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UNITED STATES ARMY FORCES, PACIFIC
OCEAN AREAS

MILITARY CONTROL OF MALARIA AND
INSECT-BORNE DISEASES

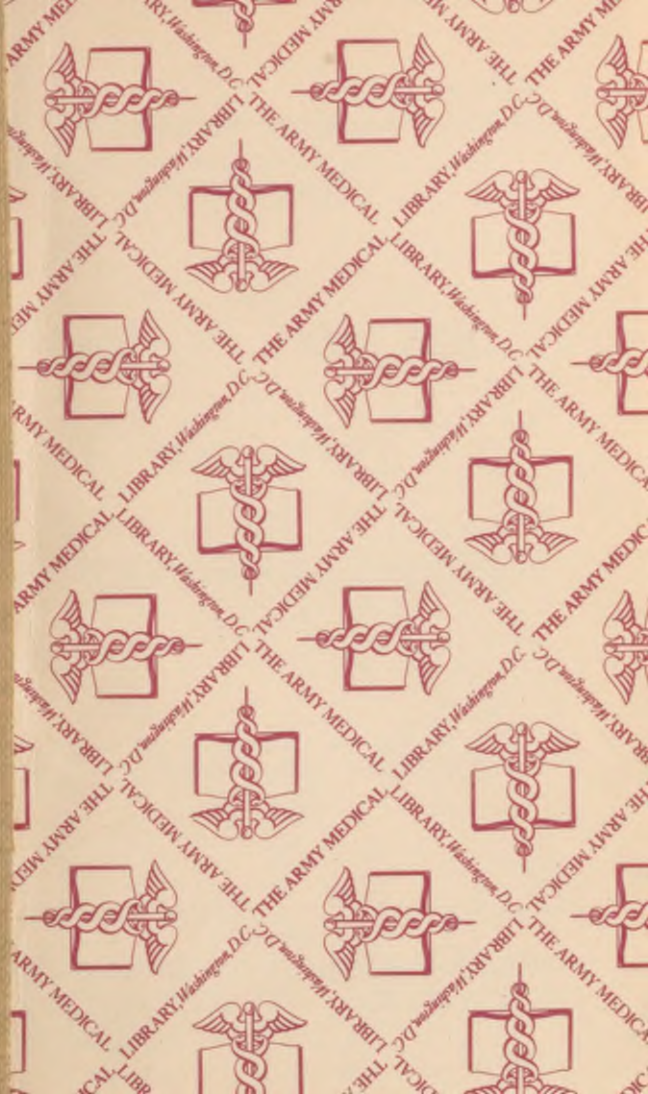
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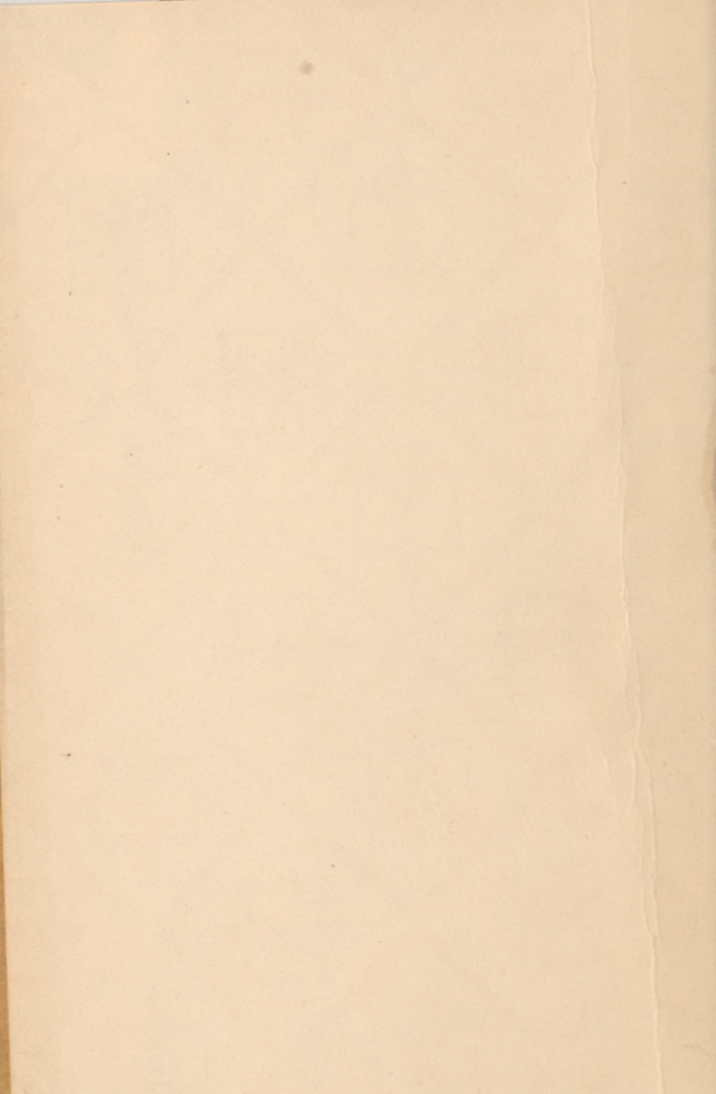
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**PREVENTIVE MEDICINE MANUAL No. 2
FOR ALL OFFICERS**

MILITARY CONTROL

of

MALARIA

and

INSECT-BORNE DISEASES



UNITED STATES ARMY FORCES, PACIFIC OCEAN AREAS

**Robert C. Richardson, Jr., Lieutenant General, U. S. Army,
Commanding**

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**MALARIA AND INSECT CONTROL • PACIFIC OCEAN AREAS
JUNE 1945**

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indirectly to the press or to any person
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1945
SUBJECT: Military Control of Malaria and Insect-
Borne Diseases. c.1

TO : All Officers, U. S. Army Forces, Pacific
Ocean Areas.

1. This manual on the military control of malaria and insect-borne diseases is published for the information and guidance of all officers.

2. It is of greatest importance that these diseases shall not jeopardize the success of a military campaign. All commanders are enjoined to assist the program outlined in this manual.

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WASHINGTON, D. C.

ROBERT C. RICHARDSON, Jr.,
Lieutenant General, U. S. Army,
Commanding.

MILITARY CONTROL OF INSECT-BORNE DISEASES*

SECTION I

Introduction

1. Insect-borne diseases of present or potential military importance in the Pacific Ocean Areas are transmitted by mosquitoes, mites, flies, fleas and lice. Those which are of immediate and urgent importance are set in bold type.

a. Mosquito transmitted diseases include **mal-
aria, dengue fever, filariasis and Japanese B encephalitis.**

b. Mites transmit **mite-borne typhus.**

c. Fly-borne diseases include the **dysenteries.**

d. Fleas transmit **plague and flea-borne typhus.**

e. Lice transmit **louse-borne typhus.**

2. Fortunately the measures which prevent one type of insect-borne disease are effective often against others. Thus anti-mosquito work which is done to prevent dengue fever is often effective also in preventing filariasis or Japanese B encephalitis.

SECTION II

Malaria

1. **Military Importance of Malaria.**

a. Malaria contributed greatly to the unhappy termination of the defense of Bataan. It is estimated that 85 percent of our forces there became infected with malaria. Over five times as many casualties in the South Pacific were due to malaria as were caused by all battle casualties. Heavily seeded troops who were sent from Guadalcanal to rear bases and ordered

*Revised and extended from Malaria Training Manuals No. 2 and No. 3, South Pacific Area.

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to stop suppressive atabrine averaged 1-1/2 to 2 attacks of malaria per man. Whole divisions were thus rendered less effective both in combat and during their rehabilitation and training periods because of the number of men ill with malaria. Similar rates occurred in New Guinea.

b. These early malaria rates followed from the urgency of the situation. It was necessary to begin the Guadalcanal and New Guinea campaigns before the newly-developed repellents and freon aerosol sprays were available, when the supply of quinine was short, and when atabrine was a relatively unknown drug. We had too little knowledge of the danger of malaria and how to cope with it. Now we are better prepared to reduce the malaria hazard; it need no longer jeopardize the success of a military campaign.

2. Malaria Can Be Effectively Controlled Only By The Joint Efforts Of Every Officer and Man.

It is urgent to emphasize this point. The present insect control organization has demonstrated that the disease can be controlled on established bases. Mosquito control in newly occupied territory is now aided by airplanes which are equipped to spray DDT solutions. Here it is important to note that too much reliance is often placed on airplane spraying. Control work by ground crews is still the most important and only proven method. Special spray teams are organized to work behind combat lines, but there is no mosquito control in the area of front line combat. Malaria prevention there becomes a matter of how well each officer knows what he can do to protect his men from infected mosquitoes and how well each man uses his clothes, his repellent, and his spray to stop mosquito bites. This is all summed up in two words: malaria discipline.

