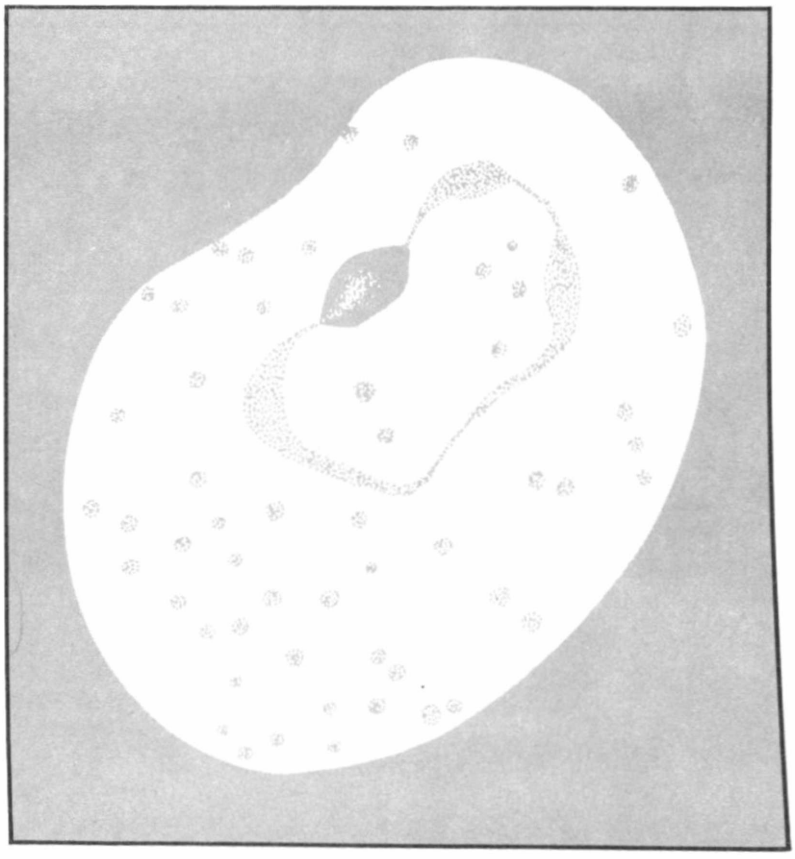
ANNUAL SUMMARY 1986
Issued October 1987

CENTERS FOR DISEASE CONTROL

MALARIA

SURVEILLANCE



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES • Public Health Service

PREFACE

This report summarizes information received from state health departments, medical departments of the Armed Forces, and other sources. It is intended primarily for those responsible for disease control activities. Before quoting this report, contact the original investigator for confirmation and interpretation.

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

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SUGGESTED CITATION

Centers for Disease Control: Malaria Surveillance Annual Summary 1986
Issued October 1987

I. SUMMARY

During 1986, 1,091 cases of malaria diagnosed in the United States were reported to the Centers for Disease Control (CDC). This compares with 1,045 cases reported in 1985, an increase of 4%. There were 410 reported cases with onset in 1986 in U.S. civilians and 646 reported cases in foreign civilians.

Plasmodium vivax was the parasite identified in 63% of the 1,091 cases, and *P. falciparum* was identified in 26%. *P. malariae* and *P. ovale* were reported in 4% and 2% of the cases, respectively. The species was not determined in the rest.

Only 36 of the 1,091 persons acquired the infection in the United States. Congenital infection accounted for 1 case, blood transfusion for 2, and infected mosquitoes for 33.

Three deaths attributed to malaria were reported for 1986, compared with 12 for 1985.

II. TERMINOLOGY

This report uses terminology derived from the recommendations of the World Health Organization (WHO)(1). Definitions of the following terms are included for reference.

A. Autochthonous

1. Indigenous--malaria acquired by mosquito transmission in an area where malaria occurs regularly.

2. Introduced--malaria acquired by mosquito transmission from an imported case in an area where malaria does not occur regularly.

B. Imported

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

C. Induced

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

D. Relapsing

Renewed manifestation (of clinical symptoms and/or parasitemia) of malarial infection that is separated from previous manifestations of the same infection by an interval greater than any due to the normal periodicity of the paroxysms.

E. Cryptic

An isolated case of malaria ascertained by appropriate epidemiologic investigation not to be associated with secondary cases.

III. GENERAL SURVEILLANCE

A total of 1,091 cases* with onset of illness in 1986 in the United States were reported to the Division of Parasitic Diseases, Center for Infectious Diseases, Centers for Disease Control (CDC) compared with 1,045 cases reported for 1985. Only 35 cases occurred in U.S. military personnel. Civilians have accounted for most of the cases each year since 1973 (Table 1).

The number of malaria cases in U.S. civilians declined from 446 in 1985 to 410 in 1986, an 8% decrease (Figure 1). Malaria in foreign civilians increased from 568 reported cases in 1985 to 646 in 1986, an increase of 14% .

Table 1. All Primary Malaria Cases in Civilians and Military Personnel with Onset of Illness in the United States, 1966-1986*

Year	Military	U.S. Civilians	Foreign Civilians	Unknown	Total
1966	621	89	32	22	764
1967	2,699	92	51	15	2,857
1968	2,567	82	49	0	2,698
1969	3,914	90	47	11	4,062
1970	4,096	90	44	17	4,247
1971	2,975	79	69	57	3,180
1972	454	106	54	0	614
1973	41	103	78	0	222
1974	21	158	144	0	323
1975	17	199	232	0	448
1976	5	178	227	5	415
1977	11	233	237	0	481
1978	31	270	315	0	616
1979	11	229	634	3	877
1980	26	303	1,534	1	1,864
1981	21	273	809	0	1,103
1982	8	348	574	0	930
1983	10	325	468	0	803
1984	24	360	632	0	1,016
1985	31	446	568	0	1,045
1986	35	410**	646***	0	1,091

*includes Puerto Rico, the Virgin Islands, and Guam.
**includes 10 cases acquired in the United States.
*** includes 26 cases acquired in the United States.

