 12 shows the annual total cases of relapsing fever in the ROK. No TB MED is available on relapsing fever, however clinical aspects of this disease are covered by Faust and Russell (1964).

### B. Filariasis

Filariasis is an infectious disease caused by the filarial worms, Wuchereria bancrofti and Brugia malayi. Studies made by Seo et al. (1965) indicate the causative agent for filariasis in South Korea is

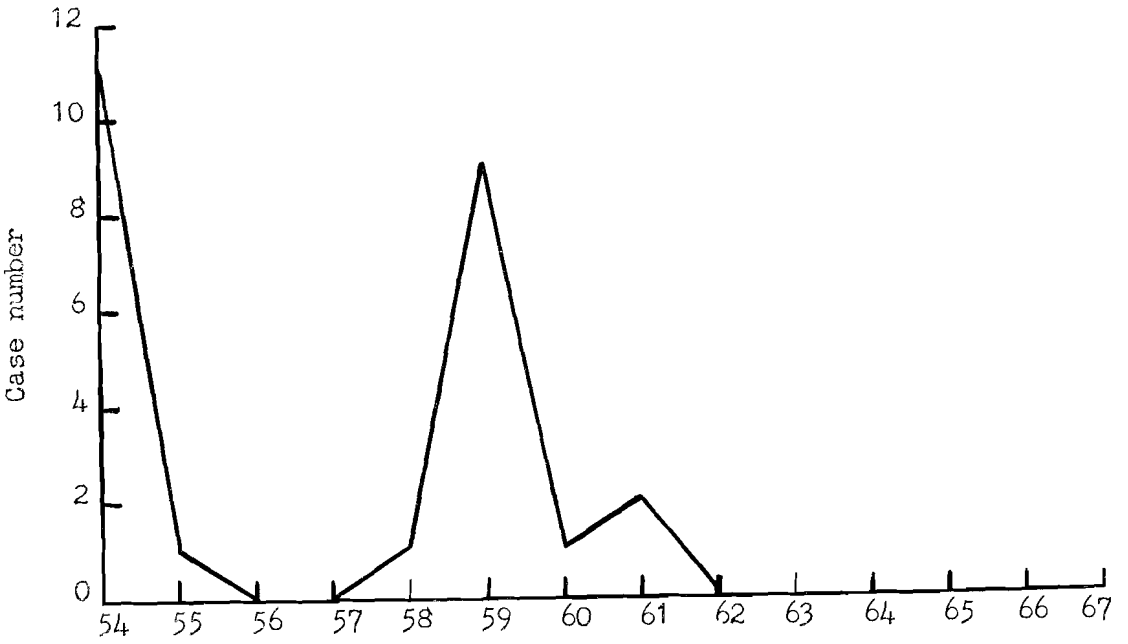


Figure 12. ROK annual total cases of relapsing fever (1954-1967).

Brugia malayi. The vector appears to be the mosquito, Aedes togoi on Cheju Island. Additional study in North Kyongsang Province indicated Anopheles sinensis as a possible vector. Filariasis has been reported from almost every province in Korea with the incidence greatest in the southern coastal half of the Republic -- Cheju Island having the highest infection rate.

The data accumulated by Seo was based on blood samples. Of the 30,149 samples examined (1964-1965), 378 persons were found to be infected with microfilariae. Some elephantiasis occurs in the endemic areas. The clinical aspects of filariasis are found in TB MED 142.

The recommended control methods for filariasis are the same as those recommended for other mosquito borne diseases. This disease was not reported as a problem among US Forces during the Korean War nor since.

C. Scrub Typhus

Scrub typhus is a rickettsial disease caused by Rickettsia tsutsugamushi and vectored by trombiculid mites. It is not a reportable disease with the Korean Health Department; hence no information on case incidence is available. No specific area has been established as endemic; however, the disease could be wide-spread and its cases reported as other diseases.

According to studies made by Chun et al. (1965) scrub typhus was not reported in Korea until the Korean War. The cases were among British and American personnel. No cases have yet been reported among Koreans.

These studies further show that the etiological agent of scrub thypus, Rickettsia tsutsugamushi, was isolated (1957) from a chigger mite, Leptotrombidium pallida, collected from the field mouse, Apodemus agrarius. Two vectors of scrub typhus, Leptotrombidium akamushi and Leptotrombidium delisensis, have not been collected in Korea.

Clinical aspects of scrub typhus are discussed in TB MED 31. Uniform impregnation with M-1960 insect repellent and mite control are recommended preventive measures. Bivouac areas infected with mites can be sprayed with pesticide to eliminate mites. An entomologist should be consulted for pesticide spray recommendations.

D. Plague

Plague is a disease caused by the bacteria, Pasteurella pestis. The classical vector of plague is the oriental rat flea, Xenopsylla cheopis, which is present in South Korea. The Ministry of Health reported that of fleas taken from rats in the Pusan port area, 99.5 per cent were Xenopsylla cheopis.