3. General Information About Malaria.

a. *Geographical distribution in Pacific Ocean Areas.* There is no malaria in the Hawaiian Islands, in Saipan or Guam or in the islands between. There is malaria in all the target areas; in Formosa, in China, in the Ryukyus, and in Japan itself.

b. *The malaria mosquito.* Malaria is transmitted by only one group of mosquitoes called anophelines. Other groups of mosquitoes do not carry malaria and are commonly called "pest mosquitoes". The female anopheline mosquito lays eggs in water and the cycle of development from eggs through the larval stage to adult requires about ten days. The anopheline (malaria) mosquito breeds in open ponds, lagoons, swamps, and streams. She flies over distances of a mile or more and hence may be thought of as a "field type" of mosquito in comparison with the "domestic type" of mosquito which breeds close around camps and dwellings and flies only short distances. The "domestic type" of mosquito is discussed under Dengue Fever. Only the female anopheline transmits malaria. She is a shy mosquito which flies and bites only at night except in dark jungle where she may bite in the daytime. Hence protective measures are most important at night.

c. *Variations due to season, control efforts, and base development.* Malaria is more prevalent during the rainy season when there are many new pools of water where malaria mosquitoes breed. The amount of mosquito control work which has been accomplished is another factor in the malariousness of a base. Thus, on entering a new base under combat conditions, little permanent control is possible and reliance must be placed on larviciding and on individual protective measures such as the use of repellents, sprays, bed nets, and atabrine. As the base develops, better malaria control measures are gradually instituted and destroy more and more mosquitoes until so few remain that many of the individual protective measures are no longer essential.

d. *Man-made malaria, a serious problem.* Over fifty per cent of the malaria mosquito breeding during the first rainy season on Guadalcanal took place in man-made pools of water which were made by:

- (1) Unnecessary ruts, formed by driving "cross country" and on unauthorized roads and trails.

- (2) Roads which were built without adequate ditches and culverts and thus blocked natural drainage courses.
- (3) Numerous small borrow pits alongside roads.
- (4) Abandoned foxholes and bomb craters which became prolific sources of mosquito breeding.

c. *Special problems in occupying new bases.* Warning should be given of the false security which too often follows a landing during the dry season. Troops who expect mosquitoes and malaria, but find none, conclude that talk about malaria has been exaggerated. Thus, the first troops on Guadalcanal in August 1942 found few mosquitoes and had little malaria in the first weeks. Meanwhile, female anophelines were laying countless thousands of eggs in water which collected in the myriad of ruts and holes made by the occupying force (man-made malaria). Malaria cases appeared in September and the disease became epidemic in late October.

A similar situation occurred during the New Georgia operations where every man was given a bottle of repellent and other antimosquito equipment. No mosquitoes were found at the time of landing, and men discarded their repellent. Meantime, increasing numbers of mosquito larvae were found in ruts and holes, a warning of malaria to come. Would these same troops have thrown away their guns and ammunition if they had not met the enemy during the first few days?

4. Nature of Malaria And Suppressive Treatment.

a. *Three factors must be present at one time and place if malaria is to be prevalent among troops:*

Persons infected with malaria. (Natives, Japs or malaria-infected troops who comprise the "seed bed".)

Malaria carrying mosquitoes. (Anophelines).

Non-infected troops.

The chain of transmission from infected persons to mosquito to healthy troops is described below.

b. *Malaria is a disease caused by a tiny parasite* which is found in man's red blood cells. The female anopheline, or malaria mosquito, must first become infected before she can spread the disease. This she does by biting and sucking up some blood containing parasites from an infected native or other person who has malaria. The parasites multiply in the mosquito for about ten days and then wait in her salivary glands for a chance to infect a well man. Every time the mosquito drills a hole in a man's skin for blood, she injects saliva into the opening, and if malaria parasites are in the saliva, they go into the hole and so into the blood. Here they enter a red blood cell and multiply until they finally fill the blood cell and burst out, destroying this red cell. They then invade other cells and repeat the process.

c. *Symptoms and diagnosis.* Symptoms usually develop about fourteen days after a man is bitten by an infected mosquito. One should suspect malaria when he has a chill followed by a fever and sweating. The symptoms of malaria may be anything from headache to delirious fever or even sudden unconsciousness. The only way to be certain that one has malaria is to find malaria parasites in a blood film examined with a microscope. Under field conditions medical officers sometimes must diagnose and treat malaria from symptoms alone, without examining the blood.

d. *Treatment and relapse.* Atabrine, quinine, or other drugs are used in the treatment of malaria. When given properly, the drugs will usually cure the attack in about a week. But sometimes, even though a man feels well after treatment, the drugs have not destroyed all the malaria parasites. A few of them may hide away in the internal organs. Then, after weeks or months the disease appears again. This is called a relapse. There may be several such relapses which have to be treated each time like a new infection.

e. *Atabrine suppressive therapy.* There is no known drug which will prevent malaria infection; but one drug, atabrine, will, when given properly, delay the onset of symptoms of the disease as long

as it is being taken. This drug is therefore of vital importance in keeping men on their feet during urgent military operations. Atabrine blood studies have demonstrated that failure of the drug to protect against malaria is almost always due to not taking the atabrine regularly as prescribed.

Dosage: Theatre directives prescribe exact dosage schedules.

Supervision: Troops do not take medicine willingly. Blood atabrine studies have shown repeatedly that atabrine is not taken well when supervision is lax. Unit commanders are responsible:

That the drug be given by roster to both officers and men.

That an officer or a competent noncommissioned officer witness the actual swallowing of the drug by each individual.

That by checking the roster regularly, all individuals who have not taken the drug be required to report and take sufficient dosage to equal that missed.

That failure to take atabrine as ordered should result in disciplinary action.

Atabrine is as completely harmless in the recommended dosage as is aspirin. It may cause vomiting and diarrhea in a few men when first started. This disappears after the first few days and can be lessened by taking the tablet on a full stomach. Less than one in 1000 persons is intolerant of atabrine. For such a person the medical officer may prescribe quinine. Here it should be noted that atabrine gives better suppressive action than quinine and has fewer toxic effects. A temporary yellowing of the skin may occur since atabrine is a yellow dye. This will disappear after the drug is stopped and is not harmful. Atabrine will not cause impotence or sterility.

Eventually when suppressive treatment is discontinued, most individuals who have been infected will become acutely ill with malaria. Recent evidence, however, indicates that suppressive treatment with atabrine will completely stop the development of one

type of malaria infection (*Plasmodium falciparum*). *Plasmodium falciparum* infections long have been considered the type of malaria most likely to cause death. It is also probable that suppressive treatment with atabrine will lessen the severity of all types of malaria infection.

A particularly hazardous aspect of the use of suppressive treatment is that it may conceal dangerously the amount of malaria which may be seeding a unit gradually. The apparent freedom from malaria may lead to carelessness in the enforcement of malaria discipline. Commanding officers of such units are apt to regard truly preventive measures such as mosquito control and individual protective measures as not necessary. If the risk of infection is sufficiently great to necessitate the use of suppressive treatment, it is all the more important to stress truly preventive measures. Failure to employ precautions against mosquitoes to the fullest possible extent is inexcusable and is a reflection upon the efficiency of the commanding officer concerned.

f. *Malaria is a serious disease.* It destroys a man's blood and makes him weak. It may keep him in the hospital for ten days or longer. It may make him a chronic invalid for a year. It may cost him his life in combat. It may kill one or two out of every hundred infected persons if they are not properly treated.

5. Malaria Preventive Measures Which Are Primarily Command Functions.

It is the responsibility of all commanders to initiate and enforce the necessary measures to control malaria within their units and unit areas (Appendix I and Circular 223, WD, 1943). These measures include:

a. *An organization and program for insect control.* Unit commanders will appoint an insect and rodent control detail consisting of 1 NCO and 2 enlisted men in each company, battery, squadron, or similar unit (see paragraph 3 a, Appendix I). These details primarily will maintain insect control within

the camp and in surrounding territory for a distance of one mile. Their insect control work will include spraying of all standing water once weekly, minor ditching to remove such water, smoothing of road ruts and the use of DDT residual effect sprays. This last method is new and is of value because of the persistent effect of DDT when sprayed on screens and walls of tents, quarters, and native dwelling. Spraying the latter is particularly profitable because most mosquitoes become infected with malaria by biting diseased natives and often rest on the walls of the dwelling where the blood is obtained. A single spraying of these buildings with DDT not only will kill all mosquitoes then present but will continue to kill mosquitoes as they come in contact with treated surfaces for one to three months. This may prove one of the most valuable of all antimosquito measures. Insect control officers of units smaller than divisions will be appointed as provided in Appendix I. For division and base insect control groups (see Appendix I).

b. *A training program in military control of insect-borne diseases for all personnel.* The details of this program are outlined in Appendix II. Every officer should seek to impress his men with the importance of individual protective measures.

c. *Supplies and equipment.* The commander is charged with the timely requisitioning of insect control supplies (Appendices III and IV). These should be forwarded in divided shipments so that loss of one shipment will not disrupt the program. It is the responsibility of unit commanders that each man is supplied with a bed net in good condition and that he has a bottle of repellent. It is his responsibility that during combat insect control supplies reach the front lines with the same regularity as food.

d. *Command responsibilities during the phase of seaborne troop movements.*

(1) Temporary landings of only a few days on malarious bases (or where dengue is epidemic) may result in large numbers of men contracting these diseases. Landings made for the purpose of exercise

should be accomplished during daylight hours, and troops should be back aboard ship by sunset when malaria mosquitoes start biting. Repellent and other measures for individual protection should be used when indicated.

