

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.

Contributions to the Surveillance Report are most welcome. Please address them to:

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MALARIA SURVEILLANCE, 1966

I. SUMMARY

During 1966, 678 known individuals became ill with malaria in the United States and Puerto Rico. This is the largest number of cases for any year since 1954. This increase was due primarily to the 538 cases of malaria in returning U. S. military personnel who were infected in Vietnam. Civilians accounted for 115 cases, of which 30 occurred in former Peace Corps volunteers.

Plasmodium vivax was the parasite identified in 56 percent of the 678 cases reported during 1966; P. falciparum was identified in 33 percent of the cases.

Only 5 of the 678 cases acquired their infection in the United States. In two cases, the source of infection was believed to be a serviceman who had been stationed overseas. Transplacental transmission occurred in one case, and infection through blood transfusion occurred in one. Finally, in one isolated case, the source of infection could not be determined.

Four fatal malaria cases, all due to P. falciparum, were reported in 1966.

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 contracted from an imported case in an area where malaria is not a regular occurrence.

2. Imported

Malaria acquired outside of a specific area (U.S.A. and Puerto Rico in this report).

3. Induced

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

The Malaria Surveillance Unit of the National Communicable Disease Center received epidemiologic information on 678 cases of malaria with onset of illness in 1966 in the United States and Puerto Rico. This is the largest number of malaria cases recorded in the United States for any year since 1954 (Figure 1). Military personnel (including recently discharged veterans) accounted for 563 cases, and 115 cases occurred among non-military persons (civilians). The number of civilian cases is comparable to that seen in the previous two years, but the number of military-associated cases has shown a ten-fold increase (Table I). All but 5 of the 678 cases were infected abroad. These 5 cases include 2 introduced, 1 congenital, 1 induced, and 1 cryptic, and are described in Section V.

The number of military cases increased markedly as the year progressed (Figure 2). Because nearly all of the malaria cases in the United States are imported, no established seasonal pattern exists.

Malaria cases had their onset of illness in all but eight of the States (Figure 3). The notable concentration of cases in some States, e.g., Kentucky, North Carolina, Georgia and California is due to the location of military centers in these States.

The Plasmodium species was identified in 636 of the 678 cases (93.8 percent). P. vivax was diagnosed in 56 percent and P. falciparum in 33 percent of the infected individuals. This compares with 65 percent and 27 percent, respectively, in 1965. The number of cases due to P. ovale increased to 13, from 4 in 1964 and 5 in 1965. Only 12 cases of P. malariae were reported, as compared with 8 in 1964 and 13 in 1965.

Table I
 Military and Civilian Cases of Malaria
 United States 1956-1966*

Year	Military	Civilian	Total
1957	56	45	101
1958	33	37	70
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	563	115	678

* Onset of illness in the United States and Puerto Rico.

Table II
Cases of Malaria by Plasmodium Species
United States, 1966

Species	Total	Percent
<u>P. vivax</u>	382	56.3
<u>P. falciparum</u>	221	32.6
<u>P. malariae</u>	12	1.8
<u>P. ovale</u>	13	1.9
Mixed Infections	8	1.2
Undetermined	42	6.2
Total	678	100.0

Of the 673 imported cases, 325 gave a history of a malaria attack while abroad (48.3 percent); 305 cases had no such history, (45.3 percent). In 43 cases (6.4 percent) no information about previous malaria was available.

The age and sex distribution showed a marked concentration of males in the 20 to 29 year age group, reflecting the large number of military cases (Table III). All military cases were in males. Only 23.5 percent of the reported non-military cases occurred in women, which is comparable to observations in previous years.

Table III

Age and Sex Distribution of Cases of Malaria
United States, 1966

Age Group	Total Cases				Non-Military Cases			
	Male	Female	Total	Percent	Male	Female	Total	Percent
0-9	2	3	5	0.7	2	3	5	4.3
10-19	67	4	71	10.5	4	4	8	7.0
20-29	443	12	455	67.1	44	12	56	48.8
30-39	75	3	78	11.5	19	3	22	19.1
40-49	21	3	24	3.6	9	3	12	10.4
50-59	6	1	7	1.0	6	1	7	6.1
60-69	4	1	5	0.7	4	1	5	4.3
70+	-	-	-	-	-	-	-	-
Unknown	33	-	33	4.9	-	-	-	-
Total	651	27	678	100.0	88	27	115	100.0

Three distinct groups accounted for 57 of the 115 non-military cases:

- a) Thirty cases occurred among former Peace Corps volunteers, as compared with 17 in 1965 and 5 in 1964. All but one of these had served in West Africa. Plasmodium vivax was diagnosed in 15 cases, P. ovale in 7, P. falciparum in 3, and P. malariae in 3 cases. In 2 cases the parasite species was not identified. These volunteers did not necessarily acquire their infection in the country in which they served, since they usually visit other African countries during vacations and after completion of the tour of duty.
- b) Twenty cases in seamen were reported (compared with 15 in 1965 and 34 in 1964). Four of these 20 individuals were foreign nationals.
- c) Missionaries and their dependents accounted for 7 cases, compared with 5 in 1965.

Thirty malaria cases occurred among foreign visitors to the United States. Nineteen such instances were observed in 1965 and 41 in 1964. Fourteen of the 30 cases were in foreign students, and 2 foreign physicians developed malaria while receiving medical training in this country.

The probable geographic source of infection is shown in Table IV. Most cases (538) originated in Vietnam.

It is important to note that implication of a specific country as the source of infection for a given individual is based on the travel history. In many instances, patients visited more than one malaria-endemic area making it difficult to assign the case categorically to a specific country.

In 1966, the onset of illness occurred more than 30 days after arrival in the United States in 56 percent of the 540 cases for which both date of onset and date of arrival are known (Table V). A marked difference in this interval is apparent in vivax and falciparum malaria: 79 percent of the falciparum cases occurred within 1 month after arrival as compared with only 27 percent of the vivax cases. A prolonged interval between travel and onset of illness can be misleading and may result in malaria being overlooked as the cause of illness.

