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CENTER FOR DISEASE CONTROL

MALARIA

SURVEILLANCE

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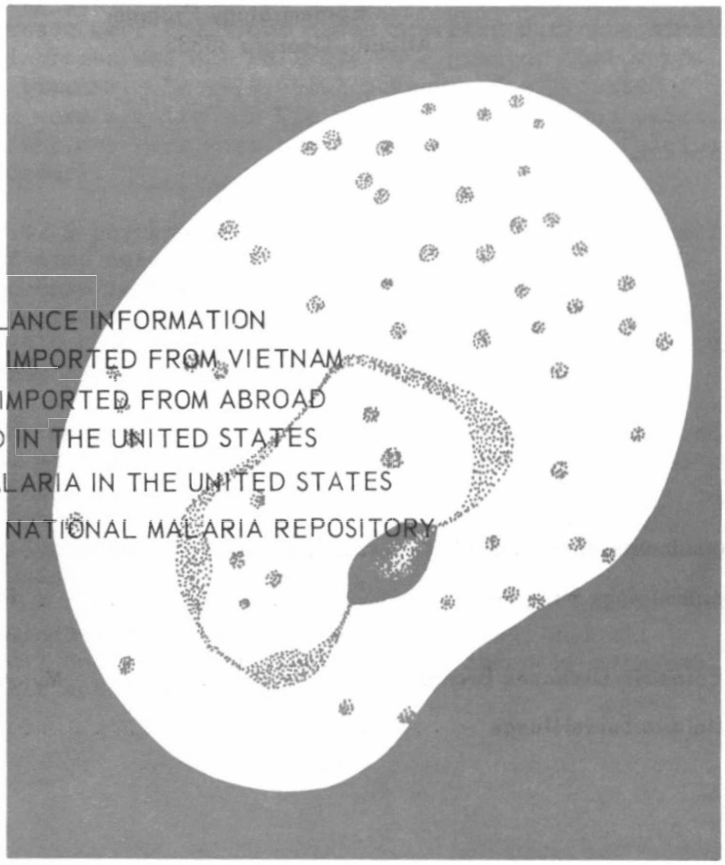

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PUBLIC HEALTH SERVICE
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CENTER FOR DISEASE CONTROL
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PREFACE

This report summarizes information received from State Health Departments, Medical Departments of the Armed Forces, and other pertinent sources. It is intended primarily for the use of those with responsibility for disease control activities. Anyone desiring to quote this report should contact the original investigator for confirmation and interpretation.

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MALARIA SURVEILLANCE 1970

I. SUMMARY

In 1970, 3,997 cases of malaria were reported in the United States. This represents a 5.0 percent increase over the 3,806 cases reported during a similar time period for 1969. This increase was due entirely to a greater number of military cases imported from Vietnam. In 1970, 96.2 percent of all cases reported in the United States were acquired in Vietnam. As in previous years, imported Plasmodium vivax infections were more common than imported P. falciparum infections (81.6 vs. 12.5 percent).

Army personnel accounted for 82.9 percent of all Vietnam-acquired infections in 1970, and the total number of Army cases (3,182) represented a 13.8 percent increase over 1969. This increase in Army cases could not be attributed to improved reporting or to increased numbers of returnees, for the number of Army returnees was lower in 1970 than in 1969. The Marines accounted for 10.9 percent of all Vietnam-acquired cases, compared to 19.2 percent in 1969.

Sixteen persons acquired their malaria infections within the United States, the highest total since 1953, and at least nine of these infections were related to malaria cases imported from Vietnam. Two were introduced cases due to P. vivax. Six cases, five with P. vivax and one with P. falciparum, were induced by the sharing of syringes and needles among heroin users. Eight cases were induced by blood transfusion.

There were only three malaria deaths, compared with nine in 1969, and all were due to P. falciparum. All occurred in persons who had recently returned from Africa: two foreign seamen and an American tourist.

II. TERMINOLOGY

The terminology used in this report is derived from the recommendations of the World Health Organization.[1,2] The definitions of the following terms are included for reference purposes.

1. Autochthonous

   a. Indigenous - malaria acquired by mosquito transmission in an area where malaria is a regular occurrence.

   b. Introduced - malaria acquired by mosquito transmission from an imported case in an area where malaria is not a regular occurrence.

2. Imported

   Malaria acquired outside of a specific area (the United States and Puerto Rico in this report).

3. Induced

   Malaria acquired through artificial means, i.e., blood transfusion, common syringes, or malariotherapy.

4. Relapsing

   Renewal of clinical activity occurring after an interval from the primary attack greater than that due merely to periodicity.

5. Cryptic

   An isolated case of malaria not associated with secondary cases as determined through appropriate epidemiological investigation.

III. GENERAL SURVEILLANCE INFORMATION

Between January 1, 1970, and February 28, 1971, 3,997 cases* of malaria with the onset of illness during 1970 in the United States and Puerto Rico were reported to the Parasitic Diseases Branch of the Center for Disease Control. This compares with 3,806 cases reported during a similar time period with onset of illness in 1969, and represents the largest annual number of malaria cases recorded in the United States since 1951 when 5,600 were reported. In addition to the 3,997 first attacks, reports were received on 248 individuals who developed one or more relapses of malaria caused by the same species as their first attack.

*A "case" is defined as an individual's first attack of malaria in the United States, regardless of whether or not he had experienced previous attacks of malaria while outside the country. A subsequent attack in the same individual caused by a different Plasmodium species is counted as an additional case. Repeat attacks in this country caused by the same species are considered relapses, not additional cases. All cases included in this report were diagnosed as malaria on the basis of a positive peripheral blood smear examined in a local or state laboratory. Doubtful cases were referred to the National Malaria Repository, CDC.

Malaria in military personnel (including recently discharged veterans) was responsible for the 5.0 percent increase in reported cases of malaria in 1970 compared with the previous year. Military cases rose from 3,679 (1969) to 3,872 (1970), and comprised 96.9 percent of all cases diagnosed in this country (Table I). All but 32 of these cases were acquired in Vietnam. Despite the increasing speed and popularity of international travel, reports of malaria in civilians has remained relatively constant over the past 8 years (Figure 1).

Table I

Military and Civilian Cases of Malaria
United States, 1959-1970*

Year	Military	Civilian	Total
1959	12	38	50
1960	21	41	62
1961	45	37	82
1962	75	40	115
1963	58	90	148
1964	52	119	171
1965	51	105	156
1966**	620	144	764
1967**	2699	158	2857
1968**	2566	131	2697
1969**	3906	144	4050
1970	3872	125	3997

*Onset of illness in the United States and Puerto Rico

**Figures for these years have been updated to include cases reported after the publication of previous annual summaries.