(2) When it is known that troops will land and camp on a malarious island, an officer should be sent ahead to select, with the aid of the island malaria control group, a relatively non-malarious campsite.

(3) All landing movements should be so planned, the military situation permitting, that troops go ashore in the morning with sufficient time to set up camp and be under mosquito nets by night time. This requires that nets, repellents, and other insect control supplies be available on the first night ashore.

e. *Selection of campsites.* The advice of the base or division malaria and insect control officer should be obtained in selection of camp sites, whenever the military situation allows. Camps should be located a mile or more from native villages and marshes or streams which are known or suspected to be breeding places for mosquitoes.

f. *Segregation of natives.* Over fifty per cent of natives on malarious islands in the Pacific have chronic malaria, and are a serious source, or "seed bed", of infection. Most of these natives also have filariasis. Preferably, they should never be allowed in troop areas. In practice, they are often essential as laborers. When so employed they should be allowed in camp areas only between the hours of 0700 and 1800. If natives are allowed in or near camp at night when malaria mosquitoes are feeding, the mosquitoes may become infected and will, in turn, transmit the disease to troops. Native camps should be "Out of Bounds," or "Off Limits."

g. *Night exercises and landing drills.* Night maneuvers, or landing drills, should be held in relatively malaria-free regions. The permanently based malaria and insect control units will designate suitable areas for tactical operations and will also mark out sectors which should be out of bounds. All anti-

mosquito precautions should be rigorously enforced, both for protection and as a training measure, even when night exercises are held in authorized sectors.

h. Night working parties in malarious areas. Night working parties should be employed in malarious regions only when essential. They should wear their shirts, use repellents, and take all other protective measures.

1. Screening. Screening is an important protective measure whenever its use is feasible. Men living inside screened tents and sleeping under bed nets have double protection. The specifications and use of screening are detailed in Appendix III.

j. Malaria discipline. Unit commanders are responsible for malaria discipline among their troops. This includes the program of suppressive therapy with atabrine described in subparagraph 4e, above, and the enforcement of individual protective measures as outlined in paragraph 6, below.

6. Individual Protective Measures Against Mosquito Bites. The malaria mosquito bites at night. The measures which each soldier, sailor, or marine will take to protect himself are described. (Note: These measures are equally effective against mosquitoes which transmit dengue fever and other diseases, except that they must be carried out during the day as well as at night. See Dengue Fever):

a. Ordinary clothing used for protection. Mosquitoes do not bite through ordinary clothing unless it is thin or tightly stretched. Shirts will be worn, beginning at sundown, with collars buttoned and sleeves rolled down. Wherever mosquitoes are present, the bottoms of trousers will be tucked into tops of shoes and socks will be drawn up around trouser bottoms to protect ankles.

b. Repellents. Repellents are chemical solutions which, when spread over the skin, will keep mosquitoes from biting for about two hours. At sunset and every two hours when exposed at night, one should rub fifteen to twenty drops of standard mosquito repellent on hands, wrists, cheeks, neck,

and lower legs. The repellent must be applied more often when men are sweating. Also, apply a few drops where clothes are tight, as across shoulders and the seat of trousers and on socks. Repellent should be taken to fox holes during night alarms. It should be kept close at hand for this purpose by placing it in steel helmet before retiring. The use of repellent is the most important and most neglected phase of malaria discipline. It is important to emphasize that there may be times, particularly in combat, when repellents are the best protection against malaria. A man may go through the most malarious area and avoid the disease completely if repellents are used regularly and well.

c. *Spray killing of adult mosquitoes.* A spray er known as a freon aerosol dispenser is available. The spray is highly concentrated. Ten seconds spraying is enough for a pyramidal tent, three seconds for a pup tent. Longer spraying does not increase effectiveness and is wasteful. Tents and nets should be sprayed at dusk and at bedtime. A supply of spray should be taken to the fox hole at night. Hospitals with malaria patients should be sprayed regularly, as should mess halls and kitchens.

d. *Bed nets and jungle hammocks.* Bed nets are one of the most valuable methods of protection from mosquito bites. There are places in the tropics where a single night of exposure to mosquito bites may result in an infection rate up to twenty per cent among unprotected troops. It is the responsibility of each officer to see that these nets are available on the first night ashore. They should be regularly inspected and repaired. Each man should practice setting up his net before entering a malarious area. The net should be so supported that it does not sag upon the sleeping man, and so arranged that his elbows and knees do not contact the meshes. In practice, such contacts are difficult to prevent. The man is well repaid who uses repellent on the knees and elbows when he retires. Nets should be ready before dusk, should be tucked in carefully, and a search for mos-

quitoes should be made preferably with a flash light, after one gets inside. When not in use bed nets should be so arranged that mosquitoes cannot enter.

e. *Avoidance of unnecessary exposure to infected mosquitoes.* Troops should not be allowed to go swimming or fishing, or to bathe in unscreened showers, or otherwise unnecessarily expose themselves after sundown. It may be feasible to postpone reveille until after sunrise in order to avoid early morning exposure in highly malarious areas.

SECTION III

Dengue Fever

1. **Military Importance.** Dengue is usually second to malaria as a hazard to military operations; but on occasions it becomes of primary and urgent importance. Serious epidemics have occurred on Saipan, Guam, and earlier on Espiritu Santo and New Caledonia. In some of these epidemics more than 25 per cent were non-effectives.

2. **Geographical Distribution.** Dengue is prevalent in the islands of the Pacific Ocean Areas and particularly in Formosa, Ryukyu Islands, Japan, and China.

3. **Nature of the Disease.** Dengue fever is an acute non-fatal disease caused by a filterable virus which is transmitted from an infected man to a healthy one by a mosquito and by no other means. The symptoms are often much like malaria as is shown in Table I, "Comparison of Malaria and Dengue." The importance of blood smears in diagnosis is apparent.

4. **Method of Transmission.** The *Aedes aegypti* mosquito is the chief vector of Dengue fever; *aedes albopictus* has also been incriminated. Both species bite freely during the day as well as at night, differing from anopheline (malaria) mosquitoes which bite at night. The mosquito vector herself must become infected by biting a dengue patient during the first

three days of the fever as this is the only time that the virus is present in the blood. After a short period of incubation in the mosquito the latter becomes ineffective and is able to transmit dengue at anytime during the rest of its life by biting a susceptible man.

5. **Life History of *Aedes Aegypti*.** The female *Aedes aegypti* lays her eggs in tin cans, flower pots, water tubs, and other artificial water containers close around a house; and is called a domestic or house type of mosquito in contrast with the anopheline (malaria) mosquito which breeds in pools and streams in the fields. A correlary of this is that the adult *Aedes aegypti* mosquitoes fly only short distances and therefore must lay eggs near the camp or house where they are found biting. The *Aedes* mosquito develops from larvae to adult in seven to ten days in warm climates.

TABLE I
COMPARISON OF MALARIA AND DENGUE

<i>Symptoms or Signs</i>	<i>Dengue</i> (100 Cases)	<i>Malaria</i> (100 Cases)
Frontal headaches	88%	96%
Chilly sensations	55%	22%
True chill	10%	56%
Pain in eyes	78%	59%
Red Conjunctivae	97%	not noted
Low backache	74%	79%
Pain on eye movement	25%	common
Abdominal symptoms	17%	47%
Toxic rash	35%	none
Temperature 103° F. or over	55%	68%
Saddle-back temperature	25%	none
"Dengue" rash	18%	none
Joint aches	common	72%

6. Control of Dengue Depends on Control of Dengue Carrying Mosquitoes.

a. *Breeding of this mosquito is controlled by destroying or emptying the artificial water containers where she lays her eggs or by putting oil or DDT on such water. This must be done at least once a week. Some of the principal breeding places which must be treated are rain barrels, tubs, cisterns, cans of all sizes, bottles, pots, pails, old shoes, canvas tarpaulins holding rain water, tires so stacked as to hold rain water, and slit trenches: anything that will hold water for ten days.*

b. *Individual protective measures against dengue mosquitoes are the same as those already discussed to protect against malaria:*

Ordinary clothes used for protection.

Repellents.

Spray killing of adult mosquitoes.

Bed nets and jungle hammocks.

Avoidance of unnecessary exposure.

Screening.

The only difference is that the dengue mosquito bites both during the day and at night; hence precautions must be taken at all times.

SECTION IV

Mite-Borne Typhus

1. **Introduction.** Mite-borne typhus (scrub typhus, tsutsugamuchi disease) is a typhus like disease of field mice, rats, and other animals which is transmitted by the bite of a mite (chigger or red bug). Man contracts the disease by being accidentally bitten by an infected mite.