Physicians in private practice diagnosed 107 of the 678 cases (16 percent), Veterans Administration Hospitals admitted 97 cases of malaria and 25 cases were seen in Public Health Service Hospitals. Only 66 percent of all cases were admitted directly to military hospitals (Table VI).

IV. MALARIA IMPORTED FROM VIETNAM

Malaria infections acquired in Vietnam accounted for 538 of the 673 imported cases (79.9 percent). P. vivax was the etiologic agent in 315 of these 538 cases (58.5 percent), P. falciparum in 177 cases (33.0 percent), and P. malariae in 6 cases (1.1 percent). Six cases had a mixed infection (1.1 percent), and in 34 cases the plasmodium species was not identified (6.3 percent). Fifty-eight percent of the 525 cases for which the information was available had a history of malaria while in Vietnam.

Table IV

Distribution by Plasmodium Species and Area of Acquisition of
Cases of Malaria, United States, 1966*

	<u>vivax</u>	<u>falciparum</u>	<u>malariae</u>	<u>ovale</u>	<u>Mixed</u>	<u>Unknown</u>	<u>Total</u>
AFRICA	28	33	3	13	1	4	82
Africa**	4	3	-	2	-	-	9
West Africa**	-	6	-	1	-	-	7
East Africa**	-	2	-	-	-	-	2
Ethiopia	2	1	-	-	-	-	3
Ivory Coast	-	1	-	-	-	-	1
Gambia	1	-	-	-	-	-	1
Niger	1	1	-	-	-	-	2
Kenya	-	3	-	-	-	-	3
Liberia	3	5	1	3	-	2	14
Nigeria	9	4	1	3	1	1	19
Guinea	2	-	-	-	-	-	2
Cameroon	3	1	1	-	-	-	5
Sierra Leone	1	2	-	1	-	-	4
Congo	-	-	-	-	-	1	1
Ghana	1	2	-	2	-	-	5
Uganda	-	1	-	-	-	-	1
Tanzania	1	-	-	-	-	-	1
Gabon	-	-	-	1	-	-	1
Upper Volta	-	1	-	-	-	-	1
ASIA	340	186	7	-	6	38	577
Asia**	-	1	-	-	-	-	1
Southeast Asia**	4	1	1	-	-	1	7
Pakistan	8	-	-	-	-	1	9
Vietnam	315	177	6	-	6	34	538
Thailand	-	4	-	-	-	-	4
India	-	-	-	-	-	1	1
Indonesia	2	2	-	-	-	-	4
Laos	2	1	-	-	-	-	3
Korea	9	-	-	-	-	1	10
MID-EAST	1	-	-	-	-	-	1
Iran	1	-	-	-	-	-	1
CENTRAL AMERICA AND CARIBBEAN	7	-	-	-	-	-	7
Nicaragua	1	-	-	-	-	-	1
Costa Rica	1	-	-	-	-	-	1
Panama	5	-	-	-	-	-	5

Table IV continued next page.

	<u>vivax</u>	<u>falciparum</u>	<u>malariae</u>	<u>ovale</u>	<u>Mixed</u>	<u>Unknown</u>	<u>Total</u>
SOUTH AMERICA	3	1	-	-	1	-	5
Colombia	1	-	-	-	-	-	1
Brazil	1	1	-	-	1	-	3
Bolivia	1	-	-	-	-	-	1
NORTH AMERICA	3	1	2	-	-	-	6
Mexico	-	-	1	-	-	-	1
United States	3	1	1	-	-	-	5
TOTAL	382	221	12	13	8	42	678

* Onset of Illness in the United States and Puerto Rico

** Country Unspecified

Table V

Interval Between Onset of First Illness and Date of Entry into the U.S.
 In 540 Imported Cases of Malaria, by Plasmodium Species
 United States, 1966

Interval (Months)	Plasmodium Species										All Cases (%)
	vivax (%)	falciparum (%)	malariae (%)	ovale (%)	Undetermined (%)						
Less than 1	87 (26.9)	138 (79.4)	3 (50)	-	12 (44)						240 (44.4)
1 - 2	127 (39.2)	27 (15.5)	2 (33)	4 (45)	10 (37)						170 (31.5)
3 - 6	94 (29.0)	7 (4.0)	1 (17)	3 (33)	5 (19)						110 (20.4)
7 - 12	14 (4.3)	2 (1.1)	-	1 (11)	-						17 (3.1)
More than 1 year	2 (0.6)	-	-	1 (11)	-						3 (0.6)
All Cases	324 (100.0)	174 (100.0)	6 (100)	9 (100)	27 (100.0)						540 (100.0)

Table VI

Malaria Cases by Type of Hospital of Initial Admission
United States, 1966

Type of Hospital	No. of Patients	Percent
Civilian	107	15.8
Public Health Service	25	3.7
Veterans Administration	97	14.3
Military	449	66.2
Total	678	100.0

In 21 returnees, an episode of falciparum malaria was followed by malaria due to P. vivax. In 19 of the 221 patients with falciparum malaria, multiple attacks were reported: 11 had two attacks, 5 had three attacks, and 3 had four attacks in 1966. More than one attack was observed in 52 of the 382 vivax cases: 34 had two attacks, 12 had three attacks, and 6 experienced four attacks in 1966.

In 62 persons, the malaria infection acquired in Vietnam did not result in clinical illness until after discharge from the military service. Three servicemen who had been in Vietnam died of malaria in 1966 in the United States (Section VI).

V. MALARIA ACQUIRED IN THE UNITED STATESIntroduced MalariaCases 1 and 2

On May 2, 1966, the 5-year-old daughter of a noncommissioned officer stationed at Fort Knox, Kentucky, experienced chills, fever, nausea, vomiting, and poorly localized abdominal pain. Physical examination revealed hepatosplenomegaly. The hematocrit was 30 vol. percent. The diagnosis of malaria was made on May 9 when P. vivax parasites were detected on a blood film prepared at Ireland Army Hospital at Fort Knox. Thick and thin blood films for malaria were obtained from the family members, and the 3-1/2-year-old brother of the patient was also found to have vivax malaria. In retrospect, this child had a clinical illness indistinguishable from malaria beginning on March 29, 1966, which consisted of four episodes of chills, fever, nausea and vomiting occurring every other day. He was asymptomatic between the episodes. The blood smears from these two patients were confirmed as P. vivax at the National Communicable Disease Center. Both children were successfully treated.