Fifteen of the 125 civilian cases and one of the military cases of malaria reported in 1970 acquired their infections in the United States, and the probable sources of infection in at least nine of these cases were Vietnam returnees. Two introduced cases of malaria due to P. vivax occurred in Texas; the probable source of infection was a Mexican agricultural worker. Eight cases of blood transfusion-induced malaria were reported. Vietnam veterans were identified as the most likely sources of infection in three of the eight cases. Two separate episodes of needle-induced malaria among heroin users were reported. The probable sources of infection for the six cases, five in one episode and one in the other, were Vietnam veterans. The clinical details of these sixteen cases are presented in Section VI.

There was no significant change in the ratios of cases caused by any Plasmodium species between 1969 and 1970. P. vivax accounted for 81.6 percent of infections, while P. falciparum was diagnosed in 12.5 percent of infections (Table II). Of the 111 mixed infections, 108 were caused by coexistent P. vivax and P. falciparum.

Table II

Cases of Malaria by Plasmodium Species
United States, 1970

Species	Total	Percent
P. vivax	3260	81.6
P. falciparum	501	12.5
P. malariae	37	0.9
P. ovale	4	0.1
Mixed Infections	111	2.8
Undetermined	84	2.1
Total	3997	100.0

The country of origin of the 3,997 cases of malaria in 1970 is shown in shown in Table III. Vietnam was listed as the source of 3,844 imported cases of malaria. Only four of these cases were in non-military personnel. Vietnam returnees, therefore, accounted for 96.2 percent of all malaria cases in 1970. Malaria in military personnel returning from Vietnam is the subject of Section IV. As in 1969, Mexico was the country from which the second greatest number of cases were reported; the largest number of cases were imported from Vietnam. During 1970, 19 cases of malaria were reported as imported from Mexico compared with 12 in 1969 and 2 in 1968.

Table III

Cases of Malaria by Distribution of Plasmodium Species and Area of Acquisition
United States, 1970*

	vivax	falciparum	malariae	ovale	Mixed	Unknown	Total
AFRICA	15	20	4	3	1	2	45
Africa**	4	6	2	1	1	0	14
West Africa**	-	1	-	-	-	1	2
East Africa**	1	1	-	-	-	-	2
Chad	-	-	-	-	-	1	1
Congo	-	1	-	-	-	-	1
Ethiopia	1	-	-	-	-	-	1
Ghana	2	5	-	-	-	-	7
Kenya	-	1	-	-	-	-	1
Liberia	-	-	1	-	-	-	1
Mali	1	-	-	-	-	-	1
Nigeria	2	5	1	1	-	-	9
Sierra Leone	3	-	-	-	-	-	3
Togo	-	-	-	1	-	-	1
Uganda	1	-	-	-	-	-	1
ASIA	3198	468	29	-	110	79	3884
Asia**	1	-	-	-	-	-	1
Southeast Asia**	6	-	-	-	-	1	7
Cambodia	1	-	-	-	2	-	3
Ceylon	-	1	-	-	-	-	1
India	2	-	-	-	-	-	2
Korea	3	-	-	-	-	-	3
Malaya	2	-	-	-	-	-	2
New Guinea	4	-	-	-	-	1	5
Pakistan	9	-	-	-	-	1	10
Philippines	4	-	-	-	-	-	4
Thailand	2	-	-	-	-	-	2
Vietnam	3164	467	29	-	108	76	3844
CENTRAL AMERICA AND CARIBBEAN	13	2	1	-	-	1	17
Central America**	2	-	-	-	-	-	2
El Salvador	-	1	-	-	-	1	2
Honduras	1	1	1	-	-	-	3
Nicaragua	10	-	-	-	-	-	10
EUROPE	-	-	-	-	-	-	-

Table III continued next page

Table III (continued)

	vivax	falciparum	malariae	ovale	Mixed	Unknown	Total
NORTH AMERICA	25	4	3	1	-	2	35
Mexico	14	-	3	-	-	2	19
United States	11	4	-	1	-	-	16
SOUTH AMERICA	-	-	-	-	-	-	-
UNKNOWN	9	7	-	-	-	-	16
TOTAL	3260	501	37	4	111	84	3997

*Onset of illness in the United States and Puerto Rico

**Country Unspecified

A history of previous malaria while abroad was obtained in 1,240 of the 3,692 imported cases (33.6 percent) in which this information was recorded. Patients with vivax malaria were more likely to give a history of prior malaria than patients with falciparum malaria (34.3 vs. 27.6 percent).

The geographic distribution of the 1970 cases of malaria within the United States is shown in Figure 2 by the State in which the patient first developed clinical symptoms of malaria. The disproportionate number of cases in California, Colorado, Georgia, Kansas, North Carolina, and Texas is due to the location of major military centers, particularly Army bases, within their borders.

The seasonal distribution of malaria cases (Figure 3) has shown no distinctive pattern in recent years, and is primarily determined by the number of troops that returned from Vietnam each month.

Clinical malaria developed within 30 days of arrival in the United States in 59.5 percent of falciparum and 17.8 percent of vivax infections for which both the exact date of arrival and the date of onset are known (Table IV). This fact is of particular importance because Vietnam veterans are commonly given one month's leave or discharged from military service as soon as they return home. As a result, they are more likely to be seen by a civilian physician who may not be as familiar with malaria as a military or Veterans Administration physician.

Within 6 months after entering this country, 97.2 percent of patients with falciparum malaria and 88.7 percent of those with vivax malaria developed clinical symptoms. Only 46 patients with vivax malaria (1.6 percent) became ill more than 1 year after their last possible exposure to malaria abroad. The longest interval between entry into the United States and clinical illness during 1970 was 19 months for falciparum malaria and 31 months for vivax malaria.

Table IV

Malaria Cases by Interval Between Date of Entry Into the United States and Onset ot Illness, and by Plasmodium Species, United States, 1970

Interval (in months)	Plasmodium Species								All Cases	
	Vivax	(%)	Falciparum	(%)	Malariae	(%)	Ovale	(%)		
<1	526	(17.8)	260	(59.5)	11	(33.3)	1	(25.0)	798	(23.2)
1-2	1375	(46.3)	133	(30.4)	17	(51.5)	1	(25.0)	1526	(44.4)
3-5	731	(24.6)	32	(7.3)	2	(6.1)	2	(50.0)	767	(22.3)
6-11	283	(9.5)	10	(2.3)	1	(3.0)	-	-	294	(8.5)
≥12	52	(1.8)	2	(0.5)	2	(6.1)	-	-	56	(1.6)
ALL CASES	2967	(100.0)	437	(100.0)	33	(100.0)	4	(100.0)	3441	(100.0)

Of the 3,997 cases reported in 1970, 69.4 percent were initially treated in military hospitals; 22.9 percent received care in a Veterans Administration hospital (Table V). The Armed Forces and the Veterans Administration have made complete malaria reporting a major responsibility of their hospital staffs. Reporting by civilian physicians, on the other hand, is largely a matter of individual initiative even though malaria is a reportable disease in every State. The above figures probably underestimate the extent to which civilian physicians encounter cases of malaria.