2. **Military Importance.** Mite-borne typhus has not yet been a disease of great hazard to military operations. There have been less than 4000 cases in the U. S. Army in the first three years of war. It has however been a disease of greatest importance to

individual organizations who happen to locate in an infected area. In some organizations nearly 50 per cent of the personnel have been infected; the mortality rate in restricted localities in the region of New Guinea has varied from about 1.5 to almost 30 per cent. Small but severe localized epidemics may therefore give rise to unfounded rumors affecting morale.

3. Geographical Distribution. The disease occurs in scattered areas lying within a rough triangle of Japan, Eastern India, and Northern Australia. All future target areas are potential sources of mite-borne typhus.

4. Nature of The Disease. Mite-borne typhus is an acute febrile disease caused by a minute organism which usually is found in the blood of infected mice and other rodents and is transmitted from rodent to rodent by mites. When man is bitten by an infected mite the disease becomes manifest after an incubation period of about two weeks. The typhus inoculations which the army gives are to protect against a more severe type of typhus which is known as louse-borne typhus. These inoculations do not protect against mite-born typhus which is a different and usually a milder disease.

5. Transmission. The six legged larval mite (red bug, chigger) which transmits the disease is so small that it is rarely seen. It is red in color. Mites are frequently described as occurring in open fields of Kunai grass, but they are found equally often in other types of tall grass and in areas overgrown with scrub. Apparently a moist loose humus soil is favorable for them. It is unknown as yet why one area in a meadow may be highly infected and result in numerous cases in troops encamped there while other troops a short distance away in the same field may escape attack. In Japan, mites are common in river bottom areas and on ground which is subject to flooding.

6. Control.

a. Mite avoidance.

(1) Standing, sitting, or lying in open grass or along jungle margins where mites abound should be reduced to the minimum. Mites remain chiefly in or on the ground but are quick to crawl up the shoes or clothing of a standing or reclining individual. Troops continuously on the march seldom show evidence of chigger bites even after traversing heavily infested areas.

(2) A vigorous soap and water scrubbing of the whole body with a wash cloth is highly desirable following exposure in a potentially mite infested area.

(3) Sleeping in direct contact with the ground is necessary under some operational conditions but is dangerous. A bare road is to be preferred for bivouac to sleeping in an adjacent field of kunai grass. Similarly jungle hammocks are better than cots where there is a choice. Native type beds of freshly cut poles on cross pieces are safer than the ground.

b. *Repellents.* The standard G.I. repellents are all helpful but dimethyl phthalate is the best. Small amounts in cupped hand should be rubbed thoroughly into socks, shoe tops, trouser cuffs, trouser fly and waist, shirt fly, collar, and sleeve cuff. This must be repeated weekly. It is not as reliable or practical for large bodies of troops as the total impregnation of clothing described below.

(1) Impregnation of clothing and blankets with a dimethyl phthalate-soap emulsion. An impregnated uniform remains mite proof during five weeks of occasional wearing or will protect wearer until laundry is necessary when worn daily. The treatment withstands sun, rain, walking in wet grass, and excessive sweating. Impregnated uniforms are still effective after being worn in swiftly running fresh water for fifteen minutes or in the ocean for thirty minutes. Hard scrubbing with soap and cold water or laundering in hot water removes the dimethyl

phthalate. Treated blankets will remain effective for two months if unlaundered. Details are given in Appendix VI.

(2) **Warning.** Repellent impregnated clothing, and DDT should not be used together. The DDT which is insoluble in water is dissolved in the repellent and toxic absorption may occur. Each alone is safe.

c. *Preparation of bivouac site in area where mite-borne typhus is prevalent.* Locations which are to be used as new camp sites should be prepared as fully as possible before the arrival of a new unit. Native labor should be employed whenever it is available. All grass and scrub should be cut level with the ground and, after drying, collected and burned or hauled away. It is desirable to burn over the camp area with a power oil sprayer or flame thrower. Underbrush in adjacent jungle strips should be cleared out in a similar manner.

SECTION V

Diseases of Potential Military Importance

1. Filariasis is transmitted by mosquitoes. In the South Pacific Area this mosquito is the same one which is the chief vector of malaria. In other areas filariasis is transmitted by the domestic type of mosquito, one of which has been described in the transmission of dengue. In any event, measures against these two types of mosquitoes (the field mosquito and the domestic mosquito) will be equally effective against filariasis.

2. Japanese B encephalitis. Little is known about this disease. It is probably transmitted by *Culex pipiens*, a house or domestic type of mosquito with breeding habits not unlike those described for *Aedes aegypti*, the vector of dengue. Similar control measures are indicated.

3. Fly-borne diseases include the dysenteries and are most common during combat operations. During this period fly control measures will be undertaken by special spray teams. See Appendix V, "Example of Standard Operating Procedure".

4. Flea-borne typhus, flea transmitted plague, and louse-borne typhus are of only potential importance and are not discussed.

APPENDIX I

An Organization for the Military Control of Malaria and Insect Borne Diseases in all Army Units

1. Definition.

Insect-borne diseases of present or potential military importance in the Pacific Ocean Areas are transmitted by mosquitoes, mites, flies, fleas and lice. Those of present importance are *italicized*.

a. Mosquito transmitted diseases include *malaria*, *dengue fever*, *filariasis*, and *Japanese B encephalitis*.

b. Mites transmit *mite-borne typhus*.

c. Fly-borne diseases include the *dysenteries*.

d. Fleas transmit plague and flea-borne typhus.

e. Lice transmit louse-borne typhus.

2. Responsibility for control of insect-borne diseases.

It is the responsibility of all commanders to initiate and enforce the necessary measures to control insect-borne diseases within their units and unit areas. The commander or his representative will make inspections to assure the enforcement of insect-borne disease control in his unit with particular emphasis on the use of individual protective measures. The commander is charged with the timely requisitioning of insect control supplies. The Army Corps of Engineers will be responsible for the ex-

ecution of insect control work on real property. The Army Air Forces will be responsible for application of DDT solutions by airplane to control mosquitoes and flies. See paragraph 5d (4), below.

3. Insect and rodent control details.

a. All units will form in each company, battery, squadron, or similar unit an insect and rodent control detail to consist of one noncommissioned officer and two enlisted men per infantry company or a proportionate number for other units and detachments. In non-medical units these details will be made up of non-medical personnel. Additional working parties as may be required for effective mosquito and rodent control will be assigned to aid these details. This personnel will be given immediate training as detailed in Appendix II, "A Training Program in Military Control of Insect-Borne Diseases," to qualify them to perform duties listed in subparagraph b, below.

b. It will be the primary duty of these insect control details to maintain insect control within the camp and in surrounding territory for a distance of one mile. Where overlapping occurs between units the commanding officers of these units will decide jointly on the area to be controlled by each group. These details will prepare a map showing all water collections and places of mosquito breeding in the area to be covered. In the preparation of this map they will be aided by the base or division malaria and insect control group. The following types of insect and rodent work will be carried on:

- (1) Spray killing of adult mosquitoes including the use of DDT residual effect sprays.
- (2) Larvicidal work directed against mosquitoes, flies, and mites.
- (3) Clearing of stream banks to facilitate larviciding, minor ditching and filling, and destruction of artificial breeding places around camps and dumps.
- (4) Minor maintenance repairs of screening.

- (5) To assist where necessary in the control of rodents bearing harmful insects and disease.

4. Malaria and insect disease control officers of units smaller than divisions.

Unit commanders of all units smaller than divisions will designate an officer, preferably a medical officer as insect-borne disease control officer. This officer will be responsible for a program of instruction in *individual protective measures* and for the training and work of the insect and rodent control details. He will maintain liaison with the base or division malaria and insect control group. He will render to his commander a monthly report, prior to the third day of the next succeeding month with an information copy to the base surgeon, covering the subjects listed in subparagraph 5g, below, but omitting subheadings (4), (5), (7), and (10).

5. Division and base malaria and insect control groups.

Special purpose Medical Department personnel will be attached to divisions and, as they become available, to base sections (operating in the Pacific Ocean Areas west of the 150th degree east longitude or in the South Pacific Base Command,) as follows:

a. Divisions:

One (1) Malariologist, MC, MOS 3138.

One (1) Malaria Survey Detachment T/O & E 8-500.

One (1) Malaria Control Detachment T/O & E 8-500.

This attached personnel constitutes a basic malaria and insect control group and will accompany the division in combat and in rehabilitation. They will assist in the control of insect-borne diseases under combat conditions as well as during the garrison phase. This personnel is in addition to present medical department personnel of a division and does not affect existing tables of organization or position vacancies.

b. Base or garrison forces, other than divisions.

- (1) For approximately every 20,000 garrison troops.

One (1) Malariologist, MC, MOS 3138.

One (1) Malaria Survey Detachment T/O & E 8-500.

- (2) For approximately every 7,500 garrison troops.