The family lived in Panama from 1957 to 1961, when they moved to the Fort Knox area. None of the family members had a history of malaria or any unexplained illness with fever. Both children were born at Ireland Army Hospital; neither child had ever traveled outside Kentucky and neither had ever had a transfusion.

The children almost never left their neighborhood at Fort Knox. Light trap mosquito catches in the area during the summer of 1965 yielded both Anopheles quadrimaculatus and A. punctipennis in low numbers. Epidemiologic investigations included a house-to-house fever survey near the children's residence, a telephone survey of practicing physicians in the area, and analysis of all malaria cases among military personnel in the United States with onset between January 1965 and May 15, 1966. No additional malaria cases were uncovered nor was an index case identified, although many servicemen previously stationed in Southeast Asia had resided in close proximity to the home of the two children at Fort Knox. The rarity of documented introductions suggests that the children were infected during the same period of time. This may have occurred during the preceding summer since the possibility of a delayed primary attack cannot be excluded. Also, low temperatures during the winter are not favorable for mosquito breeding. The data provide presumptive evidence of an episode of introduced malaria in the U.S.

(Reported by Dr. Calixto Hernandez, Medical Director, Division of Epidemiology, and Dr. Joseph Skaggs, Kentucky State Department of Health; Lt. Col. Robert Quinn, Chief of Preventive Medicine at Fort Knox, Ky., and James P. Luby, M.D., EIS Officer, Atlanta, Ga.)

Blood Transfusion-Induced Malaria

Case No. 3

A case of blood transfusion-induced malaria in a 64-year-old man was reported from New York City. The patient had onset of chills and fever on October 29, 1966; P. falciparum parasites were identified in the blood smears. He had not traveled outside the United States since he immigrated from Italy in 1913 and had no history of injections with a shared syringe. During the 2-year period prior to the onset of malaria, the patient had received 70 units of blood because of massive bleedings from the urinary tract.

During the 2 months preceding the onset of illness he received two units of blood on September 6 and 20, and on October 14, 1966. Five of the six donors were located, and none of them had a history of malaria, overseas travel, blood transfusions, or drug addiction. The sixth donor was identified as a 28-year-old male Ghanaian who had resided in New York City from July through November 1966. He had donated blood on October 14. At the time of the investigation, the donor had returned to Ghana. The blood bank records did not indicate a history of malaria in this donor, but malaria is known to be endemic in Ghana.

(Reported by Dr. Tibor Fodor, Chief, Division of Epidemiology and Diagnosis, and Dr. Howard B. Shookhoff, Chief, Tropical Disease Division, both of the Bureau of Preventable Diseases, City of New York Department of Health; and Dr. Murray Wittner, Department of Pathology, Albert Einstein College of Medicine, Bronx, New York.)

Congenital Malaria

Case No. 4

A case of congenital malaria in a 2-1/2-month-old girl was diagnosed in August, 1966 in Chicago. The infant was the first child of Filipino parents, born after a full-term normal pregnancy and delivery; she was in good health until the onset of spiking fever at 72-hour intervals at the age of 7 weeks. P. malariae schizonts were found in blood smears.

The mother had no history of malaria either in the Philippines or since her arrival in the United States in 1963. However, careful review of differential blood smears obtained from her during a routine prenatal visit and at the time of delivery revealed one trophozoite and six trophozoites, respectively, identified as P. malariae.

Neither mother nor child had a history of transfusions. The father had a history of malaria during World War II as a child, but has had no attacks since that time. Repeated blood films from him were negative for malaria parasites. The family lived in a modern, air-conditioned, and well screened apartment in Chicago. Since her birth, the infant had been outside only on four brief occasions, all in the Chicago area. No cases of P. malariae are known to have occurred in Chicago during the preceding three years and no anopheline mosquitoes have been trapped there during that period.

Congenital malaria appears to occur infrequently even in highly endemic malarious areas. The reported incidence varies from 0.03 to 9.6 percent.³ Spitz⁴ observed no malaria parasites in blood films of 136 newborn infants in Nigeria, although heavy infection of the maternal side of the placenta was found. As borne out by this case, congenital malaria can occur in the absence of symptomatic malaria in the mother during pregnancy.

(Reported by Dr. R. M. McQuay, Parasitologist, Dr. S. Silberman, Pathologist, and Pola Mudrik, all at Mt. Sinai Hospital, Chicago; Dr. L. Keith, Pediatrician, Presbyterian-St. Luke's Hospital, Chicago; Dr. Norman J. Rose, State Epidemiologist, Illinois Department of Health, Springfield; and Dr. Samuel L. Andelman, Chicago Commissioner of Health)

Cryptic Case of Malaria

Case No. 5

On October 14, 1966, a 32-year-old male nurse in a military hospital in St. Albans, Long Island, New York, was admitted with a 2-day history of intermittent fever, myalgia, and malaise. On the first, third and fifth days of hospitalization he had spiking fevers up to 105°F. Peripheral blood smears contained ring forms of P. vivax. Antimalarial treatment was initiated following diagnosis.

The patient was born in Upstate New York and had never been overseas. He did not have a history of blood transfusions or use of shared syringes. He had no previous history of unexplained fevers.

Since September 1966, the patient had worked on the surgical ward, where his duties included drawing blood specimens from patients for routine analysis. Among these

patients were at least two returnees from Vietnam who had a history of malaria. The presence of parasitemia in these patients could not firmly be established, although fluorescent antibodies to P. vivax were subsequently found in the serum of one of these patients. No other unexplained cases of malaria have been detected in the area. In the absence of a clear mode of transmission and without secondary cases, this isolated case of malaria has been classified as cryptic.