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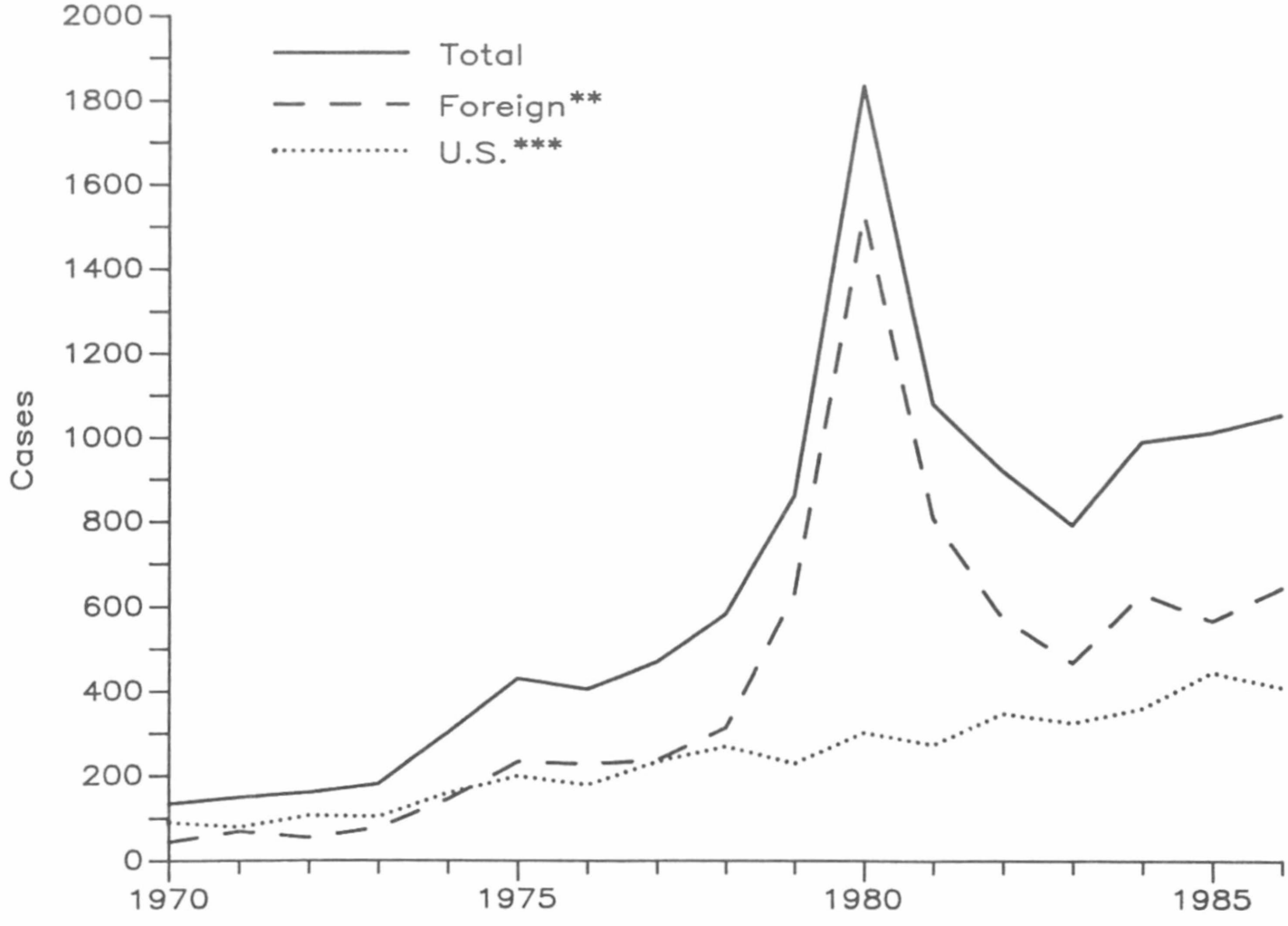
*A "case" is defined as: 1) a person's first attack of malaria in the United States, regardless of whether or not he/she had experienced previous attacks of malaria while outside the country and 2) a positive peripheral blood smear examined in the local or state health department laboratory. Inconclusive blood smears were referred to the National Malaria Repository, CDC, for confirmation. A subsequent attack in the same person caused by a different Plasmodium species is counted as an additional case. A repeated attack in the same person in this country caused by the same species is not considered an additional case.

Fig. 1 Cases of malaria in U.S. and foreign civilians, United States, 1970–1986*



* Includes Puerto Rico, the Virgin Islands, and Guam
** Includes 26 cases acquired in the United States
*** Includes 10 cases acquired in the United States

Only 36 of the 1,091 patients acquired the infection in the United States. Congenital infection accounted for 1 case, blood transfusion for 2, and infected mosquitoes for 33 cases.

The Plasmodium species was identified in 1,041 of the 1,091 cases (95.4%). In 1986, P. vivax was identified in blood from 63% and P. falciparum in blood from 26% of the infected persons (Table 2).

Table 2. Malaria Cases by Plasmodium Species, United States, 1985-1986

Species	1985 Total	1985 Percent	1986 Total	1986 Percent
P. vivax	611	58.5	692	63.4
P. falciparum	303	29.0	281	25.8
P. malariae	49	4.7	44	4.0
P. ovale	21	2.0	21	1.9
Mixed	5	0.5	3	0.3
Undetermined	56	5.4	50	4.6
TOTAL	1,045	100.0	1,088	100.0

The countries of origin of the 1,091 patients are listed in Table 3. The geographic distribution of the malaria cases within the United States is shown in Figure 2 by the State in which the patient first developed clinical symptoms of malaria.