One (1) Malaria Control Detachment T/O & E 8-500. One control detachment should be provided for each important post or station.

c. These groups contain officers and enlisted men trained in preventive medicine, entomology, parasitology, and sanitary engineering. They will work under the immediate direction of the base or division malaria and insect control officer (malariologist) who will be responsible through the surgeon to the base or division commander for the prevention and control of insect-borne diseases.

d. The duties of the malariologist, assisted by this personnel, will include:

- (1) Participation in the training program for military control of insect-borne diseases (See Appendix II).
- (2) Provision of estimates of the insect-borne disease problem in base and division areas and also in areas of anticipated operations with recommendations for control.
- (3) Provision of specialized services such as mosquito surveys, laboratory diagnostic service, power sprayer work, and all other measures within the scope of the personnel and equipment of these groups.
- (4) Technical assistance to and integration and supervision of the work directed against disease carrying insects by the following personnel:

Army Engineer Corps.

Army Air Forces.

Insect control details from each company or similar unit.

Medical Sanitary Company.

Native labor.

- (5) Preparation of requisitions for insect control supplies.

e. One or two additional Malaria Survey or Control Detachments may be temporarily attached to a division for the period of operation when in the opinion of the Commanding General, Pacific Ocean Areas, such a measure is indicated.

f. *Relation of base and division malaria and insect control groups.* During periods of assault, base malaria and insect control groups assigned to garrison forces will render all possible assistance to division groups. After a base has been secured or when a division is stationed at a base where there is an established base malaria and insect control group, the activities of the division group will be coordinated with those of other groups by the base malaria and insect control officer (malariologist).

g. Monthly and interim reports and recommendations of the base or division malaria and insect control officers will be submitted to the base or division commander through the base or division surgeon. The monthly report will cover the following subjects:

- (1) Estimation of the insect-borne disease situation with a statistical report and analysis of malaria, dengue fever, mite-borne typhus, or other insect-borne disease in the division or base.
- (2) Status of discipline with regard to individual protection against insects.
- (3) Status of atabrine suppressive therapy (when given) including number and history of troops released from suppression.
- (4) Summary of entomologist's report on mosquito, mite and fly populations, rainfall and other pertinent data.

- (5) Summary of sanitary engineer's report (malaria control detachment).
- (6) Activities of training program for military control of insect-borne diseases.
- (7) Estimation of native populations as a seed bed of malaria, dengue, filariasis, and other insect-borne diseases.
- (8) Selection of camp sites and related problems.
- (9) Status of insect control supplies.
- (10) Report of investigative work and special problems.
- (11) Personnel engaged primarily in malaria and insect control.
- (12) Recommendations.

The December report will include in addition to the data required for the monthly report, a resume of the insect-borne disease situation during the year. A copy of these monthly reports will be sent in duplicate through command channels to HUSAFPOA. Commanders will indorse these reports indicating action taken or contemplated on recommendations.

h. No duties that interfere with primary insect control duties shall be assigned to members of insect and rodent control details or to personnel of base or division malaria and insect control groups. Transportation and all other authorized equipment assigned to medical composite units (malaria control and survey) and to medical sanitary companies will not be diverted for other uses without approval by the commander of the force to which assigned.

6. Direct communication on technical matters between malariologists, scientific commissions, and the Surgeon, Headquarters, United States Army Forces, Pacific Ocean Area, is authorized.

A Training Program in Military Control of Insect-Borne Diseases

1. Unit commanders will allot in the training schedules sufficient time for the proper instruction of their troops in the prevention of insect-borne diseases.

2. Instruction for all personnel.

Lectures will be given to small groups of men by their respective medical officers on malaria, dengue fever, and mite-borne typhus. Other insect-borne diseases will be included as indicated. All personnel will be given initial instruction in these matters as soon as practicable. Subsequently, a review of the subject will be carried out once a month. On maneuvers the use of individual protective measures will be standard procedure. These lectures will cover:

a. Military importance of these diseases.

b. Nature of these diseases, how transmitted, and their effects.

c. Individual protective measures against mosquitoes with emphasis on conditions under which each is applicable:

(1) Repellents.

(2) Use of ordinary clothing for protection.

(3) Bed nets.

(4) Spray killing of adult mosquitoes.

(5) Avoidance of unnecessary exposure.

(6) Atabrine suppressive therapy.

d. Individual protective measures against mite bites.

(1) Impregnation of clothes and blankets with dimethyl phthalate.

(2) Preparation of bivouac area.

(3) Avoidance of mites.

e. Control of mosquito breeding.

f. Man-made malaria. How to avoid it.

Additional instruction will be given to officers emphasizing command responsibility for selection of camp sites, for segregation of natives, and for the enforcement of individual protective measures. Members of base and division malaria and insect control groups will assist.

3. School for insect and rodent control details.

a. A school to be conducted by the base and division malaria and insect control groups will be held for insect control officers and the members of insect and rodent control details from each company or similar unit. This school will usually occupy three days and the following subjects will be taught:

- (1) Identification of Anopheline ("Malaria") and *Aedes aegypti* ("Dengue") larvae and adult mosquitoes and characteristic breeding places.
- (2) Use of maps to mark breeding places.
- (3) Control of mosquito breeding by minor draining and filling, by spraying with larvicides, and by emptying or destroying artificial water containers.
- (4) Use of DDT residual sprays to impregnate bed nets and to spray quarters.
- (5) Assembly and repair of knapsack and continuous hand sprayers.
- (6) Impregnation of clothes with dimethyl phthalate to prevent mite bites.
- (7) Control of rodents by trapping and poisoning.
- (8) Fly control by the use of sodium arsenite spray and other measures.

4. A Mobile training center in military control of insect-borne diseases.

a. Training centers in military control of insect-borne diseases and other aspects of preventive medicine will be set up from time to time by this headquarters at the chief staging bases, preferably in conjunction with general hospitals or field training centers. The hospitals or field training centers will provide teaching facilities, and when necessary, quar-

ters and rations for faculty and students of these schools. The following officers of all units will attend a one to two week course at a time to be designated by this headquarters.

- (1) Medical Inspectors of divisions and higher echelons.
- (2) Malaria and insect control officers (malariaologists).
- (3) Regimental and battalion surgeons as designated by division surgeons.
- (4) Parasitologists, entomologists and sanitary engineers as designated by base or Army surgeons.

The faculties will be under the supervision of the Surgeon, Headquarters, United States Army Forces, Pacific Ocean Areas, and will consist of malariaologists, survey units, control units, and other personnel with experience in the prevention of tropical disease, as may be available to the base commands. Additional personnel within base commands or Army garrison forces may be placed on detached service with the training center for limited periods, as may be required.

The curriculum will consist of lectures, *field work*, war rounds, and laboratory work.

5. To aid in this program base and division malaria and insect control groups (or base and division surgeons) will issue the following training manuals.

- a. All officers.

Preventive Medicine Manual No. 2, "Military control of malaria and insect-borne diseases."

- b. Enlisted men.

Preventive Medicine Manual No. 3, "Mosquitoes, Mites, and Men."

Additional training aids such as appropriate training films, literature, posters, and material will be available at base and division malaria and insect disease control headquarters.

APPENDIX III

Supplies

The following antimalaria supplies per 1000 men per month (30 days) are authorized (Circular No. 151, WD, 1944, as amended). It is recommended that preparatory to entering a malarious area, a ninety (90) day supply be obtained. Every effort should be made to secure the items listed on the following pages before leaving rear bases for undeveloped areas, depending on availability of supplies and shipping. These supplies should always be shipped in divided lots so that the loss of any one shipment will not disrupt the program.

REQUISITION FROM MEDICAL SUPPLY

Item No.	Article	Unit	Supply per 1000 men/mo	Remarks
1084500	Atabrine 100 tablets 1-½ gr. (Quinacrine HCL, USP)	btl	400 Units	
108440	Atabrine, 5 amps, 0.2 gm, with 10 cc sterile distilled water. (Quinacrine HCL)	box	4 Units	
1391000	Quinine sulphate, 1000 tablets; USP; 5 gr.	btl	3 Units	
1389000	Quinine dihydrochloride, 12 amps; NF; 1 cc amp containing 5 gr solution	box	1-½ Units	

REQUISITION FROM QUARTERMASTER

Item No.	Article	Unit	Supply per 1000 men/mo	Remarks
27-B-343	Bar, insect, field	ea	83	Note 1
41-D-3750	Duster, insect powder, plunger type	ea	5	Note 2
51-I-159	Insecticide, aerosol, 1 lb dispenser	ea	300	Note 3 Hawaiian Dept Supply 7 1/2/1000 men per month.
		ea		1 per 10 airplanes to be disinfected by Army Air Forces.
51-I-305	Insecticide, spray, DDT Residual effect	gal	60	
51-I-169	Insecticide, liquid, fin- ished spray	gal	8	For use other than mos- quito control.
51-L-122	Larvicide, DDT, powder, dusting	lb	50	Note 3 Hawaiian Dept Supply 5/1000 men per month.
51-I-173	Insecticide, powder, louse, 2 oz can	ea	150	Note 3 Hawaiian Dept Supply 25/1000 men per month.
51-L-120	Larvicide, DDT, powder, dissolving	lb	200	
51-R-265	Repellent, insect, 2 oz btl.	btl	3000	Note 3 Hawaiian Dept Supply 350/1000 men per month (normally requir- ed May to Oct inclusive)
51-R-300	Repellent, insect, spray clothing	Gal	40	Note 3

REQUISITION FROM QUARTERMASTER (Continued)

41-S-4110 to 12	Sprayer, liquid, insect, pump type	ea	15	Note 2 & 3 Hawaiian Dept Supply 10/1000 men per month.
41-S-4106	Sprayer, liquid, insect, continuous spray	ea		2 per cafeteria mess or theater building.
7-O-200	Oil, fuel, oil burner, grade FS2	gal	150	Note 3 Hawaiian Dept Supply 10/1000 men per month.