Table V

Malaria Cases by Type of Initial Hospital Admission
United States, 1970

Type of Hospital	Number of Patients	Percent
Military	2772	69.4
Veterans Administration	914	22.9
Civilian	233	5.8
Public Health Service	26	0.6
Other	17	0.4
Not Specified	27	0.7
Not Hospitalized	8	0.2
TOTAL	3997	100.0

Three deaths, all due to P. falciparum, occurred in the 501 cases of falciparum malaria reported in 1970 (case fatality rate = 0.6 percent). These cases are discussed in detail in Section VII. Intravascular hemolysis was the most frequent complication reported by physicians on patients for whom the information was recorded. Cerebral malaria occurred in five cases and renal failure in two. However, the true incidence of these complications is not known because reporting of clinical course of non-fatal cases is far less complete than for the fatalities.

IV. MILITARY MALARIA IMPORTED FROM VIETNAM

Three thousand, eight hundred and seventy-two military cases of malaria were reported during 1970, and 3,840 of these (99.2 percent) were imported from Vietnam (Table VI). P. vivax was the etiologic agent in 3,159 of the Vietnam military cases (82.3 percent), P. falciparum in 467 cases (12.1 percent) and P. malariae in 29 cases (0.8 percent). No cases of P. ovale malaria were reported, compared with four cases reported in 1969. Mixed Plasmodium infections occurred in 108 cases (2.8 percent), and the Plasmodium species could not be identified in 77 cases (2.0 percent).

Army personnel accounted for 82.9 percent of the military malaria cases from Vietnam, and Marines accounted for 10.9 percent. Navy and Air Force personnel rarely contracted the disease (Table VI). The number of cases imported from Vietnam in Army returnees was 13.8 percent greater in 1970 than in 1969. This increase is not due to increased troop withdrawals, because the number of Army returnees in 1970 was lower than in 1969. There were 2,796 Army cases among 326,659 returnees[3] in 1969, giving an attack rate of 86 per 10,000 returnees, while in 1970 there were 3,182 cases among 298,803 returnees[3] for an attack rate of 106 per 10,000 returnees. This increase in the attack rate of malaria cannot be explained by improved reporting; it is probably due to decreased adherence to the 8-week chloroquine-primaquine used as terminal chemoprophylaxis on return to the United States.

Table VI

Malaria in Military Returnees from Vietnam by Branch of Service, U.S.A., 1970

Branch of Service	Number of Cases	Percent of Cases	Percent Change 1969-1970
Army	3182	82.9	+ 13.8
Marines	418	10.9	- 39.9
Navy	18	0.4	+ 5.9
Air Force	8	0.2	- 11.0
Unknown	214	5.6	+ 98.1
TOTALS	3840	100.0	+ 5.9

The relapse rates in patients with vivax malaria imported from Vietnam during the years 1966-1970 is given in Table VII. Since relapse of vivax infections is unusual after 3 years, the 1966 and 1967 figures may now be presumed to be complete, whereas, there may be additions to the figures for 1968-1970. Nevertheless, there is a diminishing rate of relapse for each successive year which we believe will persist despite the receipt of additional reports. This is probably due to the more thorough use of primaquine in military hospitals in the past few years.

The recrudescence rate in military cases from Vietnam with falciparum infections was 3.2 percent in 1970 (15 of 467 infections) compared with 1.6 percent in 1969, 1.2 percent in 1968, 6.7 percent in 1967, and 8.4 percent in 1966. The decline in the rate of falciparum recrudescences from 1966 to 1969 may be the result of the development of more effective chemotherapeutic regimens for the treatment of chloroquine-resistant strains of *P. falciparum*.

Table VII

Relapse Rates of Military Cases of Vivax Malaria Imported from Vietnam, U.S.A., 1966-1970

Year	Number of Primary Attacks	Percent of Patients with Relapses				
		First	Second	Third	Fourth	Fifth
1966	350	29.4	8.6	1.4	0.0	0.0
1967	2198	18.5	3.4	0.8	0.1	0.0
1968	2061	7.9	0.9	0.2	0.1	0.1
1969	3089	6.9	5.5	0.1	0.0	0.0
1970	3159	5.2	0.4	0.0	0.0	0.0

V. CIVILIAN MALARIA IMPORTED FROM ABROAD

In contrast to the increase in military cases, the number of civilian cases of malaria has remained at the same level for several years. The age and sex distribution of the 125 civilian malaria cases is presented in Table VIII. United States citizens accounted for 80 of the 125 (64.0 percent) and the remaining 45 cases occurred in citizens of other countries. College students and teachers traveling abroad contracted more malaria than tourists (Table IX). The Peace Corps reported six cases of malaria in volunteers each in 1970, 1969, and 1968, compared with 25 in 1967 and 44 in 1966. Twelve seamen (only two of whom were American citizens) developed malaria in 1970. College students and teachers comprised the largest group of foreign nationals with imported malaria.

Table VIII

Civilian Malaria Cases by Age and Sex
United States, 1970

Age Group	Male	Female	Total	Percent
0-9	6	3	9	7.2
10-19	7	11	18	14.4
20-29	37	10	47	37.6
30-39	15	2	17	13.6
40-49	10	6	16	12.8
50-59	7	1	8	6.4
60-69	2	2	4	3.2
70+	1	-	1	0.8
Unknown	4	1	5	4.0
TOTAL	89	36	125	100.0

Table IX

Imported Civilian Malaria Cases by Occupation and Nationality
United States, 1970

Occupation	U.S. Citizen	Foreign Visitor	Total	Percent
Tourist	10	1	11	8.8
Businessman	5	3	8	6.4
Government representative	6	1	7	5.6
Missionary	5	0	5	4.0
Peace Corps	5	1	6	4.8
Seaman	2	10	12	9.6
College Student or Teacher	14	13	27	21.6
Other	9	8	17	13.6
Unknown	24	8	32	25.6
TOTAL	80	45	125	100.0

VI. MALARIA ACQUIRED IN THE UNITED STATES

Sixteen persons acquired malaria infections within the United States, the highest annual number since 1953. Two cases were introduced, six were induced by sharing of syringes and needles among heroin users, and eight were induced by blood transfusion, the highest number of transfusion-induced cases reported annually in more than 15 years. Table X summarizes characteristics of the five infective blood donors who were identified as the result of epidemioloic investigations. For at least nine of the 14 induced cases, the probable source of infection was a Vietnam veteran.