Fig. 2 Geographic distribution of malaria cases with onset in the United States, 1986

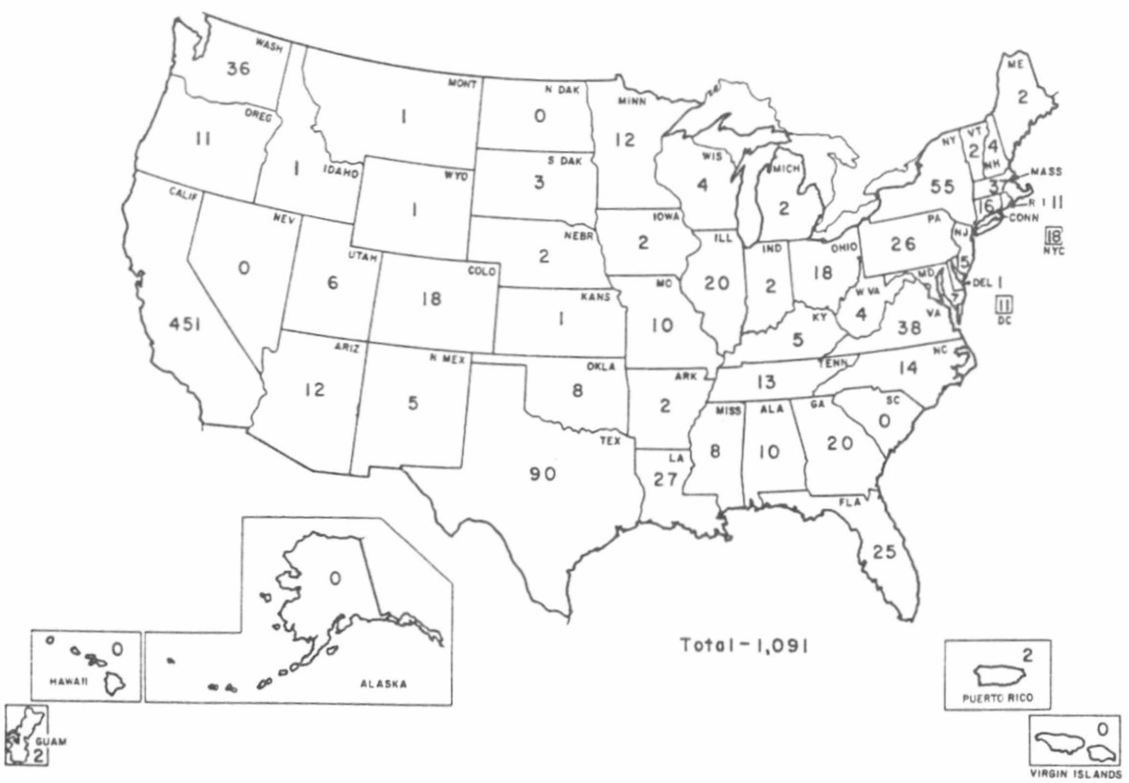


Table 3 Malaria Cases by Distribution of Plasmodium Species and Area of Acquisition, United States, 1986*

Area of Acquisition	vivax	falciparum	malariae	ovale	mixed	unknown	Total
AFRICA	60	217	15	20	0	21	333
Africa, East**	5	11	0	0	0	0	16
Africa, West**	2	4	2	3	0	2	13
Africa, South**	0	0	0	1	0	0	1
Africa, Central	1	0	0	0	0	0	1
Africa, Unspecified**	10	9	1	0	0	1	21
Angola	0	3	0	0	0	0	3
Benin	0	1	0	0	0	0	1
Cameroon	0	1	0	1	0	1	3
Central Afr. Rep.	0	3	0	1	0	0	4
Chad	0	1	0	1	0	0	2
Ethiopia	2	1	0	0	0	0	3
Gabon	0	3	0	0	0	0	3
Gambia	0	0	0	0	0	1	1
Ghana	4	7	1	3	0	1	16
Guinea	0	1	0	0	0	0	1
Ivory Coast	0	2	0	0	0	0	2
Kenya	9	60	2	3	0	4	78
Liberia	2	2	2	2	0	2	10
Malagasy Republic	0	2	0	0	0	0	2
Malawi	0	5	0	0	0	0	5
Mali	0	1	0	0	0	0	1
Nigeria	12	66	6	4	0	7	95
Senegal	0	1	0	0	0	0	1
Sierra Leone	2	7	0	1	0	0	10
Somali Republic	1	1	0	0	0	0	2
Sudan	5	1	0	0	0	0	6
Tanzania	1	12	0	0	0	0	13
Togo	0	1	0	0	0	0	1
Uganda	1	0	0	0	0	0	1
Zaire	2	8	0	0	0	0	10
Zambia	1	3	0	0	0	1	5
Zimbabwe	0	0	1	0	0	1	2
ASIA	359	33	20	1	3	19	435
Asia, South East**	56	7	1	0	1	2	67
Asia, Unspecified**	0	1	0	0	0	0	1
Afghanistan	4	4	0	0	1	0	9
India	201	8	16	0	0	14	239
Indonesia	12	1	1	1	0	0	15
Iran	2	0	0	0	0	0	2
Kampuchea	2	0	0	0	0	1	3
Malaysia	1	0	0	0	0	0	1
Pakistan	41	1	1	0	0	1	44
Philippines	29	8	0	0	1	1	39
Thailand	3	2	0	0	0	0	5
Vietnam	9	1	1	0	0	0	11
CENTRAL AMERICA AND CARIBBEAN	84	9	3	0	0	5	101
Central Amer. Unspec.**	2	0	0	0	0	0	2
Belize	8	0	0	0	0	0	8
El Salvador	46	0	1	0	0	2	49
Guatemala	8	0	0	0	0	0	8
Haiti	0	6	0	0	0	1	7
Honduras	13	3	1	0	0	0	17
Nicaragua	4	1	1	0	0	1	7
Panama	3	0	0	0	0	1	4
NORTH AMERICA	147	2	6	0	0	1	156
Mexico	114	1	5	0	0	1	121
United States	34	1	1	0	0	0	36
SOUTH AMERICA	7	6	0	0	0	0	13
Bolivia	1	1	0	0	0	0	2
Brazil	2	1	0	0	0	0	3
Colombia	4	1	0	0	0	0	5
Ecuador	0	1	0	0	0	0	1
Guyana	0	2	0	0	0	0	2
OCEANIA	24	10	0	0	0	4	38
New Guinea	23	10	0	0	0	4	37
Solomon Islands	1	0	0	0	0	0	1
UNKNOWN	9	3	0	0	0	0	12
TOTAL	692	281	44	21	3	50	1,091

*includes Puerto Rico, Virgin Islands, and Guam
**Country Unspecified

The interval between the date of arrival in the United States and the date of onset of illness was known for 588 of the imported cases for which the infecting Plasmodium species was also identified. Clinical malaria developed within 1 month after arrival in 87.8% of the patients with P. falciparum malaria and in 26.8% of the patients with P. vivax infections (Table 4). Only 19 (3.2%) of the 577 patients became ill 1 year or more after their arrival in the United States.