REQUISITION FROM ARMY ENGINEER CORPS

Item No.	Article	Unit	Supply per 1000 men/mo	Remarks
41-7839.7-7	Paris green, standard lar- vicide	lb	40	
41-3115.5-10	Duster, insect, hand ro- tary blower type Spare parts for above duster	ea set	3 3	Note 2 & 3
41-7839.5-5	Sprayers, insect, knapsack type, 3 gal capacity	ea	10	Note 2 & 3 Hawaiian Dept Supply 1/1000 men per month.
	Sprayers, insect, knapsack type, spare parts	set	10	Note 2 & 3 Hawaiian Department of Supply 1/1000 men per month.

REQUISITION FROM ARMY ENGINEER CORPS (Continued)

40-9030.6-3	Sprayer, insect, portable, gasoline, engine driven for larvicide with four 50 ft lengths of $\frac{3}{8}$ inch oil resistant hose and spray nozzle	set	$\frac{1}{2}$	Note 2 & 3
	Parts, spare for above	set	$\frac{1}{2}$	Note 2 & 3
	*Screening, cloth-bobbinette, 18-20 mesh, bar 3 ft wide	ft	16,000 lin. ft	Note 2
	*Screening, cloth-bobbinette, 18-20 mesh, bar 3 ft wide	ft	4,000 lin. ft	Note 1
	*Screen, wire, heavy grade, 16 meshes to inch			Note 4
	*Screen, standard grade, 18 meshes to inch			Note 4
	*Saran-plastic screening (Dow Chemical Co.)			Note 4

*Allowances for screening are not available. These recommendations are based on plans to screen nearly all tents. Enough to screen field hospitals, caring for malaria and dengue patients should come ashore with hospital units, to be followed as soon as possible by screen for kitchens, mess halls, offices, latrines, and later all tents, in that order of priority. Cloth bobbinette is preferred to wire for field use. Wire or plastic screening is preferred whenever wooden mess halls, or other stable semi-permanent buildings are to be screened.

Note 1: Replacement factor per 1000 men per month, applies to Army Ground Forces only.

Note 2: Initial supply only.

Note 3: Except Hawaiian Department

Note 4: May be issued in lieu of cloth bobbinette when use of permanent buildings is anticipated. Replacement rate should be half that of cloth screening.

APPENDIX IV

Supplies for Insect and Rodent Control Details

The following equipment should be available to the insect and rodent control details of each battalion from the T/BA equipment of the unit. Smaller units should have similar equipment in amount proportional to their strength. Items not included in unit T/BA's should be requisitioned as indicated below (Initial issue). A motor vehicle is needed for use in bivouac area to haul oil and other supplies, labor details, etc.

Item No.	Article	Unit	Amount
Engineer Equipment			
	Compass	ea	1
74-70005-22	Machetes, w/scabbard	ea	8
	Paper, overlay or tracing, for maps	Roll	1
41-3780.43-02	Funnel, iron, galvanized, plain, 2 qt	ea	4
Quartermaster equipment			
	Spigot, (valve, molasses) with approximately 2 $\frac{3}{8}$ inch male thread connection to fit bung of 55 gal drum	ea	4
41-A-1277	Axe, single bit, w/handle	ea	3
70-H-1180	Brush hook, w/handle	ea	2
	Note book, field	ea	6
41-M-720	Mattocks, w/handles	ea	5
41-S-3170	Shovel, D-handles, round No. 2	ea	3
41-S-3220	Shovel, long handle, round point, No. 2	ea	3
Medical supplies			
Class 7			
7263000	Dipper, 1 pt	ea	3

Example of Standing Operating Procedure

This S.O.P. is merely a sample plan adapted to and used during one operation. All such plans should be flexible. Several general plans should be prepared by each division malaria and insect control group. The exact plan and details will be determined by current requirements of the particular military situation.

Standing Operating Procedure For Control of Malaria and Other Insect- Borne Diseases During X Operation

1. Statement of Problem.

"X" operation will take place in an area where malaria is the fourth cause of death, where dengue fever is prevalent, and where mite-borne typhus and fly-borne intestinal diseases are potent hazards. A native population which averages over 500 per square mile is a seed bed of disease.

2. Mounting Phase.

a. All personnel will again be trained in individual measures to protect against mosquito and mite bites. Officers will review the importance of campsite selection to avoid proximity to infected natives and to breeding places of disease carrying insects.

b. Suppressives atabrine will be given to all personnel as outlined in TB Med 65, 3 July 1944, beginning three weeks before D day.

c. Bed nets of all personnel will be sprayed with a five (5) per cent solution of DDT in kerosene as outlined in Appendix VI.

d. Each man will be provided with two uniforms and one blanket impregnated with dimethyl-phthalate as outlined in TB Med 121, Dec. 1944, (see Appendix VI). Measures in this and preceding subparagraph will be carried out as short a time before embarkation as possible.

e. Each organization will be issued thirty days supply of the following items which will be conspicuously marked and carried with the organization so as to be readily available:

Sprayer, oil knapsack type	1 per 100 men
Diesel oil No. 2, 55 gallon drum	1 per sprayer, oil knapsack type
Repellent, 2 oz bottles	300 per 100 men
Atabrine tablets 0.1 Gm.	4000 per 100 men
Insecticide, freon-aerosol 1 lb dispenser	30 per 100 men

A further sixty day supply of insect control items should be shipped in divided lots so that the loss of any one shipment will not disrupt the program. (See Appendix III, Insect Control Manual No. 2).

Each individual will be provided with:

Bar, mosquito or hammock, jungle, complete	1
Repellent insect, 2 oz. bottle	2
Atabrine tablets, 0.1 Gm.	30

3. Combat Phase.

a. Anti-mosquito measures will be carried out by airplanes and temporary spray teams as outlined in paragraph 5, against both "malaria" and "Dengue" mosquitoes. The application of DDT solution to native dwellings will be emphasized. This method is of value because most mosquitoes become infected by biting diseased natives and then rest in or near the

buildings where the blood meal is obtained. A single spraying of such buildings with DDT not only will kill all mosquitoes in the building but will continue to kill mosquitoes as they come in contact with treated walls for several months.

b. Fly control will be done when feasible by hand spraying of dead bodies and by proper care of garbage dumps and human waste.

c. The malariologist, with the entomologist and parasitologist, will provide the surgeon with a mosquito survey and an estimate of the malaria and dengue hazard as rapidly as feasible after D day, with subsequent estimates as determined by current conditions and needs.

4. The personnel to carry out malaria and epidemic control work during "X" operation is as follows:

a. Division malaria and insect control group (attached medical department personnel).

4 officers.

22 enlisted men.

b. Pilots of L4B cub airplanes.

2 pilots.

c. Troop unit insect and rodent control details.

Enlisted men: Insect and rodent control details of three enlisted men, including one NCO, from each of the 75 companies, batteries, or similar units in the division.

5. Four temporary spray teams, chart I, will be drawn from the above personnel for the period of "X" operation as follows:

a. *Division headquarters spray team.*

(1) Personnel

4 officers.

1 malariologist from attached division malaria and insect control group.

1 entomologist from attached division malaria and insect control group.

2 pilots L4B cub airplanes.

21 enlisted men.

10 technicians from attached division malaria and insect control group.

11 men drawn from insect and rodent control details of division Hq. Co., Signal Co., QM Co., Ord. Co., and similar units.

(2) This spray team will be attached to division headquarters company for period of operation.

b. Temporary spray team attached to each regiment.

(1) Personnel of each spray team will comprise:

1 officer.*

24 enlisted men.

4 technicians from attached division insect control group.

20 men: 1 from each insect and rodent control detail in the regiment. The remaining men of each insect and rodent control detail will remain with their companies.

(2) Each regimental spray team will be quartered with its regimental headquarters company for the period of "X" operation.

c. Duties of these spray teams.

In amphibious operations these spray teams will go ashore with the headquarters to which they are attached and begin antimalaria and insect control work when the beachhead is about one mile deep. It will often be necessary to arm some of the men in the spray teams to protect the remainder against snipers. Each team will carry out the following measures in the rear of combat lines.

* The engineer and parasitologist will each be attached to a regiment for the operation. The division sanitary officer or other officer designated by the division surgeon will be attached to the third regiment.

(1) Spraying of dwellings and other temporary mosquito control measures in area of headquarters, medical facilities, supply stations and along communication lines. Fly control measures will be carried out when feasible.

(2) Initial survey and map work.

(3) The division headquarters spray team will have additional duties:

(a) General supervision of malaria and insect control program.

(b) Relocation of insect control personnel and supplies as necessary to meet changing conditions.

(c) Airplane spraying.

d. Equipment of these spray teams.