(Reported by Dr. Howard B. Shookhoff, Chief, Tropical Disease Division, Bureau of Preventable Diseases, City of New York Dept. of Health, and Captain Donald C. Kent, Chief of Medicine, U. S. Naval Hospital, St. Albans, Long Island, N.Y.)

VI. DEATHS DUE TO MALARIA IN THE UNITED STATES

Case No. 1

A 24-year-old white serviceman left Vietnam on April 2, 1966. At the time of departure he had a fever. Upon arrival in the United States on April 3, his fever had increased, and on April 7 he experienced chills, fever, malaise, and myalgia. He was admitted to a military hospital in North Carolina on April 8, 1966, where blood smears were found to be positive for P. falciparum. He was treated with 2-1/2 gram of chloroquine over a 2-day period. On the day after admission, intravascular hemolysis was evident with hemoglobinuria and impairment of the renal function. The plasma hemoglobin level was 99 mg.percent. On April 10 he was given 30 grains of quinine orally. On April 11 the hematocrit was 23. He was then given 10 grains of quinine intravenously which was repeated 16 hours later. He also received one unit of whole blood and two units of packed red blood cells. On April 12 the plasma hemoglobin was 340 mg. percent. He received two additional doses of 10 grains of quinine intravenously. On April 13, his hematocrit was 27 and he received an additional unit of packed cells and 400 mg. of chloroquine intramuscularly. On that date the patient was transferred to the Walter Reed General Hospital in Washington, D.C.

On admission to this hospital his BUN was 102, hematocrit 30, the urine showed numerous red and white blood cells. A blood smear showed 226,000 parasites per mm.³ Quinine, 10 grains was given by mouth and an alkaline diuresis was initiated with I.V. mannitol and sodium bicarbonate. The patient developed a hemorrhagic pneumonitis due to Escherichia coli. Despite penicillin and packed red blood cell transfusions, the patient died 8 hours after his transfer. The diagnoses in this case were hemorrhagic pneumonitis, due to E. coli; malaria due to P. falciparum; acute intravascular hemolysis secondary to malaria, and acute renal failure.

(Reported by Colonel Hershell E. Griffin, MC, USA, Chief, Preventive Medicine Division, Office of the Surgeon General, Department of the Army, Washington, D.C.)

Case No. 2

A Negro minister from Florida and his wife arrived in Liberia on June 20, 1966. They stayed in Monrovia for 2 days before proceeding to a small village 18 miles from the capital where they remained until July 2. During their trip they took no malaria chemoprophylaxis and no precautions against mosquitoes.

On July 12 while en route to the United States by ship, the minister complained of weakness and fever. After the ship docked in Baltimore, Maryland, on July 14, the couple traveled by train to their home in Ocala, Florida. During the following week the minister remained alert but felt tired. He died suddenly on July 18.

The autopsy demonstrated a heavy infection with P. falciparum; parasites were found in all organs, including sections of brain.

(Reported by Dr. E. Charlton Prather, Director, Division of Epidemiology, Florida State Board of Health; Dr. James B. Stapleton, Director, Marion County Health Department, Ocala, Florida)

Case No. 3

A 36-year-old white serviceman arrived in California on November 8, 1966, from Vietnam. Eight days later the patient experienced fever, chills, headache, and a single episode of nausea. On the night of his hospital admission in Utah on November 18, 1966, his temperature was 103°F., but returned to normal the next morning.

Physical examination and laboratory data on admission revealed no abnormal findings. His hematocrit was 46 percent. During his entire hospital stay the patient complained only of a slight headache and lethargy. The patient remained afebrile.

On the morning of the seventh hospital day, the patient became increasingly lethargic and semi-stuporous. At this time the peripheral blood smears revealed the presence of P. falciparum. One gram of quinine and one gram of chloroquine were given by mouth. The patient died within a few hours.

The autopsy revealed hepatosplenomegaly, visceral congestion with malaria pigment in all organs, small perivascular petechial hemorrhages in the brain, and the presence of a few mature schizonts in the red blood cells.

(Reported by Dr. Robert Sherwood, Director, Division of Preventive Medicine, and Dr. Alton Jenkins, Head, Communicable Disease Section, both of the Utah State Department of Health, Salt Lake City, Utah; and Col. Arthur E. Weigel, USAF, MC, Commander, Hill Air Force Base, Utah)

Case No. 4

After returning from Vietnam on December 14, 1966, a 24-year-old white serviceman was admitted to a hospital in Florida on December 24 with a history of recent chills and fever. During the next 7 days he had irregular spiking fevers and was in a semi-comatose condition. Peripheral blood smears showed large numbers of P. falciparum. Rapidly progressive anemia resulted in a hemoglobin level of 5.4 gm. on December 28. The patient was treated with chloroquine and quinine and blood transfusions but expired in coma on January 2, 1967. Autopsy showed cerebral edema with microscopic focal necrosis in addition to hepatosplenomegaly with marked pigmentation.

(Reported by Dr. E. Charlton Prather, Director, Bureau of Preventable Disease, Florida State Board of Health, Jacksonville, Florida)

VII. MALARIA SURVEILLANCE REVIEW, 1957-1966

During the past 10 years of malaria surveillance in the United States, 1,633 malaria cases have been reported to the NCDC (Table VII). Only 39 of these cases acquired their infection in the United States. Four of these 39 cases occurred in Oklahoma in 1957, and they were the last reported malaria cases in the United States that could be classified as indigenous.

Three episodes of introduced malaria occurred in the past 10 years: California - 3 cases, 1957; Georgia - 2 cases, 1964-65; and Kentucky - 2 cases, 1966. All of these were infected with P. vivax. The source of infection in California was thought to be a Mexican agricultural worker. The Georgia cases were epidemiologically associated with a serviceman who had been stationed in Korea, and the two cases in Kentucky were presumably also related to an infected serviceman. No further cases associated with these episodes of introduction were detected.

One case of congenital malaria due to P. malariae occurred, in 1966 (page 12).