Table 4. Imported Malaria Cases by Interval between Date of Entry and Onset of Illness and by Plasmodium Species, United States, 1986

Interval (in months)	PLASMODIUM SPECIES								Total	(%)
	vivax	(%)	falciparum	(%)	malariae	(%)	ovale	(%)		
<1	105	(26.9)	144	(87.9)	11	(50.0)	2	(18.2)	262	(44.7)
1-2	94	(24.1)	15	(9.1)	6	(27.2)	3	(27.3)	118	(20.0)
3-5	85	(21.7)	2	(1.2)	4	(18.2)	4	(36.4)	95	(16.2)
6-11	90	(23.0)	2	(1.2)	1	(4.5)	1	(9.1)	94	(15.9)
≥12	17	(4.3)	1	(0.6)	0	(0)	1	(9.1)	19	(3.2)
TOTAL	391	(100.0)	164	(100.0)	22	(100.0)	11	(100.0)	588	(100.0)

Three fatal malaria infections were reported in 1986, compared with 12 in 1985. These cases are discussed in Section VII.

IV. MALARIA IN MILITARY PERSONNEL

Thirty-five cases of malaria in U.S. military personnel were reported in 1985. The Army accounted for 11 cases, the Navy for 3, and the Marine Corps for 20; for 1 case the branch of service is not known.

V. IMPORTED MALARIA IN CIVILIANS

Of the 1,020 imported malaria cases in civilians, 400 (39.3%) were in U.S. citizens, whereas 620 (60.7%) were in citizens of other countries (Table 5). Of the 400 imported cases in U.S. civilians, 219 (54.8%) were acquired in Africa and 88 (22.0%) were acquired in Asia.

Of the 219 infections acquired in Africa, 141 (64%) were caused by P. falciparum; 85 (60%) of these had been acquired in Kenya or Nigeria. P. falciparum infections acquired in Kenya by U.S. citizens increased from 10 cases in 1980 to 53 in 1986. The attack rate of P. falciparum in U.S. travelers to Kenya increased from 27 cases per 100,000 travelers in 1978 to 113 cases per 100,000 travelers in 1986 (Table 6).

Table 5. Imported Malaria Cases in Civilians, by Area of Infection, United States, 1986

Area of Acquisition	United States		Foreign		Total	
	Cases	Percent	Cases	Percent	Cases	Percent
Africa	219	54.6	112	18.1	331	32.5
Asia	88	21.9	324	52.4	412	40.4
Central America	21	5.3	67	10.8	88	8.6
Caribbean	3	0.8	4	0.5	7	0.7
Mexico	25	6.3	96	15.5	121	11.9
South America	5	1.3	8	1.3	13	1.3
Oceania	36	9.0	2	0.3	38	3.5
Unknown	3	0.8	7	1.1	10	1.0
TOTAL	400	100.0	620	100.0	1,020	100.0

Table 6. Attack Rates of P. falciparum in U.S. Travelers to Kenya 1978-1986

Year	Attack Rate*
1978	27
1979	24
1980	32
1981	50
1982	83
1983	91
1984	77
1985	189
1986	113

*Number of cases per 100,000 travelers

Of the 620 cases in foreign civilians 324 (52.3%) were acquired in Asia. Infections acquired in India accounted for 169 (27%) of the malaria infections in foreign civilians during 1986.

Most imported cases in U.S. civilians were in tourists (Table 7).

Table 7. Imported Malaria Cases in U.S. Civilians, by Category, United States, 1986

Category	Cases	Percent
Tourist	106	26.8
Business Representative	60	15.1
Government Employee	4	1.0
Missionary	50	12.7
Peace Corps	8	2.0
Seamen/Aircrew	6	1.5
Teacher/Student	21	5.3
Other	51	12.9
Unknown	94	23.7
TOTAL	400	100.0

VI. MALARIA ACQUIRED IN THE UNITED STATES

A. CONGENITAL MALARIA

One case of congenital malaria with onset of illness in 1986 was reported. The infection was due to P. vivax.

Case 1--A 30-day-old male infant was admitted to a Los Angeles hospital on August 6, 1986, with diarrhea, fever, and convulsions. P. vivax parasites were identified on a peripheral blood film. The infant was treated with chloroquine and had an uneventful recovery. The mother had visited her native Mexico at the end of 1985 and had been seen in June at the hospital with a history of fever, but no malaria parasites were observed on blood films. The infant had received a blood transfusion at 7 days of age. The donor had no history of foreign travel, intravenous (IV)-drug use, or malaria. Antibody titers of the donor with an indirect immunofluorescence (IIF) test for malaria were negative. The mother had a titer of 1:4096 to P. vivax and no antibodies to other Plasmodium species.

(Reported by M. Tormey, M.D., M.B. de Larde, M.D., M. Young, P.H.N., Los Angeles County Department of Health Services, R.R. Roberto, M.D., California Department of Health Services, Berkeley, California.)

B. TRANSFUSION MALARIA

Two cases of transfusion-associated malaria were reported in 1986.

Case 1--A 67-year-old West Virginia woman underwent open heart surgery on September 9, 1986, in Pittsburgh, Pennsylvania. On November 12, 1986, she was hospitalized in Steubenville, Ohio, with fever, nausea, vomiting, anemia and confusion. On November 15 P. malariae parasites were identified on a peripheral blood smear. The patient was treated with 2,500 mg of chloroquine and recovered uneventfully.

The patient had no history of previous malaria infection, foreign travel, or IV-drug use but had received 3 units of packed red blood cells and 2 units of fresh frozen plasma for the operation. Serum samples of the 5 donors were tested with an IIF test to determine the presence of antibodies to malaria. Only 1 donor had positive titers: 1:65,336 to P. malariae, 1:4,096 to P. ovale, 1: 256 to P. vivax and 1:256 to P. falciparum. This donor was a 41-year-old native of Rhodes, Greece, who had emigrated to Australia in 1960 and to the United States in 1970. She had returned to Greece for brief visits in 1973 and 1980. There was no history of previous malaria infection, travel to other malarious areas, blood transfusion, or IV-drug use.

This donor had given blood on 5 previous occasions. Four recipients of her red blood cells or platelets have died. Their physicians reported no malarial illness or fever of unknown origin before the patients' death. The fifth recipient was still alive and his serum was negative for antimalarial antibodies.