Table X

Transfusion-Induced Malaria
Characteristics of Five Infective Donors, 1970

Case Number	Causative Organism	Infection Acquired in	Nationality of Donor	Length of Residence in U.S.A. before Blood Donation	History of Malaria	Identified by IFA	Identified by Peripheral Smear
9	*P. falciparum*	Vietnam	U.S.	7 months	-	+	-
13	*P. falciparum*	Vietnam	U.S.	9 months	-	+	-
14	*P. falciparum*	Ghana	Ghana	12 months	-	+	-
15	*P. vivax*	Vietnam	U.S.	15 months	+	-	+
16	*P. ovale*	Ghana	U.S.	26 months	+	+	-

A. Introduced Malaria

Cases 1 and 2

On September 17 in Bergheim, Texas, a 9-year-old boy, J.R., had onset of fever, nausea, vomiting, malaise, and tiredness; 2 days later his 11-year-old sister, D.R., began having abdominal pains and fever. On September 20, both children were asymptomatic, but the next day they began having fever to 106° F. on alternate days. They were seen by a local physician who referred them to a pediatrician. The children were admitted to a San Antonio hospital on September 28 with a diagnosis of "fever of undetermined origin," and P. vivax parasites were found on peripheral smears from both patients.

Epidemiologic Investigation

The children live with their family in Bergheim and had not traveled outside the immediate area in the recent past. They had never traveled outside the United States nor received blood transfusions. There were no recent contacts with persons who had returned from Vietnam or other malarious areas or with persons with febrile illnesses. On September 5 the children had camped with their immediate family and other relatives at a recreation area on their grandparents' nearby ranch (Figure 4). Several persons complained of being bitten by mosquitoes and ticks while at the campsite which is located at the dammed headwaters of a small creek.

The campsite lies on private property and is adjacent to the property line of the "K" ranch. There is no public access to the area, and the only persons believed to have been at the campsite, beside the campers, were several Mexican workers. These men are illegal immigrants to the U.S. who resided on the "K" ranch while employed in a cedar cutting operation. They slept in unscreened shelters located several hundred yards from the campsite, which they were known to frequent in order to bathe and wash clothes. Residents of the area stated that three of these workers had departed from the area in early September for unknown destinations. One of the workers reportedly was ill with a fever at that time.

The two children obviously acquired their malaria infections in the United States, and the probable source of infection was a Mexican agricultural worker from the adjacent "K" ranch. No further cases of malaria were identified in the investigation, and no other cases were recognized in the area subsequently.

Entomology

Larva and light trap collections were made in early October on the "R", "K", and "J" (home of the patients) ranches. Larval, pupal, and adult stages of Anopheles punctipennis were found along Swede Creek, both at the campsite and on the "K" ranch. A. pseudopunctipennis adults were found near the "K" ranch foreman's house, and adults and larva on the "J" ranch. No anophelines were identified in any of the small collections of standing water near the Mexican workers' campsite (Figure 4).

Both A. punctipennis and A. pseudopunctipennis are known members of the insect fauna of south-central Texas. A. punctipennis has been demonstrated as a malaria vector experimentally in a laboratory setting, but it has never been reported as the primary documented vector in field conditions. A. pseudo-punctipennis, although it is a known malaria vector, was not trapped in the

immediate vicinity of Swede Creek. The exact identity, therefore, of the anopheline which actually transmitted malaria to the two children, remains undetermined.

(Reported by Aurora Villafana, M.D., Attending Physician, Santa Rosa Hospital, San Antonio; Howard C. Day, Health Officer, Kendall County; Paul Fornier, Entomologist, and M. S. Dickerson, Chief, Communicable Disease Services, Texas State Department of Health; and two EIS officers.)

B. Induced Malaria

Case 3

On June 24 and July 2, 1970, a 20-year-old serviceman stationed at Fort Bragg, North Carolina, presented himself at sick call with complaints of fever, chills, sweating, left upper quadrant tenderness, and abdominal cramps. The diagnosis of gastroenteritis was made on both occasions, and he returned to his quarters. On July 22 he was admitted to the post hospital with essentially the same complaints as before; 5 days after admission P. falciparum parasites were found on a routine peripheral blood smear.

The patient entered the Army on May 13, 1969, at Fort Knox, Kentucky. He was transferred to Fort Benning, Georgia, on August 21, 1969, and then to Fort Bragg on October 13, 1969. He had never traveled to Vietnam or to any other malarious area, and he had never received a blood transfusion.

Upon questioning, the patient admitted use of heroin intravenously during the past 6 months and stated that he had shared injection equipment with at least eight other persons. Four of the eight individuals were located, and two gave a history of malaria while in Vietnam in 1968. These four contacts had negative peripheral blood smears for malaria parasites, and their sera were negative for malaria antibody when tested with the IFA technique.

The patient donated two units of blood, 2 days and 1 day preceding his first sick call visit. The first unit was sold to a commercial blood bank on June 22 in Fayetteville, North Carolina, which then shipped the blood to its branch office in New York City on June 23. On July 2 the blood was given to a patient who was being treated for a fractured hip. The recipient had had no unexplained febrile illness since receiving the blood, but his physician was alerted to the possibility of transfusion malaria. The recipient's IFA test was negative. The second unit was donated to the Army on June 23 and sent to Vietnam; the proper military authorities were notified.

(Reported by Capt. Robert M. Giller, MC, USA, Assistant Preventive Medicine Chief, and Capt. Darwin Palmer, Entomologist, Fort Bragg, North Carolina; Martin P. Hines, D.V.M., Director, Division of Epidemiology, North Carolina State Board of Health; and the Malaria Surveillance Unit, CDC.)

Cases 4 through 8

Between mid-November and mid-December 1970, six cases of malaria due to P. vivax were diagnosed in male residents of a coastal agricultural valley in Ventura County, California. The men's ages range from 20 to 35 years. Four of the patients had never traveled outside the United States; the other two had returned from Vietnam in July 1970, where they had been treated for malaria. One of these veterans was later treated for vivax malaria at a local hospital on

December 7, 1970. The other veteran reportedly had had five attacks of malaria in the 6-month period prior to his return from Vietnam. He had also had several attacks after returning home and had treated himself with quinine and Dapsone. In spite of this medication, parasites of P. vivax were still present on his peripheral blood smear in December 1970.

The six men live in or near a town of 500 persons. Four of them admitted to the use of intravenous drugs, particularly heroin, and they named the other two patients as co-users. Syringes and needles were shared, often without intermediate cleansing, by two or more men at a time. The Vietnam veteran with recurring malaria-like symptoms was almost always present when the drugs were used.