(1) Every man will be equipped with a sprayer for DDT solution. Technicians from division malaria and insect control groups will carry a dipper for sampling larvae populations and preliminary spot maps. All other men will carry a one pound aerosol dispenser. Each spray team will be equipped with a power sprayer.

6. Insect and Rodent Control Details — Each Company or Battery.

These details are temporarily reduced in size; one man being drawn from each detail to form the temporary spray team (See paragraph 3). It is rarely feasible to do antimosquito work in frontline combat. These smaller insect and rodent control details will work as directed by the unit insect control officer (usually the battalion surgeon) and will aid in the distribution of repellent and other antimalaria supplies to the front lines. Spraying and other antimosquito work will be done when practicable.

7. A rear echelon insect control group will be formed, if indicated, by one NCO technician from division

insect control group and by insect and rodent control details in rear echelon. This group will continue larviciding and other control work in rear echelon area.

8. Procedure:

Exact procedures will depend on local conditions, the speed of the operation, and the relative importance of malaria, dengue, and of fly-borne diseases. In rear areas emphasis probably will be on larviciding, which is worthwhile in territory to be occupied for two weeks or more and of decreasing value as time of occupancy is shortened. Emphasis in more forward areas probably will be on spray killing of adult mosquitoes and larviciding will be of secondary importance. The need for flexibility in this malaria and insect control program is apparent.

a. The malariologist will supervise the entire insect control program and will be particularly concerned that personnel and supplies are allocated according to changing needs.

b. The entomologist will be directly in charge of spraying and other control work in territory assigned to division headquarters spray team. He will be responsible for initial survey and map work in the entire area of operation.

c. The airplane pilots will work under the direction of the malariologist. They will begin airplane spraying as soon as it is feasible for airplanes attached to the artillery regiment to operate.

d. The temporary spray teams are formed for the period of active operation only. As soon as conditions become stabilized and when designated by the division malariologist this personnel will return to routine control measures. The engineer will then resume his normal duties to supervise control activities in the entire division area, the other officers will resume their usual work, and the enlisted personnel will return to their company insect and rodent control details.

9. Shipping and supplies.

a. Each spray team will take one power sprayer, one additional vehicle, adequate hand sprayers for all personnel, one weeks supply of DDT solution prepared in advance, and three weeks supply of DDT powder, dissolving, and other necessary supplies. Deck loading of these supplies will be arranged.

b. The division headquarters malaria and insect control group will be responsible for shipment of additional DDT, the remaining vehicles, one or more power sprayers, and all other equipment. This group will be responsible to have a detail to assist in storing and distribution of insect control supplies when is necessary.

c. Supplies will go in divided shipments. Check list of insect control supplies is given in Appendix III and IV, Preventive Medicine Manual No. 2.

d. The L4B cub airplanes will be shipped with other planes of division artillery observation group.

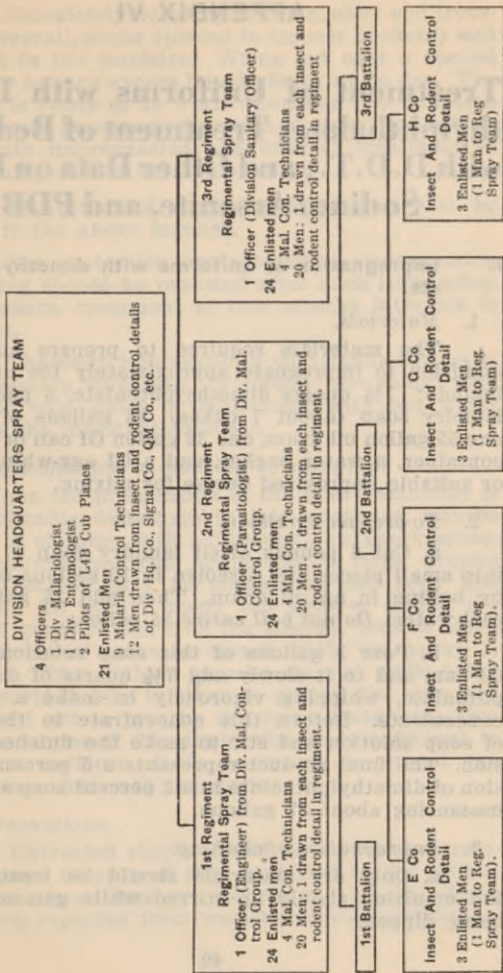
10. No duties that interfere with their malaria and insect control functions will be assigned to the above personnel.

11. Individual protective measures against mosquito-borne diseases and mite-borne typhus will be carried out by all division personnel as directed in memorandum . . . this headquarters.

12. Regimental commanders will immediately forward to this headquarters a roster of enlisted men who are assigned to temporary spray teams.

CHART I

TEMPORARY ORGANIZATION OF DIVISION INSECT CONTROL PERSONNEL INTO FOUR SPRAY TEAMS FOR "X" OPERATION



APPENDIX VI

Treatment of Uniforms with Dimethylphthalate; Treatment of Bed Nets with D.D.T.; and Other Data on DDT, Sodium Arsenite, and PDB

I. Impregnation of uniforms with dimethylphthalate.

1. *Materials.*

The materials required to prepare sufficient emulsion to impregnate approximately 100 uniforms include: 7½ quarts dimethylphthalate, 6 pounds GI laundry soap (about 7 cakes), 35 gallons of water, one 55 gallon oil drum, one 32 gallon GI can or similar container, a water bucket, and a GI egg-whip (wire) or suitable improvised device for mixing.

2. *To prepare emulsion.*

a. Cut 6 pounds of GI laundry soap (7 cakes) into small pieces and dissolve in 10 gallons of water by boiling in an oil drum. Then add 25 gallons of cool water. *Do not boil entire 35 gallons.*

b. Pour 3 gallons of this soap solution into a GI can, and to it slowly add 7½ quarts of dimethylphthalate, whipping vigorously to make a creamy concentrate. Return this concentrate to the drum of soap solution and stir to make the finished emulsion. The final product represents a 5 percent emulsion of dimethylphthalate in a 2 percent soap solution, measuring about 37 gallons.

3. *Impregnation of clothing.*

a. Only dry materials should be treated and the emulsion should be stirred while garments are being dipped.

b. Completely immerse clothing, shirt and trousers or coverall, socks (placed in trouser pockets) and leggings, in the emulsion. Wring out over a second container to save excess liquid. Hang up to dry. The clothing is ready to be worn when dry. To facilitate inspection of personnel, a system of marking clothing to indicate impregnation and date of treatment of the clothing should be employed.

c. Blankets and mosquito bars may also be treated in the above manner.

d. For protection against mites, impregnation of clothing should be repeated after each laundering. For blankets, treatment at two months intervals is sufficient.

e. Thorough impregnation withstands sun, rain, and excessive sweating. Vigorous scrubbing with soap and cold water or laundering with hot water removes the dimethylphthalate.

4. *Impregnation of clothing by spraying.*

When the preparation of the above emulsion is not practicable, dimethylphthalate, undiluted, may be applied to clothing with a "flit-gun", knapsack sprayer, or paint-spray gun, delivering a large droplet spray. Clothing may be treated off the body and buttoned. To apply, insert the sprayer inside the reversed garment and hold the sleeves, neck of shirt, and bottoms of trousers closed while the spray is delivered. The clothing may be sprayed while being worn, provided care is taken to protect the eyes and mouth and not to breathe the spray materials. Two to three ounces of dimethylphthalate is sufficient to treat one uniform. It is necessary to repeat the application after each laundering.

5. *Precautions.*

a. Untreated shorts should be worn under treated uniforms to prevent skin irritation in the groins. No other precautions are necessary. No ill effects have been reported from wearing treated clothing.

b. It should be emphasized that clothing impregnated with dimethylphthalate does not protect exposed body surfaces from insect bites. For protection of these areas, application of repellent to the skin must supplement the use of impregnated clothing. The standard two ounce bottle of insect repellent (QM Item 51-R-265) should be employed for this purpose.

II. Treatment of bed nets with DDT.

1. Materials.

The materials required to impregnate approximately 100 bed nets with DDT include:

5 percent DDT in kerosene	14 gallons
Power sprayer	1
or hand sprayers (knapsack type or C. W. decontamination type)	3

QM Item 51-I-305 Insecticide, spray, DDT, residual effect is a 5% solution of DDT in kerosene, or this solution may be prepared by dissolving 6 lbs of 51-L-120 Larvicide, DDT, powder, dissolving in 14 gallons of kerosene. DDT goes into solution slowly and all solutions should be prepared 1 to 3 days in advance of use. Solution is aided by agitation and by placing kerosene in warm sun.

2. Procedure.

a. The bed nets should be arranged in piles. Spray the top net on one side, reverse it to start a new pile and then spray it on the other side. Hang nets in the sun to dry.

b. Six to eight men are able to spray 150 to 200 nets per hour with a power driven sprayer with two outlets, and half this number of nets with hand sprayers.

c. Mosquitoes which come in contact with a treated bed net cease to attempt to bite after a few minutes and die after an hour or more. The duration of this residual effect is still to be determined. Washing or exposure to heavy rain removes the DDT from

the bed net. Present information is that under normal conditions bed nets should be retreated every 3 months. Large scale impregnation may be done by Chemical Warfare Processing Companies.