(Reported by R. Singh, M.D., K. Aggrawol, M.D., T. Gagliardi, R.N., Steubenville, Ohio, G. Ramsey, M.D., Director, Central Blood Bank, Pittsburgh, Pennsylvania, A.M. Eroshevich, Health Commissioner, Steubenville Health Department, Steubenville, Ohio, R. Agresta, M.D., Health Commissioner, Jefferson County Health Department, Steubenville, Ohio, Ellen Peterson, Ohio Department of Health, Columbus, Ohio, L. Haddy, West Virginia Department of Health.)

Case 2--A 64-year-old woman in Huntsville, Alabama, who had undergone a hysterectomy, developed postoperative fever at the end of May 1986, and P. falciparum parasites were identified on a peripheral blood smear. The patient was treated with quinine and tetracycline and recovered uneventfully from the malaria infection. She had no history of travel to malarious areas or of IV-drug use. She had, however, received 15 units of blood in multiple blood transfusions during hospitalizations in March, April, and May 1986. Blood samples of all 15 donors were tested with an IIF test for antibodies to malaria. Only 1 sample had positive titers: 1:4,096 to P. falciparum, 1: 4,096 to P. ovale, and <1:64 to P. vivax and P. malariae. This donor was in the Coast Guard stationed in Puerto Rico and could not be traced for follow-up.

(Reported by L.F. Harris, M.D., Huntsville, Alabama, L.R. Robey, M.D., Health Officer, Huntsville-Madison County Health Department, Huntsville, Alabama, W. Birch, M.D., State Epidemiologist, Montgomery, Alabama.)

C. INTRODUCED MALARIA

Four episodes of introduced malaria were identified in California in 1986. Episode 1 occurred in California in 1985 and was identified retrospectively. Episode 2 occurred in Carlsbad and included 2 American California residents and 25 Mexican migrant workers and represented the largest outbreak of introduced malaria since 1952. Episodes 3 and 4 occurred in 1986 and each involved 2 cases of P. vivax malaria.

Episode 1--An 8-year-old girl living in Yuba County, California, experienced onset of nausea, headache, chills, and fever (103.4° F) around July 23, 1986. Upon her admission to the hospital, P. vivax parasites were identified in a peripheral blood smear. The patient was treated with chloroquine and primaquine and had an uneventful recovery.

The patient had not traveled abroad, had not received transfusions, and denied IV-drug use. Her mother, a 27-year-old woman, had P. vivax malaria 9 months earlier, probably also acquired locally (Malaria Surveillance Annual Summary 1985, p. 11, Case 2). It is likely that the mother and daughter were infected in August 1985, when residing in neighboring Sutter County. The daughter may have been infected with a strain with a long prepatent period. Since 1974 almost all of the more than 300 cases of imported P. vivax in Sutter County have been in immigrants from the Punjab in India, where P. vivax strains with a prepatent period of 9-12 months have been documented. It is also possible that she had a mild illness due to P. vivax that was overlooked at about the same time as her mother, and the present illness represented a relapse of untreated P. vivax malaria. It is unlikely that the daughter independently acquired a local infection in Yuba County because no imported cases were reported there in 1986, and few Anopheles mosquitoes were found.

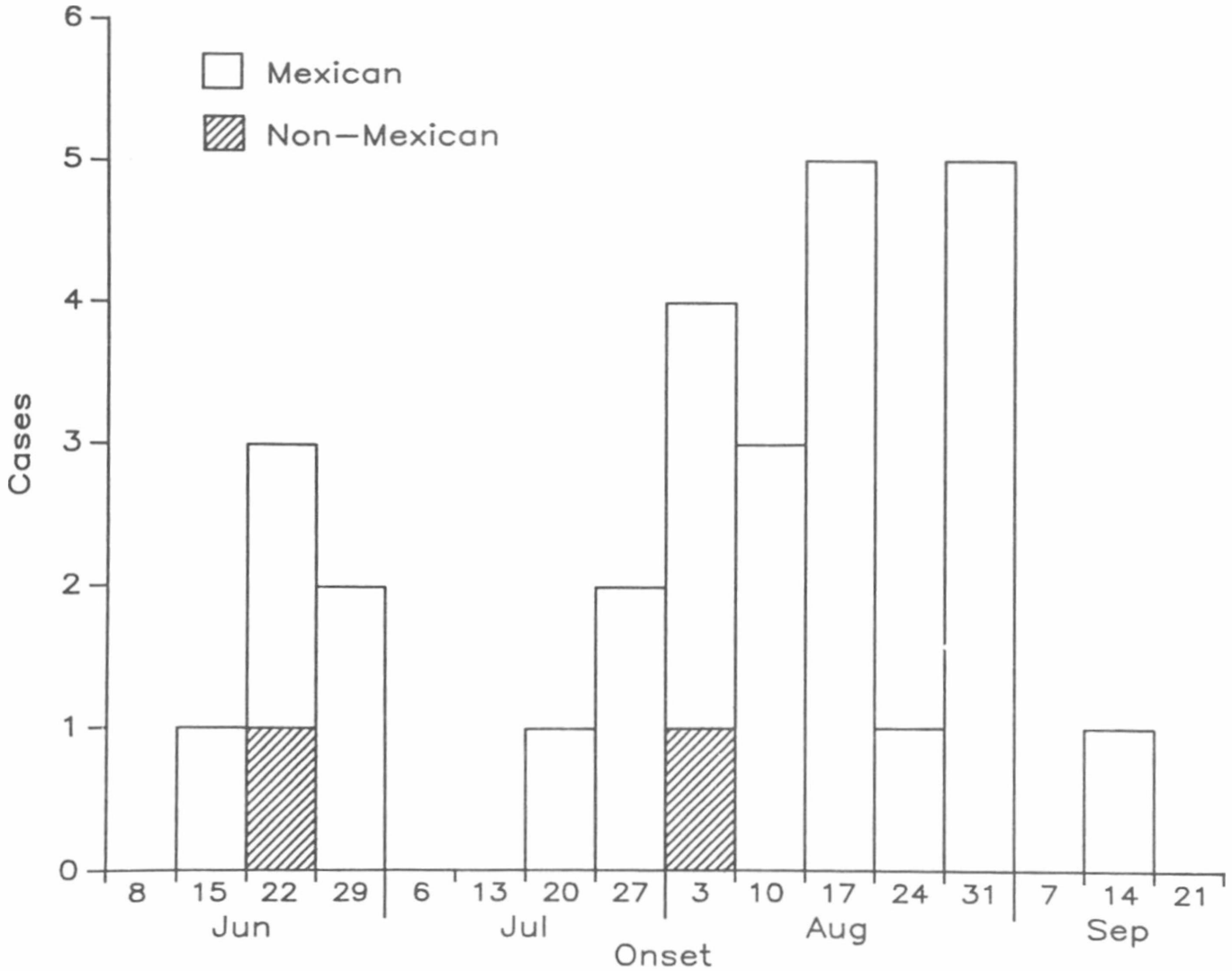
(Reported by C. Johnson, M.D., Health Officer, Yuba County, R. Mc Bryde, Sutter Yuba County Mosquito Abatement District, D. Womeldorf, Vector Surveillance and Control Branch, and R. R. Roberto, M.D., California Department of Health Services, Berkeley, California.)