During the 10-year period, 12 isolated malaria cases (cryptic) were reported in individuals who had not been in malaria endemic areas. They had no history of previous malaria, blood transfusions, or use of shared syringes. Appropriate investigations were unsuccessful in detecting any associated cases, so the mode of transmission remains obscure. Three plasmodium species were identified in these solitary cases: P. vivax in 6 cases, P. malariae in 5, and P. falciparum in one.

In 15 cases, the infection was acquired through artificial means. Vivax malaria was diagnosed in 1962 and 1963 in two persons who experienced a relapse following release from a Federal penitentiary where they had voluntarily participated in malaria chemotherapy studies. A case of P. malariae occurred in 1961 in a drug addict in Washington, D.C. In the remaining 12 induced cases, malaria occurred following administration of blood transfusions (Table VIII). In only 2 of these were the infected donors identified. P. malariae accounted for 7 cases; P. vivax, 2; P. falciparum, 1; mixed infection of P. malariae and P. falciparum, 1; and in 1 case the species was not identified.

All 11 deaths in the 10 year period were due to P. falciparum infections.

VIII. REPORT FROM THE NATIONAL MALARIA REPOSITORY - 1966

The diagnosis of the plasmodium species could be confirmed in blood smears from 252 of the 403 cases (62.5%) in which slides were reviewed at the NCDC. In 19 cases (4.7%) a different species was identified by the NCDC Laboratory, and in 35 cases (8.7%) no species identification had been made by the submitting laboratory. Examination of the smears of 86 cases (21.3%) did not reveal the presence of malaria parasites. Improper preparation of slides of 11 cases (2.7%) precluded adequate identification.

The necessity of an accurate diagnosis and the quality of the blood film on which it is inevitably based cannot be overemphasized. The following guidelines are

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Physical examination and laboratory data on admission revealed no abnormal findings. His hematocrit was 46 percent. During his entire hospital stay the patient complained only of a slight headache and lethargy. The patient remained afebrile.

On the morning of the seventh hospital day, the patient became increasingly lethargic and semi-stuporous. At this time the peripheral blood smears revealed the presence of P. falciparum. One gram of quinine and one gram of chloroquine were given by mouth. The patient died within a few hours.

The autopsy revealed hepatosplenomegaly, visceral congestion with malaria pigment in all organs, small perivascular petechial hemorrhages in the brain, and the presence of a few mature schizonts in the red blood cells.

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After returning from Vietnam on December 14, 1966, a 24-year-old white serviceman was admitted to a hospital in Florida on December 24 with a history of recent chills and fever. During the next 7 days he had irregular spiking fevers and was in a semi-comatose condition. Peripheral blood smears showed large numbers of P. falciparum. Rapidly progressive anemia resulted in a hemoglobin level of 5.4 gm. on December 28. The patient was treated with chloroquine and quinine and blood transfusions but expired in coma on January 2, 1967. Autopsy showed cerebral edema with microscopic focal necrosis in addition to hepatosplenomegaly with marked pigmentation.

(Reported by Dr. E. Charlton Prather, Director, Bureau of Preventable Disease, Florida State Board of Health, Jacksonville, Florida)

VII. MALARIA SURVEILLANCE REVIEW, 1957-1966

During the past 10 years of malaria surveillance in the United States, 1,633 malaria cases have been reported to the NCDC (Table VII). Only 39 of these cases acquired their infection in the United States. Four of these 39 cases occurred in Oklahoma in 1957, and they were the last reported malaria cases in the United States that could be classified as indigenous.

Three episodes of introduced malaria occurred in the past 10 years: California - 3 cases, 1957; Georgia - 2 cases, 1964-65; and Kentucky - 2 cases, 1966. All of these were infected with P. vivax. The source of infection in California was thought to be a Mexican agricultural worker. The Georgia cases were epidemiologically associated with a serviceman who had been stationed in Korea, and the two cases in Kentucky were presumably also related to an infected serviceman. No further cases associated with these episodes of introduction were detected.

One case of congenital malaria due to P. malariae occurred, in 1966 (page 12).

During the 10-year period, 12 isolated malaria cases (cryptic) were reported in individuals who had not been in malaria endemic areas. They had no history of previous malaria, blood transfusions, or use of shared syringes. Appropriate investigations were unsuccessful in detecting any associated cases, so the mode of transmission remains obscure. Three plasmodium species were identified in these solitary cases: P. vivax in 6 cases, P. malariae in 5, and P. falciparum in one.

In 15 cases, the infection was acquired through artificial means. Vivax malaria was diagnosed in 1962 and 1963 in two persons who experienced a relapse following release from a Federal penitentiary where they had voluntarily participated in malaria chemotherapy studies. A case of P. malariae occurred in 1961 in a drug addict in Washington, D.C. In the remaining 12 induced cases, malaria occurred following administration of blood transfusions (Table VIII). In only 2 of these were the infected donors identified. P. malariae accounted for 7 cases; P. vivax, 2; P. falciparum, 1; mixed infection of P. malariae and P. falciparum, 1; and in 1 case the species was not identified.

All 11 deaths in the 10 year period were due to P. falciparum infections.

VIII. REPORT FROM THE NATIONAL MALARIA REPOSITORY - 1966

The diagnosis of the plasmodium species could be confirmed in blood smears from 252 of the 403 cases (62.5%) in which slides were reviewed at the NCDC. In 19 cases (4.7%) a different species was identified by the NCDC Laboratory, and in 35 cases (8.7%) no species identification had been made by the submitting laboratory. Examination of the smears of 86 cases (21.3%) did not reveal the presence of malaria parasites. Improper preparation of slides of 11 cases (2.7%) precluded adequate identification.