Thick smears and sera for testing with the IFA test for malaria were obtained from household contacts of the patients; the results were negative.

Five of these cases were classified as induced; the veteran with asymptomatic parasitemia at the time of the investigation was considered to be the probable source of the infection.

(Reported by Mrs. Sherrie S. Ensor, R.N., Mrs. Marjorie A. Lenhart, R.N., Public Health Nurses; Terrance D. Gilday, R.S., Robert J. Boese, M.D., Assistant Director, Ventura County Health Department; Lois Ann Shearer, Nurse Epidemiologist, James Chin, M.D., Chief, Bureau of Communicable Disease Control, California Department of Public Health; and an EIS officer.)

Case 9

On February 15, 1970, a 62-year-old woman was transferred from a New York City nursing home to a Bronx hospital because of fever, chills, and hepatosplenomegaly. A diagnosis of falciparum malaria was made on the basis of a blood smear, and she was treated with chloroquine phosphate and improved. Because of a recrudescence of symptoms 72 hours after admission, she was given pyrimethamine and quinine which promptly cleared the parasitemia.

The patient, who had been bedridden with Parkinson's disease for many years, had received a single unit of whole blood on January 27, 1970, in another New York City hospital, following repair of a hip fracture. The blood had been obtained from a commercial blood bank in Columbus, Georgia. The donor, at the time he had donated the blood, denied that he had been in a malarious area during the preceding 24 months. With subsequent questioning he admitted that he had served in Vietnam from June 1968 until June 1969 and then had been assigned to Fort Benning, Columbus, Georgia. While in Vietnam, he took anti-malarial medication only until March 1969 and did not take the prescribed 8-week malaria chemoprophylactic course after return from Vietnam. He denied experiencing malaria or a malaria-like illness both while in Vietnam and since his return. Thick and thin blood smears were obtained on several occasions and were found to be negative. A malaria IFA test was positive at 1:256 against P. falciparum antigen, suggesting recent infection.

(Reported by Murray Wittner, M.D., Associate Professor, Pathology and Parasitology, Albert Einstein Medical College, Jacobi Hospital, Bronx, New York; Dale Harro, M.D., Assistant Commissioner for Preventive Health Services, New York State Department of Health, Vincent F. Guinee, M.D., Director, Bureau of Preventive Diseases, New York City Health Department; John E. McCroan, Ph.D., Director, of Epidemiologic Investigations Branch, Georgia Department of Public Health;

D. S. Fleming, M.D., Director, Division of Disease Prevention and Control, Minnesota State Department of Health; and an EIS officer.)

Conversations with the blood bank involved in Case 9 disclosed two further cases of transfusion-induced malaria involving blood from the same blood collection agency.

Case 10

A 76-year-old white man was readmitted to a Miami hospital with fever and chills on February 4, 1970. Parasites of P. vivax were found on a peripheral blood smear, and he was successfully treated with standard doses of chloroquine and primaquine. He had received one unit of whole blood on January 15, 1970, during a previous hospitalization for fever of undetermined etiology. He had not been outside the U.S. during the previous 2-year period, denied previous malaria or malaria-like illness, and denied the use of shared syringes.

The blood donor had served in Vietnam with the Army and had returned to the U.S. in January 1969. This individual had returned to Vietnam at the time of the investigation and could not be contacted.

(Reported by Parasitic Diseases Branch, Epidemiology Program, CDC.)

Case 11

On February 3, 1970, a 29-year-old white man was admitted to a Miami hospital for sudden onset of hematamesis. He required seven units of whole blood given over the period February 3 to February 9, and he was discharged on February 17. On the following day he experienced onset of fever and chills, for which he consulted his physician. A blood smear demonstrated P. vivax parasites, and he had a rapid, uneventful recovery after treatment with chloroquine.

The patient had no history of travel to a malarious area, previous malaria, or use of shared syringes. Six of the seven units of blood came from the Columbus blood bank, and the seventh from a local hospital blood bank. Five of the seven donors were contacted; four were returnees from Vietnam. All those contacted denied ever having had malaria or sharing syringes. Their peripheral blood smears and IFA tests were negative. Of the two remaining donors, both servicemen, one had been in Vietnam as recently as August 1969, and the other had been in Egypt, Greece, and Turkey in 1966. Neither could be contacted because of their reassignment.

(Reported by Parasitic Diseases Branch, Epidemiology Program, CDC.)

Case 12

On February 20, 1970, a 31-year-old man required 11 units of blood because of esophageal bleeding. On March 7, he experienced onset of fever and chills, and parasites of P. vivax were seen on a peripheral blood smear.

The patient had never traveled to malarious areas nor had he shared syringes. The blood had been supplied by a local blood collection agency, and five donors were contacted. Although four of the five donors had recently traveled to malarious areas, they all denied ever having experienced malaria, malaria-like illness, and the use of shared syringes. All five had negative blood smears

for malaria parasites. One of them, a Vietnam returnee, had an IFA end-point dilution titer of 1:16 against P. falciparum antigen only, and the other four had negative IFA tests. The remaining six donors could not be located.

(Reported by Ichiro Kamei, M.D., Chief, Acute Communicable Disease Division, Los Angeles County Health Department, and two EIS officers.)

Case 13

On July 24, 1970, a 28-year-old man was transferred to a hospital in Baltimore, Maryland, for treatment of hypertension resulting from chronic renal disease. He began peritoneal dialysis on July 25,and on that day was given two units of whole blood. Subsequently hemodialysis was initiated, and he received two additional transfusions, one each on August 5 and 8.

On August 5 he began to have spiking temperature elevations to 104° F. and chills. A massive pericardial effusion was tapped on August 13, from which an Escherichia species was cultured. On August 17 another pericardicentesis was performed, and parasitic ring forms were detected in approximately 5 percent of the red blood cells of the effusion; they were tentatively identified as P. falciparum. On review of previous peripheral smears, parasites were found on smears obtained as early as August 11. Treatment was begun with oral quinine and pyrimethamine.

The patient denied recent travel to a malarious area, history of malaria or unexplained febrile illness, and the use of commonly-shared syringes. The donors of the four units of blood were identified. Three had donated blood to a blood collection service in North Carolina. Each of the three denied foreign travel, and two had donated blood previously without incident, therefore, they were considered unlikely as the source of infection. The fourth unit was donated on July 22 at a collection center in Columbia, South Carolina, by a 21-year-old serviceman and was given to the patient on July 25. This donor denied travel to a malarious area when the blood was collected, but a check of his Army records revealed that he had returned from Vietnam on October 16, 1969. Upon repeat questioning, he denied having had malaria or any febrile illness while in Vietnam or after his return, and he stated that he took all of his antimalarial prophylactic drugs as required. A peripheral blood smear obtained on August 18 demonstrated rare P. falciparum parasites. The end-point dilutions of his serum when tested with the IFA test for malaria were P. falciparum 1:256, P. vivax 1:64, and P. malariae 1:64. Peripheral blood smears and IFA tests from the three remaining donors were negative for malaria.