III. Technical data on DDT.

1. DDT is usually dissolved in diesel oil No. 2 or kerosene. The amount of DDT used depends upon the skill of labor, the type of equipment available, and on other local conditions. DDT is so effective when applied by airplane sprayer that only 2 quarts per acre of a 5 per cent solution are needed. Other equipment is less effective. Table II shows that ordinary labor applies an average minimum of 2 gallons per acre of water surface with a "flit gun" type sprayer and 6 gallons per acre of water surface with a knapsack sprayer. This table also shows the recommended maximum and minimum concentrations of DDT for various types of equipment. Quartermaster Corps item (51-L-120) Larvicide, DDT, powder, dissolving, is used in these solutions.

TABLE II
RECOMMENDED CONCENTRATION OF DDT
RELATED TO OUTPUT OF EQUIPMENT

<i>Equipment</i>	<i>Average Output Gal/acre #</i>	<i>Recommended Concentration</i>			
		<i>Maximum</i>		<i>Minimum</i>	
		<i>per cent</i>	<i>Lbs per acre DDT</i>	<i>per cent</i>	<i>Lbs per acre DDT</i>
Knapsack or C. W. Decontamination Sprayer	6.0	2.5	1.2	1.0	0.48
"Flit gun" type Sprayer	2.0	5.0	0.8	2.5	0.4
Airplane	0.5	10.0	0.4	5.0	0.2

Acre of water surface.

Unskilled oiling crews use larger amounts of spray and should be given DDT solutions which approach the minimum. They use smaller amounts of spray as they become more skilled and may then be given more concentrated solutions.

2. *Preparation of DDT Solutions.*

Table III shows the amount of DDT to be used in obtaining approximate concentrations.

TABLE III
PREPARATIONS OF VARIOUS DDT
CONCENTRATIONS

<i>Desired Solution Per-cent</i>	<i>Number Lbs Larvicide DDT, Powder Dissolving</i>	<i>Number Gallons Diesel Oil or Kerosene</i>
5	2	5
5	20	50
2.5	10	50
1.0	5	50

Measuring equipment is often scarce in the forward areas and the following approximations may be helpful. A number 10 food can filled to $\frac{2}{3}$ of its top is the equivalent of 2 lbs of DDT. DDT is usually supplied in 10 lb cans. Diesel oil No. 2 and kerosene are usually in 55 gallon drums from which about 5 gallons may be removed before adding the DDT. Solutions should be prepared a minimum of 24 hours and preferably several days in advance of use to facilitate dissolving. Rolling of barrels in the sun or agitation with mechanical equipment aids in preparing solutions. Agitation can be obtained by blowing air through a solution with an air compressor. It should be emphasized that only Larvicide, DDT, powder, dissolving is used for making oil solutions.

3. *The choice of diesel oil No. 2 or kerosene.*

Diesel oil No. 2 is used in solutions for killing mosquito larvae and against adult mosquitoes and flies in the open. Kerosene does not leave a sticky film of oil and is preferable for spraying bed nets, tents, and dwellings for residual effect.

4. *DDT for insect and larvicidal dusting.*

Quartermaster item (51-L-122) Larvicide, DDT, powder, dusting is a 10 per cent DDT powder. It may be used in the field undiluted but is usually diluted with 4 parts of waste flour, road dust, or other diluent to make a 2 per cent dust. Mixing should be carefully and thoroughly done. A home made mechanical mixer is easily improvised. The nearest malaria control unit will usually be set up to provide ready mixed dust when this is indicated. Larvicide, DDT, powder, dusting is not suitable for making oil solutions.

5. *DDT louse powder for dusting individuals and bedding.*

DDT louse powder is supplied as Quartermaster item (51-I-173) Insecticide, powder, louse, 2 ounce can. It is also supplied in bulk for mass treatment of a louse infested population. Individual treatment is accomplished by rubbing about $\frac{1}{2}$ ounce of louse powder into the seams of underwear and outer clothing and then dusting the bedding. Mass treatment is done with a small plunger type duster as follows:

a. Dust the hat and replace it on the head.

b. With arms extended pump the dust between the skin and inner garments, then between all layers of clothing.

c. Insert the pump behind the neck and spray powder between all layers of clothing.

d. Unbutton the shirt and other clothing down to the skin. Blow powder to right and left toward the armpits and then dust the center portion of the chest.

e. Loosen the trousers at the waist, insert the duster to contact the skin and then spray into the seams and crotch. Do this to both front and back of trousers.

Approximately $1\frac{1}{2}$ ounce of Insecticide, powder, louse is required per individual by this procedure. A team of 2 men can dust 35 to 40 individuals and their

bedding per hour if the individual after being sprayed helps with his own bedding. Treated clothes must be worn for one week in order to kill all lice and those which will hatch out. Otherwise the dusting must be repeated after one week.

6. *Warning.*

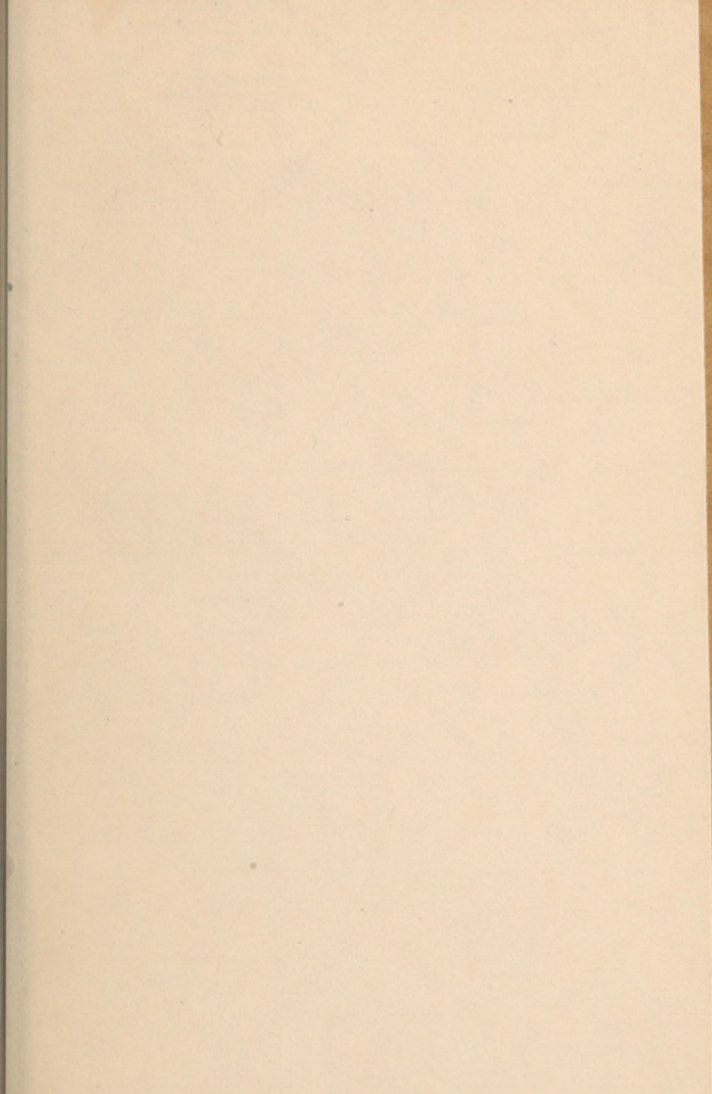
Repellent impregnated clothing and DDT should not be used together. The DDT which is insoluble in water is dissolved in the repellent and toxic absorption may occur. Each alone is safe.

IV. Use of sodium arsenate for fly control during combat.

A 1½ per cent solution of sodium arsenite is an effective temporary expedient for fly control when properly applied to dead bodies, to unburned garbage, to damaged latrines and to other sources of fly breeding. Sodium arsenite is supplied in a 54 per cent solution (Penite). This concentrated solution is a dangerous poison and should be handled with care. One part of this solution is mixed with 40 parts of fresh or salt water to make the finished spray (approximately 1½ per cent). A total of 1 to 1½ quarts of this dilute solution is sprayed evenly over the entire surface of each dead body and on the ground beneath. The solution should also be sprayed on damaged rations and on the ground of pill boxes that have contained dead bodies. Only trained personnel should be assigned to this work. Rubber gloves should be worn by those working with these solutions. Spraying should be done from the windward side.

V. Paradichlorobenzene (PDB) for fly control in covered latrines.

Paradichlorobenzene is effective by virtue of a vapor of gas which is deadly to flies and maggots. It is most efficient in tightly closed latrine boxes. Three (3) pounds of paradichlorobenzene per 8 hole latrine should be evenly scattered on the feces twice a week. Further details are available in Circular No. 42, HUSAFPOA, 1944.





PRESSBOARD
PAMPHLET BINDER

Manufactured by
GAYLORD BROS. Inc.
Syracuse, N. Y.
Stockton, Calif.

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