The necessity of an accurate diagnosis and the quality of the blood film on which it is inevitably based cannot be overemphasized. The following guidelines are

Table VII

Classification of Reported Malaria Cases, United States, 1957-1966

Year	Presumptive Indigenous	Introduced	Cryptic	Induced	Imported	Total	Deaths
1957	4	3	-	1	93	101	-
1958	-	-	1	4	65	70	-
1959	-	-	-	2	48	50	1
1960	-	-	2	-	60	62	-
1961	-	-	2	2	78	82	1
1962	-	-	1	2	112	115	-
1963	-	-	3	2	143	148	3
1964	-	1	1	1	168	171	-
1965	-	1	1	-	154	156	2
1966	-	2	1	1	673	678*	4
TOTAL 1957-1966	4	7	12	15	1594	1633*	11

* Includes 1 case of congenital malaria.

Table VIII

BLOOD TRANSFUSION INDUCED MALARIA, UNITED STATES, 1957-1966

Year	State	<u>Plasmodium</u> <u>Species</u>	Number of Units of Blood	Blood Donor Identified
1957	Calif.	<u>vivax</u>	several	no
1958	N.Y.C.	<u>malariae</u>	1	yes
	Calif.	<u>malariae</u>	75	no
	Ark.	<u>vivax</u>	6	no
	Hawaii	unknown	unknown	unknown
1959	Calif.	<u>malariae</u>	40	no
	Md.	<u>malariae</u>	unknown	no
1960	-	-	-	-
1961	Calif.	<u>malariae</u>	unknown	no
1962	Upstate N.Y.	<u>malariae</u>	unknown	no
1963	N.Y.C.	<u>malariae</u> & <u>falciparum</u>	23	no
1964	Upstate N.Y.	<u>malariae</u>	3	no
1965	-	-	-	-
1966	N.Y.C.	<u>falciparum</u>	70	yes

important in the preparation of blood films for malaria diagnosis. The ideal smear is one which incorporates a thick and a thin film as illustrated below.

1. Manufacturers' "pre-cleaned" slides are not considered clean enough for use in malaria diagnosis. Prior to use, such slides should be washed in mild detergent, rinsed thoroughly in warm running water, then in distilled water, and dipped in ethyl alcohol (90-95%). Slides may then be wiped dry with a lintless cloth or tissue for immediate use or stored in 95% alcohol until needed.
2. The patient's finger should be cleaned with alcohol and wiped dry with a clean cloth or gauze.
3. After puncturing the finger with the blood lancet, allow a large globule of blood to form.
4. Place cleaned surface of slide against drop of blood and with a quick circular motion, make a film the size of a dime in the middle third of one end of the slide. Ordinary newsprint should be barely legible through such a wet drop (Fig. 4). (Excessive mixing or stirring with a second slide leads to distortion of blood cells and parasites.)
5. The finger should then be wiped dry and a small drop of blood gently squeezed from the puncture and placed at the edge of the middle third of the same slide (Fig. 5).
6. Apply a clean "spreader" slide to the edge of the small drop at a 45° angle and allow the blood to extend about two-thirds of the slide width; then keeping even contact, push the spreader forward along the slide. This will produce an even layer of red blood cells with a "feathering" at the lower edge (Fig. 6).
7. The blood film should be kept horizontal and protected from dust and insects while the thick film dries (minimum of 6 hrs. at room temperature). *
8. Label the slide in the upper part of the thin film with the date and the name or initials of the patient as illustrated (Fig. 6).

* If a rapid diagnosis is desired, the thin and thick films may be made on separate slides. The thin film can be air dried, fixed with methyl alcohol, and stained immediately. If no parasites are found on the thin film, the thick film should be examined subsequently for rare organisms not detected on the thin preparation.

IX. ACKNOWLEDGMENT

The Malaria Surveillance Report, prepared annually at the National Communicable Disease Center, is based on information provided on individual case reports. The tremendous 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. We are especially grateful to Dr. William E. Collins of the Laboratory of Parasite Chemotherapy, NIAID, NIH, for performing the fluorescent antibody tests noted in the report.

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, 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 PHS 4.80 (CDC). Extra copies of this form are available on request. Every effort should be made to obtain thick and thin blood smears for each case. These smears may be submitted with the Surveillance Form. Blood smears not only enable diagnostic confirmation but also serve, in the event of relapse or reinfections, as reference to previous disease.

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Figure 1.