(Reported by Patricia McIntyre, M.D., Attending Physician, Duane Smith, M.D., Fellow in Infectious Diseases, Alfred Grindon, M.D., Director, Blood Bank, Johns Hopkins Hospital School of Medicine; and Howard Garber, M.D., State Epidemiologist, Maryland State Dept. of Health.)

Case 14

On October 29, 1970, one unit of whole blood was administered to a 34-year-old man who was a patient on the hemodialysis unit of a New York City hospital. On November 6, he had a temperature of 105° F., chills, headache, malaise, and cough. His fever spikes occurred every 2 days, and on November 13, trophozoites of P. falciparum were seen on a peripheral blood smear. He was treated with standard doses of chloroquine phosphate and responded promptly. The patient denied recent foreign travel, history of malaria, and the use of commonly-shared syringes.

The unit of blood was donated to a New York hospital blood program in late October by a 34-year-old native of Ghana. The donor entered the United States from Ghana in October 1969 and denied any subsequent travel to malarious areas and use of shared syringes. He stated that, to the best of his knowledge, he had never had malaria or malaria-like illnesses and had not taken any antimalarial drugs since receiving quinine as a child. Several peripheral blood smears were negative for malaria parasites; serum tested by the IFA technique gave end-point dilution titers of P. falciparum 1:256, P. ovale 1:64, and P. malariae 1:16.

(Reported by Stephen J. Seligman, M.D., Associate Professor of Medicine, and Margaret Choa, M.D., Fellow in Infectious Diseases, Downstate Medical Center, Brooklyn; Howard B. Shookhoff, M.D., Division of Tropical Diseases, and Vincent F. Guinee, M.D., Director, Bureau of Preventable Diseases, New York City Health Department.)

Case 15

On October 21, 1970, a 40-year-old woman was admitted to a West Virginia hospital for treatment of alcoholic gastritis. Because she had suffered acute loss of blood, she received two units of whole blood. On November 19, she experienced a temperature of 103° F., chills, and muscle cramps. The next day, she became afebrile, but the symptoms recurred intermittently until December 7, when she was admitted to another hospital for investigation of "fever of unknown origin." P. vivax parasites were seen on peripheral blood smears.

The two units of blood were obtained locally by the first hospital on the day the transfusions were given. One unit was donated by a West Virginia resident who had never traveled or had malaria. The other donor was a 20-year-old Marine who had returned from Vietnam on July 18, 1969. He had a confirmed malaria attack while in Vietnam in 1968, but he stated that he had not had any recurrences or malaria-like illnesses since his return. It is not known if he took any chloroquine-primaquine tablets after his return to the United States. A thick blood smear obtained on December 9, 1970, contained a few Plasmodium ring stages, but species identification was not possible; his serum was negative for malaria antibodies with the IFA test.

(Reported by W. Guy Fiscus, M.D., Attending Physician, Tucker County Hospital (W. Va.); John Hall, Professor of Microbiology, University of West Virginia Medical Center, Morgantown, and Eugene J. Powell, Administrative Assistant, Division of Disease Control, State of West Virginia Department of Health.)

Case 16

On September 10, 1970, a 28-year-old man underwent a renal transplant operation in Little Rock, Arkansas. He experienced fever 36 hours after the operation, which was associated with rejection of the transplant. He was still febrile on October 2 when a routine peripheral blood smear showed infection with P. ovale. The patient was treated with chloroquine and recovered promptly.

The patient gave no history of malaria, foreign travel, or use of shared syringes. On September 7 and 9, he received seven units of blood. One of the seven donors, an American, stated that he had been treated for malaria in August 1967, while in Nigeria, and again in July 1968 when his symptoms recurred shortly after his return to the United States. His peripheral blood smears were negative for

malaria parasites, but his serum when tested by the IFA technique for malaria, gave an end-point dilution titer of 1:16 against P. ovale antigen (P. falciparum 1:64, P. vivax and P. malariae negative).

(Reported by Thomas E. Brewer, M.D., Instructor in Medicine, William J. Flanigan, M.D., Associate Professor of Medicine and Director, Clinical Research Center, Howard Quittner, M.D., Associate Professor of Pathology and Director of Laboratories and Blood Bank, Ruby Bland, Laboratory Technologist, University of Arkansas Medical Center, Little Rock, Arkansas; and J. T. Herron, M.D., State Health Officer, Arkansas State Board of Health.)

VII. DEATHS DUE TO MALARIA IN THE UNITED STATES

Case 1

On March 3, 1970, a 40-year-old Norwegian seaman became ill at sea with headache, fever, chills, and dizziness. On the following day, however, he felt well enough to return to his duties. On March 5 he experienced a recurrence of the symptoms and was confined to bed. On the following day the ship docked in New Jersey, and the seaman was seen by a physician. On March 7 because of persistent symptoms, the patient was transferred to a Bayonne, New Jersey, hospital, where he was noted to be seriously ill with a temperature of 103° F., jaundice, and dyspnea. A peripheral blood smear revealed a very heavy infection with P. falciparum. Chloroquine phosphate was given promptly, and in 6 hours he became more alert and was afebrile; however, later that evening he became hypotensive, did not respond to emergency supportive measures, and died.

Postmortem examination revealed acute congestion of all organs. Heavy deposition of malarial pigment was seen in the spleen and liver, and parasitized red blood cells were seen in smears of the spleen.

(Reported by John Bedrick, M.D., Attending Surgeon, Bayonne Hospital, Bayonne, New Jersey; Angelo Gnassi, M.D., Pathologist, Hudson County Medical Examiner's Office, New Jersey; the Foreign Quarantine Program, CDC; and an EIS officer.)

Case 2

On July 20, 1970, a Norwegian bulk cargo ship made a radio request to the Foreign Quarantine Program, CDC, for medical assistance for two seamen who became ill while crossing the Atlantic. The ship departed from Takoradi, Ghana, on July 6 after a 6-day stay, made a 4-hour stop at Cape Verde Islands for refueling on July 11, and docked at Newport News, Virginia, on July 21, where the ill crewmen were admitted to a local hospital.