Episode 2-- Two clusters of malaria involving 28 patients were identified in San Diego County, California, in the period August 8-September 30, 1986. The case that confirmed the occurrence of local transmission was in a 58-year-old resident (Patient A) of Carlsbad, a coastal community of 35,000 in San Diego County, who was seen by his physician because of high fever and diarrhea. He was initially diagnosed as having a viral illness, but when his symptoms worsened on August 11, he was admitted to a local hospital. Three days later a blood smear was positive for P. vivax malaria. Treated with chloroquine and primaquine, he recovered without complications. He had no history of IV-drug use, blood transfusion, or travel to areas with endemic malaria. The patient lived in a residential area across the street from a fresh-water marsh that emptied into a brackish lagoon, and in July he took frequent evening walks through the marsh area.

On August 16 an effort was begun to identify all cases of malaria reported in San Diego County since January 1, 1986. The San Diego Health Department records were reviewed, and local hospitals and physicians were contacted to detect unreported cases. As a result, an additional 27 cases of P. vivax malaria were identified as having occurred in the Carlsbad area in the period June 18-September 20. The epidemic curve shows a bimodal distribution with a 24-day interval between the 2 clusters. (Figure 3).

The first cluster of cases involved 6 patients who became ill between June 18 and July 2 -- 5 Mexican migrant agricultural workers and 1 San Diego County resident who lived 20 miles from Carlsbad. The latter, a 30-year-old man (Patient B) had gone swimming on May 31 and June 7 in a lake 3 miles southeast of the lagoon area frequented by Patient A during his evening walks. In September 1985, Patient B had been in an area north of Puerto Vallarta, Mexico, where he slept on the beach. He denied any previous malaria infection, IV-drug use, or blood transfusions.

Fig. 3 Cases of *Plasmodium vivax* malaria, by week of onset, San Diego County, California, June 8–September 21, 1986



The second cluster of cases involved 22 patients who became ill between July 26 and September 20, 21 Mexican migrant workers, and the local Carlsbad resident (Patient A) discussed above. Twenty-one of the 26 infections involving Mexican migrant workers from both time periods were reported by the same local hospital. The other 5 were diagnosed during an active case-detection survey involving interviews with 319 migrant workers on 3 agricultural farms in the lagoon area.

Eighteen of the migrant-worker patients were interviewed. None of them had a history of IV-drug use or blood transfusion, and only 1 had a history of malaria infection. All were male workers 17-30 years of age. They were employed in a variety of jobs, came from 5 different states in Mexico, and had arrived in the United States 2 weeks-20 months before becoming ill. Eleven of these patients had been in the United States at least 2 months.

On August 14, a baited light trap placed in the marsh area contained 115 adult female Anopheles freeborni mosquitoes, competent vectors of malaria. On August 18, after the San Diego Vector Surveillance Unit had applied adulticide/larvicide to the area, a baited light trap placed in the area contained 16 adult female An. freeborni. No An. freeborni were found in the trap on August 22, and subsequent trapping efforts led to counts of 0-10 An. freeborni per light trap in the marsh area.

(Reported by J. Turley, Tri-City Hospital, Oceanside, E. Orellana, S. Hunt, M. Mizrahi, M.S., M. Ginsberg, M.D., M. Thompson, Dr.P.H., G. Reaser, M.D., D. Ramras, M.D., San Diego County Department of Health Services, T. Smith, M.S., Vector Surveillance and Control Branch, R.R. Roberto, M.D., California Department of Health Services, Berkeley, California.)

Comment: This 2-cluster outbreak of P. vivax malaria involving 27 patients and occurring within a 14-week period represents an unusually high number of reported cases of malaria in San Diego County in such a short time. In all of calendar year 1985, only 20 cases of imported malaria in civilians were reported to the San Diego County Health Department. In January through August 1986, only 2 cases in civilians in addition to the outbreak reported here were reported in San Diego County. One of these represented importation from India and the other from Papua New Guinea.

Some if not all of the 28 cases of P. vivax malaria in these 2 clusters were acquired by local transmission in San Diego County. For example, the P. vivax infection of patient A, who had no other identified risk factors, indicates local transmission. Furthermore, the occurrence of 2 clusters in space and time suggests that some or all of the cases in Mexican migrant workers represent P. vivax infection acquired in the marsh area rather than imported from Mexico. Data from the vector surveillance program indicate that adult female An. freeborni were present in large numbers in the lagoon area during the time transmission occurred. The 24-day interval between the 2 clusters is consistent with the time required for development of the parasite in the infected mosquito (range 11-20 days) and the incubation period of P. vivax in humans (12-17 days). Furthermore, the case investigations indicate that the common factor shared by the Mexican migrant patients was that they all slept in the open on a hillside bordering the marsh.

Episode 3--P. vivax malaria was diagnosed in a 43-year-old woman and her 16-year-old daughter who lived in a rural area of Yolo County, 12 miles south of Sacramento, California. They became ill on August 24 and 23, 1986, respectively. Both patients were treated with chloroquine and primaquine and had an uneventful recovery. Neither mother nor daughter had a history of blood transfusions, IV-drug use, or recent travel to malaria-endemic areas. Both had visited a town in Sonora, Mexico, in December 1984, but malaria transmission has not been reported from that state, and a 20-month incubation period has not been reported for P. vivax. Migrant field workers from Mexico and Central America worked in nearby farms. No other cases of malaria have been identified despite retrospective and prospective surveillance of malaria cases in Yolo, Sacramento, Solano, and San Joaquin counties. Entomologic surveys 4 weeks after the transmission probably occurred did not reveal high counts of An. freeborni and An. punctipennis. It is likely that both cases were acquired via mosquito transmission.