The Korean Health Department has reported no cases of plague in recent years. Pasteurella pestis is not known to be present in Korea. The Ministry of Health now quarantines all ships coming from areas where plague cases are being reported, such as Vietnam. Should the plague bacteria be introduced into Korea, there are abundant fleas to spread the disease.

The clinical aspects of plague are found in TB MED 124. No plague was reported during the Korean War.

E. Dengue Fever

Dengue fever is a viral disease that can be vectored by Aedes albopictus or Aedes aegypti. Since there is no record of Aedes aegypti being present in South Korea, Aedes albopictus is considered to be the only potential vector present. Dengue fever is not known to occur in Korea. Clinical aspects of dengue fever can be found in TB MED 272.

F. Filth Diseases

The housefly, Musca domestica and several other species of flies are vectors of several filth diseases because of their feeding and breeding habits. Studies have shown the housefly to be able to transmit typhoid bacilli, cholera bacilli and dysentery bacteria either by mechanical deposits or regurgitation deposits. Musca domestica and other flies are abundant in Korea.

No cholera was reported during the Korean War among USFK or ROK. Few typhoid cases were reported among USFK; however, during 1951 over 7,500 cases were reported per month on the average among South Korean civilians. Dysentery was a major problem among USFK and especially among prisoners of war. In August 1951 the dysentery case rate among USFK was 120 per 1,000.

Basic sanitation, fly screening and chemical control of flies in their breeding areas are preventive measures. Cockroaches, like houseflies, possess the abilities to transmit filth diseases; however, studies have not proven cockroaches actually guilty of disease transmission.

G. Paragonimiasis

Paragonimiasis is an infectious disease caused by the oriental lung fluke, Paragonimus westernmani. There are two intermediate hosts involved in the transmission of this disease. The first intermediate host is the snail. Crayfish and fresh water crabs serve as the second intermediate host. Infection in man results when the crustacea containing metacercariae of Paragonimus westernmani are eaten raw or partially cooked. The adult worms encyst in the lungs and the eggs they lay are expelled in sputum or swallowed and then eliminated in feces.

Cases of paragonimiasis have been reported from South Korea; however, the Korean Health Department does not have data on case incidence.

The most effective means of controlling the disease is thorough cooking of all fresh water crustaceans before eating them.

H. Dipylidiasis

Dipylidiasis is a disease caused by a common tapeworm Dipylidium caninum found in dogs and cats. Infection in man results from accidental ingestion of adult fleas or flea parts containing the cysticerocoid larvae. This disease has been found principally among children under fifteen years of age.

Three common fleas found on dogs and cats are suitable hosts. The larval stages of the dog flea, Ctenocephalides canis, the cat flea, Ctenocephalides felis and the human flea, Pulex irritans might ingest the eggs of the causative organism, becoming the intermediate host of the parasite. These fleas are present in South Korea.

DDT dusting of dogs and cats to eliminate the fleas is recommended to prevent human infection and reinfection of pets.

I. Heartworm of Dogs

Heartworm of dogs, a filarial worm, is transmitted by mosquitoes and perhaps fleas. Newton and Wright (1956) have shown that two types of microfilariae are involved in this disease, one of which, Dirofilaria immitis is mosquito-borne and the other, an undetermined species of Dipetalonema is flea-borne. Presently, only Dirofilaria immitis has been reported in Korea.

Culex pipiens is probably the main vector of the disease in Korea. The infected animals are the reservoirs, whereas the mosquitoes or fleas are required as intermediate hosts. Adult worms are found in the lumen of the heart and the larval stage is found in the circulating blood.

The 406 Medical Laboratory survey (Warne et al. 1967) of sentry dogs during 1954 showed 1.9 per cent of 157 dogs examined to be infected with heartworm. A survey conducted during 1967 showed that out of 421 dogs examined 9 cases were confirmed positive, thus resulting in a 2.1 per cent incidence for the year. The 1967 incidence was about the same as in the 1954 survey. In the later survey, most of the dogs had been in Korea for more than one year. This infection is considered indicative of the true incidence in Korea. No specific geographical distribution was established.

Prevention, control and treatment of Dirofilaria immitis infections constitutes a serious problem. The use of drugs to kill the adult worms after the disease has become established is often frustrating and disappointing. The drugs commonly used today are effective in killing the circulating microfilariae but have no known effect on the female worm, so when treatment is discontinued the microfilariae appear again. The only completely effective treatment is an adulticide followed with a microfilaricide. Some veterinarians recommend administering sodium caparsolate to kill the adult worm and diethylcarbamazine to kill the larval stage in the blood. Other preventive measures include the use of screened kennels, mosquito control and eradication, topical repellants and insecticides.

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