One patient, the chief officer, a 45-year-old Norwegian, experienced vomiting, right upper quadrant abdominal pain, and right costovertebral angle pain radiating to the right leg on July 16. On the following day a high fever began, and he was treated with aspirin and opium tablets. On July 19 his fever subsided and he felt better, but he fainted when he attempted to return to his duties. On July 20 the fever resumed, and he complained of back pain.

On admission to the hospital he complained of weakness, nausea, diarrhea, headaches, fever, and right upper quadrant pain. His temperature was 105° F., and he appeared slightly dehydrated and icteric. Hepatosplenomegaly was not

observed. The initial impression was acute infectious hepatitis, and intravenous fluid therapy was begun. On July 22 while examining a routine peripheral blood smear, a medical technologist observed that approximately 75 percent of the red cells contained trophozoites of P. falciparum. Some cells contained as many as four ring forms, and an occasional cell with schizonts was seen. Therapy was begun with intravenous quinine hydrochloride and intravenous corticosteroids. On the following day he became stuporous, then comatose, uremic, and oliguric. Pulmonary edema developed, and small ecchymotic patches were seen in the posterior pharynx. Quinine was discontinued; he was given intramuscular chloroquine hydrochloride, digitalis, and diuretics, and peritoneal dialysis was initiated. In spite of these measures, the patient died early on July 24.

The other seaman had a similar onset and course of illness, He also was diagnosed initially as having infectious hepatitis, but on July 22 infection with P. falciparum was diagnosed, and the appropriate therapy was instituted. He recovered but had persistent neurologic deficits.

(Reported by Ralph Price, M.D., and Grover Thompkins, M.D., Physicians, Newport News, Virginia; H. E. Gillespie, M.D., Director, Bureau of Epidemiology, Virginia State Department of Health; Charles T. Caraway, D.V.M., Chief, Section of Epidemiology, Louisiana State Department of Health; the Foreign Quarantine Program, CDC; and two EIS officers.)

Case 3

On November 4, 1970, a 72-year-old woman from Dallas, Texas, returned home after a 5-week camera safari in South and East Africa. The next day, she experienced myalgia, malaise, and nausea, followed by fever and progressive weakness. She was seen by a physician who diagnosed a respiratory illness and treated her with antibiotics. Her symptoms persisted, however, and on November 10, she had a shaking chill.

On November 11, the patient was admitted to a local hospital, febrile and acutely ill. Blood sugar and electrolytes were normal, SGOT was 44 units, BUN 49 mg percent, total bilirubin 3.2 mg percent. A chest X-ray showed mild cardiomegaly. The initial diagnosis was fever of undetermined etiology, and the patient received an antiemetic and analgesics. On November 12, she was afebrile, but when her temperature spiked to 105° F. the next morning, accompanied by a shaking chill, she became comatose. At that time, P. falciparum parasites were seen on a peripheral blood smear. She was treated with quinine hydrochloride, followed by chloroquine phosphate, pyrimethamine, and sulfadiazine. She subsequently experienced hypotension, jaundice, thrombocytopenia, hematemesis, and cyanosis. Consumptive coagulation defect was suspected, and she was treated with dexamethasone, anticoagulants, digitalis, and blood transfusions. Her condition continued to deteriorate, however, and she died on November 14. A review of the peripheral blood smears obtained on admission showed P. falciparum trophozoites.

Postmortem examination revealed a swollen brain with moderate uncal herniation. Microscopic examination of the brain showed multiple focal hemorrhages and congested blood vessels which were filled with numerous parasitized red blood cells. There were heavy pigment deposits in the liver and spleen, and the lungs had moderate pulmonary edema.

(Reported by George T. DeVaney, M.D., Attending Physician, Van Q. Telford, M.D., Pathologist, Presbyterian Hospital, Dallas, Texas; David N. Gilvert, M.D., Fellow in Infectious Disease, Department of Internal Medicine, University of

Texas Southwestern Medical School; Hal J. Dewlett, M.D., Director of City of Dallas Public Health Department; R. F. Sowell, Jr., M.D., Medical Consultant, and M. S. Dickerson, M.D., Chief, Communicable Disease Services, Texas State Department of Health.)

VIII. REPORT FROM THE NATIONAL MALARIA REPOSITORY - 1970

The presence of Plasmodium species or agreement that there were no parasites present was confirmed by the National Malaria Repository in blood films from 1,516 of the 1,531 cases (99.0 percent) submitted in 1970. Malaria organisms could not be found in blood films from 14 persons (0.9 percent) submitted as having parasites present. One specimen was submitted as negative, but parasites were found at CDC. It should be noted that in 62 cases (4.0 percent) the National Malaria Repository determined that a different species was present than that identified by the laboratory of origin.

Tables illustrating the origin (Table XI) and species diagnosis (Table XII) of malaria smears examined by the Repository are shown below. Totals for the calendar year 1969 are included for comparison.

Table X

Origin of Positive Slides for Malaria Submitted to the National Malaria Repository, 1969 and 1970

	ORIGIN							
	Army	Navy	VA Hosp.	Air Force	Health Dept. (State, County, City)	PHS Hosp.	Others - Hospitals Clinics, Physicians etc.	Cumulative
Cumulative total positive 1970	199	53	716	92	98	17	131	1306
Cumulative total positive 1969	630	34	516	78	44	19	111	1432

Table XI

Species of Malaria Identified by National Malaria Repository
1969 and 1970

Species	Cumulative Total 1970	Cumulative Total 1969
P. vivax	1073	1163
P. falciparum	216	231
P. malariae	6	13
P. ovale	5	11
Plasmodium sp.	6	14
Negative	225	139
Unsatisfactory	0	1
Total examined	1531	1572
Cumulative positive	1306	1432