(Reported by P. Hom, M.D., Health Officer, Sacramento County, R. Bates, M.D., Health Officer, Yolo County, D.R. Cobb, M.D., Health Officer, Fresno County, R. Washino, Ph.D, University of California at Davis, D. Womelsdorf, Vector Surveillance and Control Branch, and R.R. Roberto, M.D., California Department of Health Services, Berkeley, California.)

Episode 4--P. vivax malaria was diagnosed in a 58-year-old man and his 4-year-old grandson who lived in La Habra, Orange County . Both were treated with chloroquine and primaquine and recovered uneventfully. They experienced onset of illness on August 15 and 13, respectively. Neither had a history of foreign travel or blood transfusions within the preceding 4 years, and both denied a history of malaria and use of IV-drugs.

On August 29, 1987, the man, his wife, son, daughter-in-law, and grandson visited family members in different parts of California, staying in motels en route. On August 31 they camped for the night at Skagg's Bridge Park on the banks of the San Joaquin river in Fresno County. The man and his grandson slept together in a sleeping bag outdoors close to the river bank, the man's wife slept on a cot outdoors, and the son and daughter-in-law slept in the car. Family members noted many biting mosquitoes in the park that evening; they also noticed a number of Hispanic migrant workers bathing in the river and sleeping on the banks. The family left on September 1 to return to La Habra.

Investigation of malaria cases diagnosed in 1986 in Fresno county revealed 6 cases of malaria in Hispanic migrant workers. Two of these workers lived and worked on a farm 8 miles south of Skagg's Bridge Park but denied having visited the river area near the park. They had arrived in the United States in July 1986. The other 4 were unavailable for interview, but review of the county malaria case-report forms revealed that 2 had been in the United States. for 2 months before the onset of illness, 1 for 1 month, and 1 for a year. On September 30, a limited mosquito survey (biting collection) along the river bank at Skagg's Bridge Park yielded 63 anophelines, of which 60 were An. punctipennis, a riverine species and documented vector of P. vivax in California. There are no previous mosquito trap data from this site, but data from nearby nonriverine areas demonstrated very low numbers of this species. A review of Orange County vector-surveillance data revealed that fewer than 15 female An. freeborni were trapped in the county each week between June and October 1986, but none of the traps were located in La Habra. The 2 Orange County residents probably acquired their infection via infected mosquitoes at the Skagg's Bridge Park.

(Reported by T. Prendergast, Health Officer, Barbara Peck, S.P.H.N., Orange County, D.R. Cobb, Health Officer, Fresno County, J. Caton, Fresno Mosquito Abatement District, R. Washino, Ph.D., University of California at Davis, E. Lusk, Vector Surveillance and Control Branch, and R.R. Roberto, M.D., California Department of Health Services, Berkeley, California.)

Comment: Four separate episodes of introduced P. vivax malaria in 1 year in California constitute an unusual occurrence. Only 14 isolated episodes of introduced malaria had been reported in the United States between 1950 and 1985 despite periodic increases in the number of imported malaria cases in the same period. Seven of the 14 episodes occurred in California. In the period 1966-1971, 16,872 cases of malaria imported by American military personnel returning from Southeast Asia were reported. In the same period, only 3 episodes of introduced malaria could be related to Vietnam veterans. In 1979-1981, 1,571 cases of malaria in refugees from areas in Southeast Asia with endemic malaria were reported. No cases of introduced malaria have been attributed to this influx of immigrants. The episodes in California may be related to the increased importation of malaria by migrant workers from Mexico. The number of cases of malaria imported from Mexico into California rose from 20 in 1983 to 111 in 1986. The number of reported malaria cases in Mexico tripled in the past 4 reporting years--rising from 42,104 in 1981 to 128,418 in 1986.

VII. MALARIA DEATHS

Case 1--A 52-year-old California resident traveled on safari in Kenya and Tanzania from February 9 until March 1, 1986. He took chloroquine prophylaxis one week before and weekly during his trip. Two days after his return to the United States he developed fever, nausea, and vomiting; his fever persisted and on March 8 he sought medical attention. Upon arrival in a San Francisco emergency room he had a temperature of 39°C, he was sluggish, in mild respiratory distress, and anuric. His blood pressure was 100/60. Blood smear examination revealed P. falciparum parasites with a parasite density of 35%.

Eleven units of whole blood were phlebotomized during the next 24 hours, and 11 units of packed red blood cells were transfused. The patient was given 10 mg/kg of intravenous quinidine over 1 hour, followed by a continuous infusion of 0.02 mg/kg per min. Within 24 hours, the parasitemia was reduced to less than 2%. However, he became increasingly dyspneic, his chest X-ray revealed bilateral interstitial infiltrates consistent with adult respiratory distress syndrome (ARDS), and he was intubated and placed on mechanical ventilation. During the second hospital day, despite reduction of the parasitemia to less than 0.1%, he developed E. coli sepsis and was placed on broad-spectrum antibiotics. He became hypotensive and was given pressor agents, but he died a few days later.

(Reported by R. Pechan, M.D., and G. Blum, M.D., Pacific Medical Center, San Francisco, California, F. Taylor, M.D., San Francisco Department of Health, and R.R. Roberto, M.D., California Department of Health Services, Berkeley, California.)

Case 2--A 35-year-old woman was admitted on April 22, 1986, to a hospital in New York with a 25% of the erythrocytes parasited with P. falciparum. She had returned from a 2-week safari in Kenya on April 5. When seen by a physician on April 16, she had a 4-5 day history of recurrent night sweats, fever episodes (temperature to 103°F), chills, myalgia, diarrhea, and vomiting. She informed the physician of her trip to Kenya and her taking chloroquine for malaria prophylaxis. She was told she had a viral infection. On April 22, she presented at the emergency room and was admitted with jaundice, fever, chills, and myalgia. She was treated with IV-quinine for 3 days and doxycycline for 7 days. She also received a 16-unit exchange transfusion. Her parasitemia rapidly declined to less than 1% over 48 hours. However, she developed ARDS, coagulopathy, and renal failure. Her pulmonary function continued to deteriorate, and she died on May 13, 1986.