REPORTED MALARIA IN THE UNITED STATES, 1933-1966

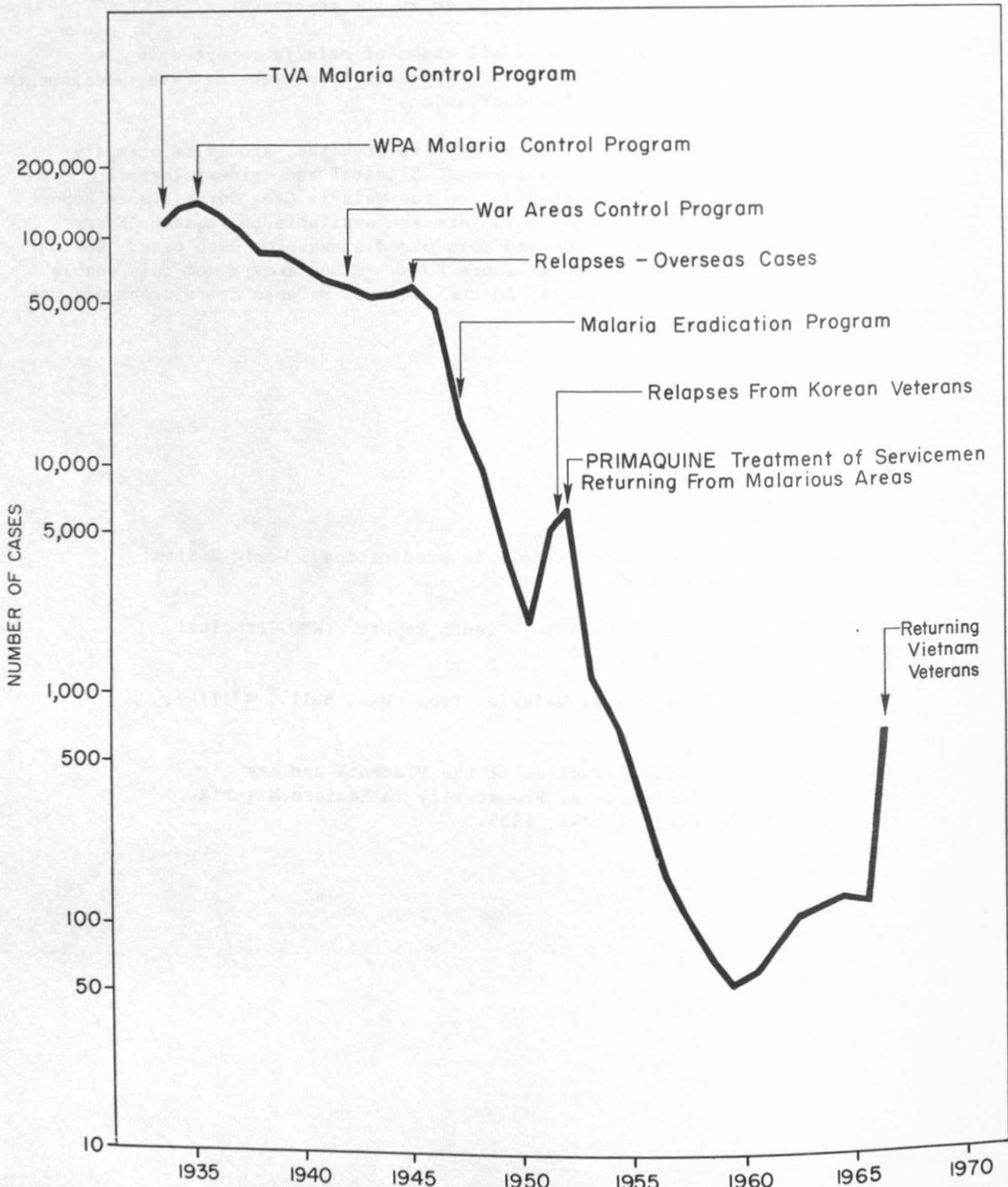


Figure 2.