Figure 1

MILITARY AND CIVILIAN CASES OF MALARIA,
UNITED STATES 1959 - 1970

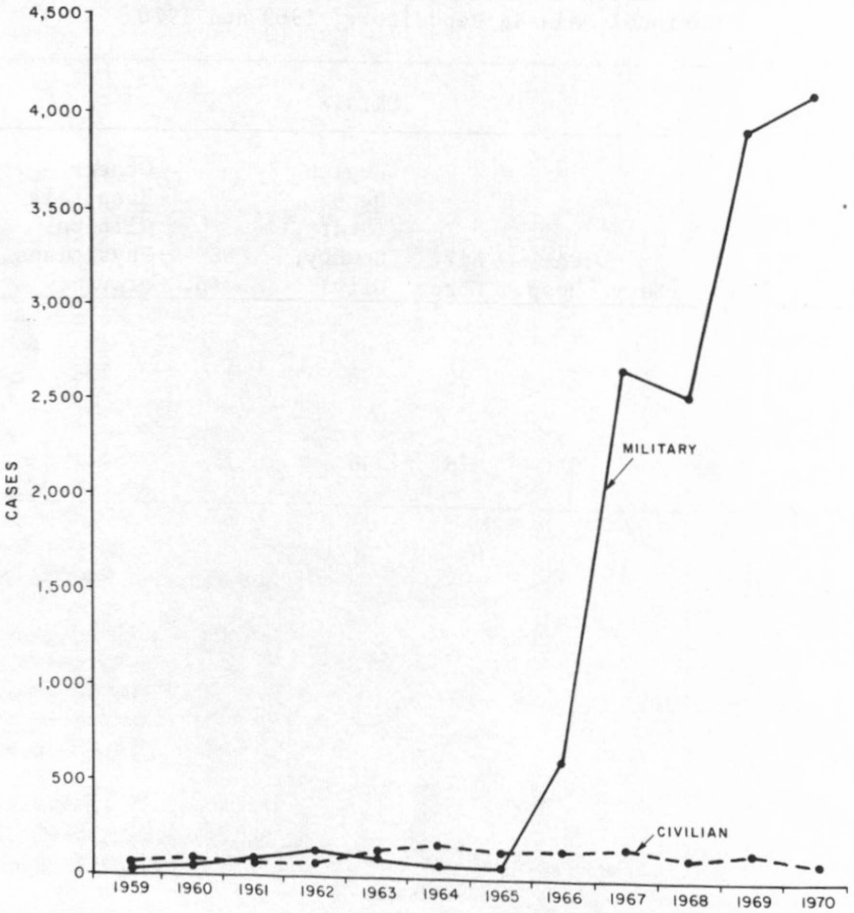


Figure 2 GEOGRAPHIC DISTRIBUTION OF MALARIA CASES WITH ONSET IN UNITED STATES, 1970

Figure 3 MALARIA CASES, BY MONTH OF ONSET, UNITED STATES, 1970

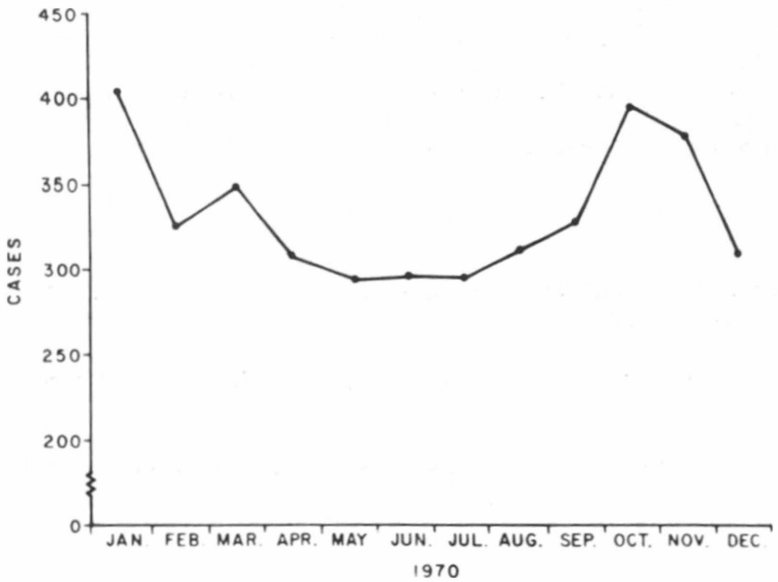
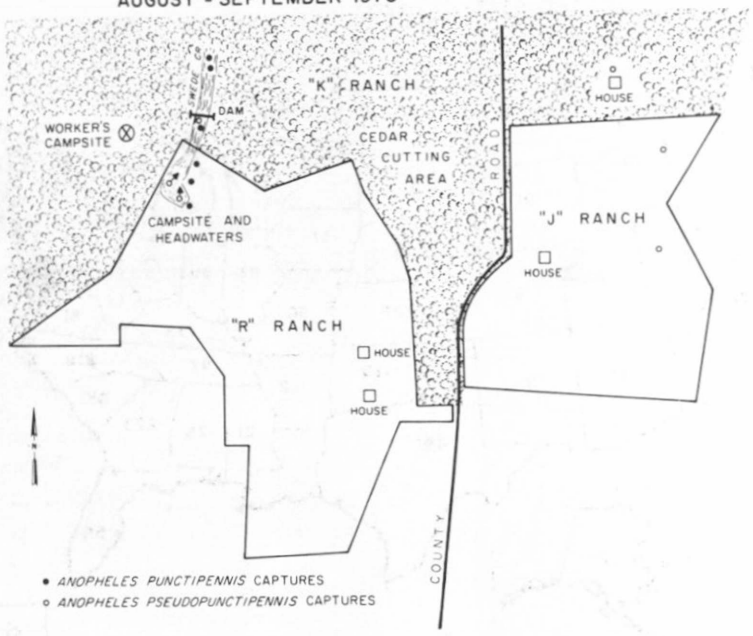


Figure 4 AREA OF MALARIA TRANSMISSION, BERGHEIM, TEXAS, AUGUST - SEPTEMBER 1970



IX. ACKNOWLEDGMENT

The Malaria Surveillance Report, prepared annually at the Center for Disease Control, is based on information provided in individual reports. The excellent support given to the malaria surveillance program by State and local health departments and personnel of the Preventive Medicine Services of the U.S. Army, Navy, and Air Force is greatly appreciated.

Thorough and comprehensive evaluation of all cases of malaria reported in the United States constitutes the most effective approach to preventing re-establishment of malaria transmission subsequent to importation.

All cases of malaria, whether first attacks or relapses, regardless of where they are acquired, should be promptly reported to the appropriate health department. Clinical and epidemiological information on each case should be provided on the Malaria Case Surveillance Report Form 4.80 (CDC). Extra copies of this form are available on request. Every effort should be made to obtain pretreatment thick and thin blood films for each case. These films may be submitted with the Surveillance Form.

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1. Terminology of Malaria and of Malaria Eradication. Geneva, World Health Organization, 1963, p 32

2. WHO Expert Committee on Malaria - Tenth Report. WHO Techn Rep Ser No. 272, p 34

3. Unpublished data, Office of the Surgeon General, Department of the Army, 1971

STATE EPIDEMIOLOGISTS

Key to all disease surveillance activities are those in each State who serve the function as State epidemiologists. Responsible for the collection, interpretation and transmission of data and epidemiological information from their individual States, the State epidemiologists perform a mast vital role. Their major contributions to the evolution of this report are gratefully acknowledged.

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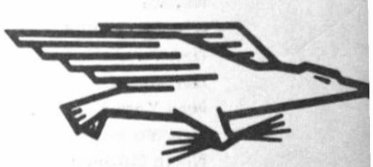

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