(Reported by T. Dickenson, M.D., Nyack, New York, and R. Gallo, Regional Epidemiologist, New York State Department of Health.)

Case 3--A 59-year-old California resident presented on May 17, 1986, to a hospital with a 7-day history of fever. He had returned from Papua New Guinea 1 week before admission. He had taken only 1 or 2 doses of chloroquine for prophylaxis early in his trip. Two days before admission he was seen by a physician, who diagnosed pneumonia and prescribed doxycycline. The patient had taken 3-4 doses of doxycycline before admission. After admission P. falciparum parasites were identified in a blood smear with a parasite density of 1%-2%. He had metabolic acidosis and was hypoxic. He also had thrombocytopenia, anuria, and jaundice. He was treated with IV-quinine and tetracycline. The parasitemia disappeared on day 4 of hospitalization. However, during the following 2-1/2 weeks, multiple complications, including renal failure, progressive pulmonary failure, septic shock, gastrointestinal and pulmonary hemorrhage, ileus, and pancreatitis, developed. The patient died on June 4, 1986.

(Reported by G. Grant, M.D., Monterey, California, R. Melton, M.D., Monterey County Health Department, and R.A. Murray, Dr.P.H., California Department of Health Services, Berkeley, California.)

VIII. MICROSCOPIC DIAGNOSIS OF MALARIA

Early diagnosis of malaria requires a high level of clinical suspicion and, in particular, a comprehensive travel history from every patient with a fever of unknown origin. Once malaria is suspected, a Giemsa-stained smear of peripheral blood should be examined for parasites. Since the accuracy of diagnosis depends on the quality of the blood film, the following guide is offered for the proper preparation of thick and thin blood smears.

1. Manufacturers' "precleaned" slides are not considered clean enough for use in malaria diagnosis. Before using, wash these slides in mild detergent, rinse them thoroughly in warm running water, then in distilled water, and dip them in ethyl alcohol (90%-95%). Then, wipe slides dry with a lintless cloth or tissue for immediate use, or store them in 95% alcohol until needed.

2. Clean the patient's finger with alcohol, and wipe the finger 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 the cleaned surface of the slide against the drop of blood and, with a quick circular motion, make a film the size of a dime in the middle third of 1 end of the slide. Ordinary newsprint should be barely legible through such a wet drop (Figure 4). (Excessive mixing or stirring with a second slide leads to distortion of blood cells and parasites.)

5. Wipe the finger dry, and gently squeeze a small drop of blood from the puncture, placing it at the edge of the middle third of the same slide (Figure 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's 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 (Figure 6).

7. While the thick blood film dries (minimum of 6 hours at room temperature)**, keep the film horizontal and protected from dust and insects.

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 (Figure 5).

**For rapid diagnosis, make the thick and thin films 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, examine the thick film for organisms not detected on the thin preparation.

Fig. 4

in all their phases. The importance of the examination of blood films for the presence of malaria parasites will be fully understood

Fig. 5

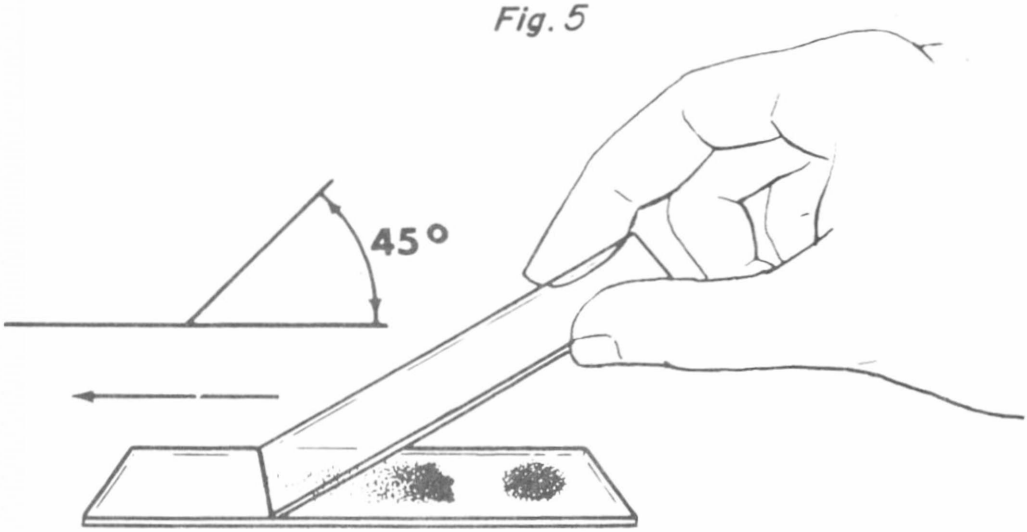
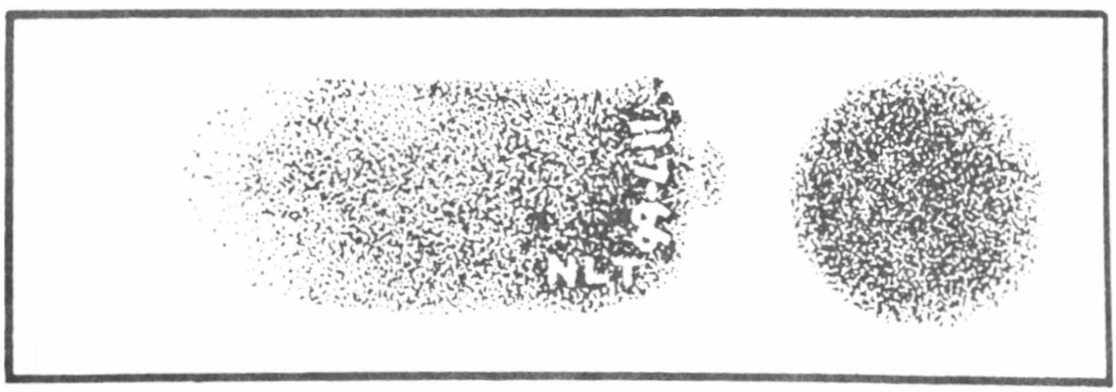


Fig. 6



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