MILITARY AND CIVILIAN CASES OF MALARIA
DIAGNOSED IN THE UNITED STATES DURING 1966
BY MONTH OF ONSET

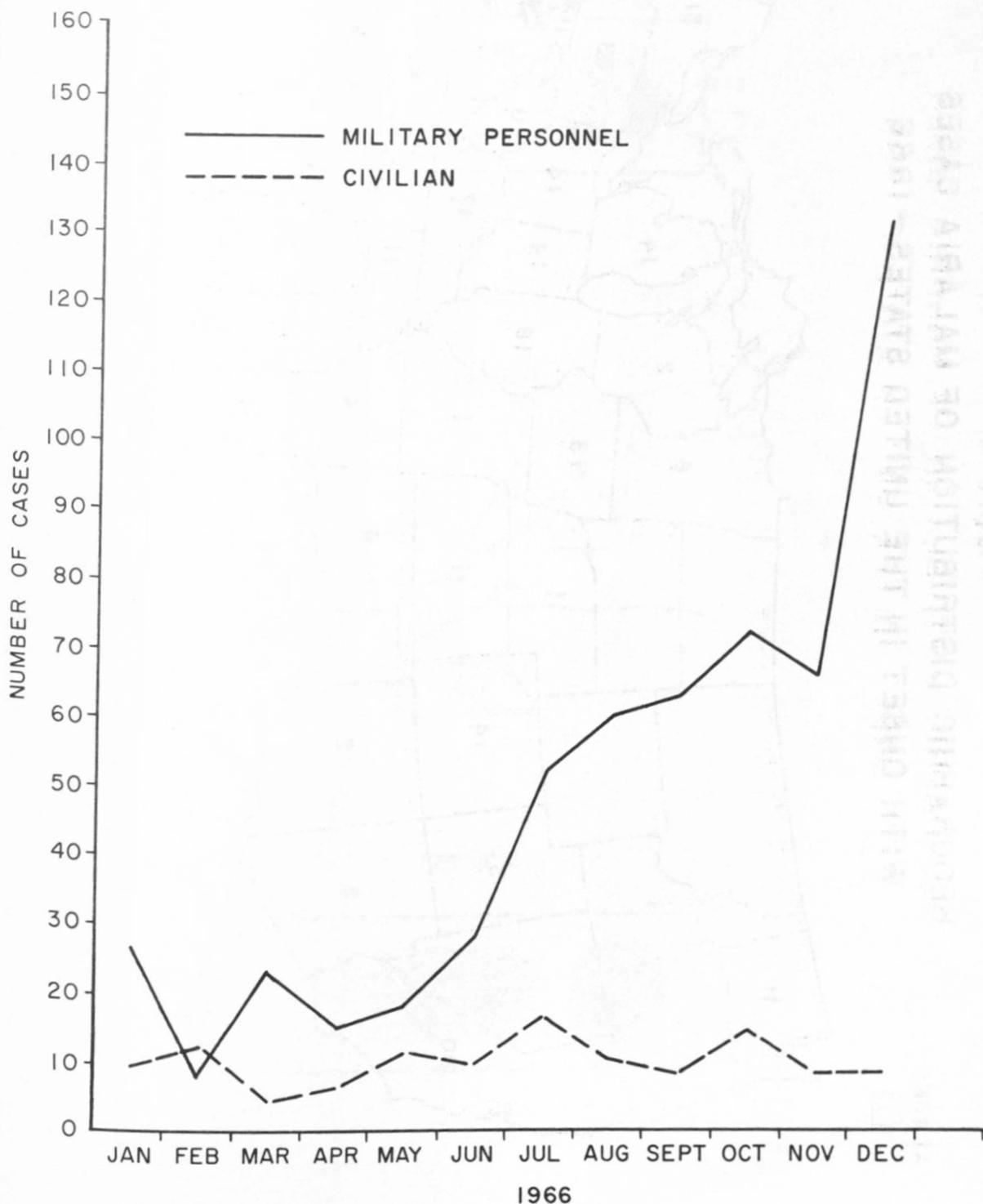
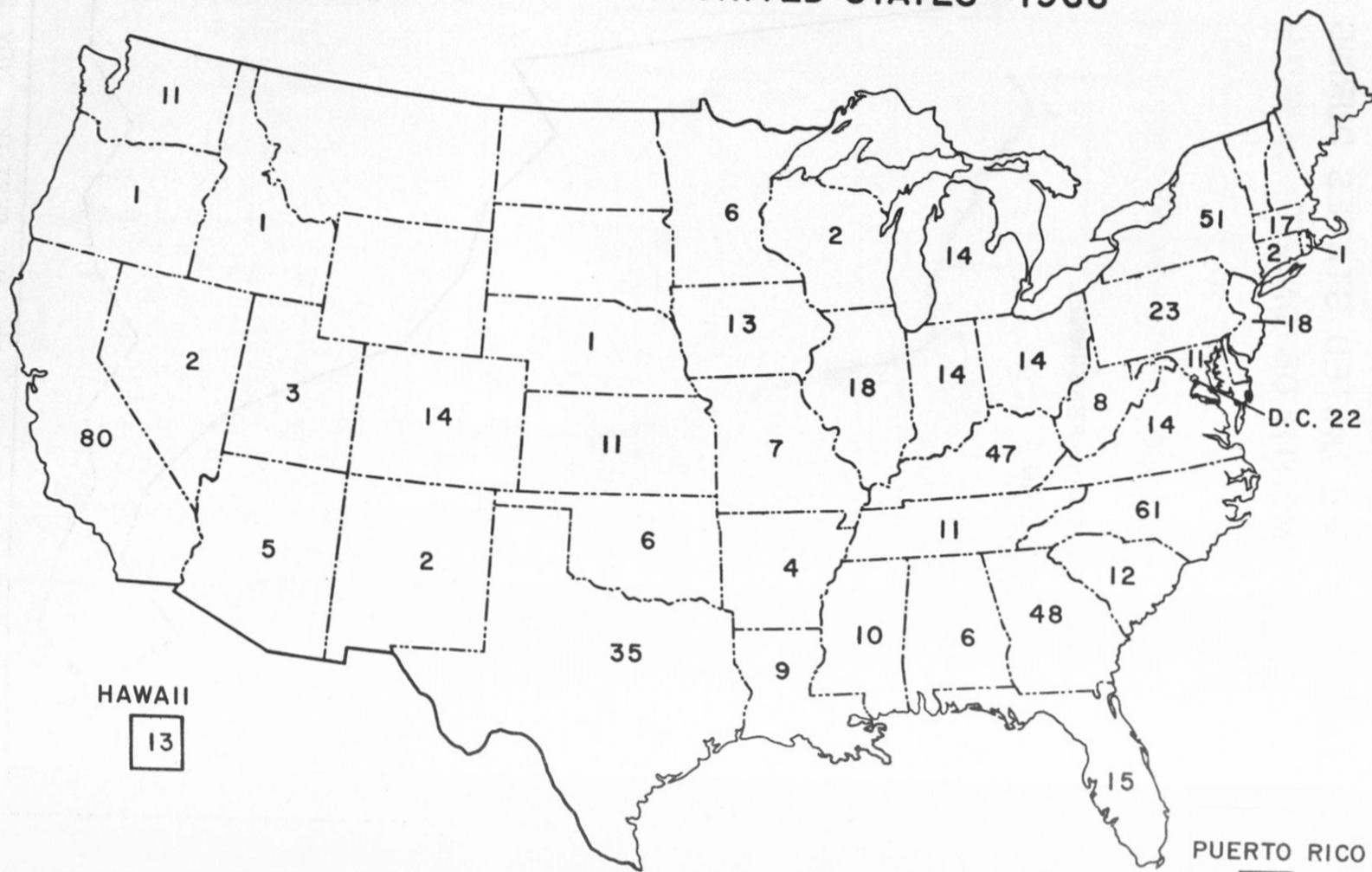


Figure 3.

GEOGRAPHIC DISTRIBUTION OF MALARIA CASES WITH ONSET IN THE UNITED STATES - 1966

ALASKA

1



HAWAII

13

PUERTO RICO

5



FIGURE 6

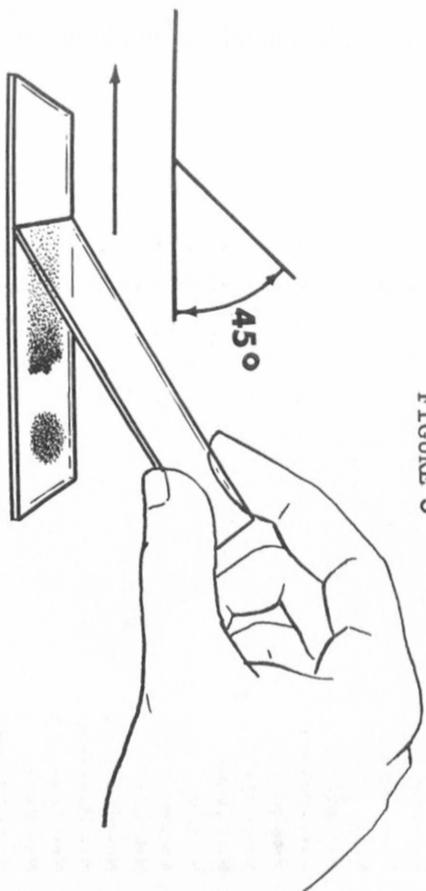


FIGURE 5

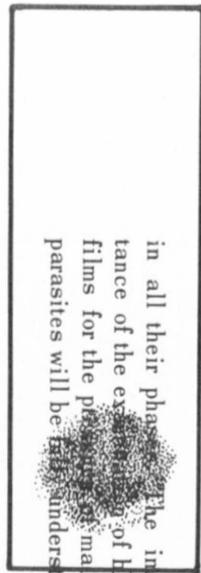


FIGURE 4

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 most vital role. Their major contributions to the evolution of this report are gratefully acknowledged.

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