FEDERAL SECURITY AGENCY

U. S. PUBLIC HEALTH SERVICE

Malaria Control in War Areas

FIELD BULLETIN

SEP 11 '45

DISTRIBUTION AND HABITS OF *ANOPHELES FREEBORNI*

ATLANTA, GEORGIA

MAY, 1945

U.S. PUBLIC HEALTH SERVICE ★ 1798 ★

Courtesy of the David J. Sencer CDC Museum

Table I

MCWA Larvicide, Minor And Major Drainage Work

April 1 - 30, 1945

STATE	Areas in Operation	Residual Number Houses Sprayed	Spraying Pounds DDT Used	LARVICIDAL WORK				DRAINAGE OPERATIONS										Total Man Hours
				Larvicide Used		Surfaces Treated Acres		Clearing		Cleaning Hundred Sq. Ft.	New Ditching				Ditch Lining Lin.Ft.	Underground Drainage Lin.Ft.	Fill C.Y.	Water Surf. Eliminated Acres	
				Oil Gals.	Paris Green Lbs.	Oiled	Dusted	Removal Surf.Veg. Acres	Stumping Grubbing Acres		Hand	Lin.Ft. Mech.	Dynamite	Total Cu.Yds.					
Alabama	8	4,581	1,516	255	32	27	16	2	---	5,695	1,690	---	---	285	---	24	---	4	6,265
Arkansas	18	23,695	5,733	17,938	396	1,775	236	95	1	8,549	20,788	530	---	4,284	526	---	---	15	42,848
California	4	---	---	1,018	35	71	4	1	---	2,664	1,800	---	60	103	---	---	---	5	3,253
District I	2	---	---	---	---	---	---	1	---	277	13,537	---	---	1,380	---	---	---	7	1,961
Florida	19	1,056	890	1,276	573	77	307	49	1	14,253	18,131	---	2,743	3,601	915	---	4,190	4	27,381
Georgia	12	2,129	1,241	---	1,200	---	1,031	29	---	1,697	8,597	---	---	523	---	---	847	2	19,239
Kentucky	1	1,402	455	---	---	---	---	---	---	754	90	---	---	10	---	---	---	1	5,542
Louisiana	9	694	189	62,807	948	3,226	216	46	1	9,377	39,315	---	---	2,479	---	---	12	13	58,222
Maryland	1	---	---	---	---	---	---	1	---	100	140	---	6,700	4,828	---	---	15	---	2,414
Mississippi	16	4,503	1,911	12,372	142	668	86	68	1	3,755	13,065	---	---	926	---	---	10	48	25,893
Missouri	4	4,861	2,100	700	166	95	58	18	---	450	2,700	---	---	418	---	---	---	---	7,836
North Carolina	10	472	226	395	---	45	---	91	1	16,938	32,136	---	3,810	6,383	18	---	114	4	25,146
Oklahoma	5	1,136	270	---	---	---	---	18	---	1,138	7,054	---	---	3,192	---	---	---	9	8,835
Puerto Rico	7	---	---	539	2,071	51	2,208	15	---	8,122	6,070	---	---	1,350	---	785	---	3	43,647
South Carolina	19	681	394	6,954	272	550	217	216	6	31,687	39,620	---	3,400	10,237	180	1,553	202	12	61,320
Tennessee	3	3,831	1,103	---	---	---	---	7	---	---	7,486	---	---	970	349	---	149	3	15,360
Texas	14	7,166	2,198	6,873	175	250	17	147	---	8,823	42,036	---	---	3,550	---	---	---	33	46,613
Virginia	4	---	---	1,146	160	48	155	38	1	11,876	45,682	---	585	3,760	51	---	33	---	17,666
Total	156	56,207	18,226	112,273	6,170	6,883	4,551	842	12	126,155	299,937	530	17,298	48,279	2,039	2,362	5,572	163	419,441
March Total	145	8,759	2,793	34,564	3,379	1,797	2,382	835	30	157,171	547,396	705	19,775	57,314	5,703	1,293	10,769	217	430,515

DISTRIBUTION AND HABITS of *Anopheles freeborni*

By Sr. Malariologist (R) S. B. Freeborn

A vast amount of detailed information has been accumulated concerning *Anopheles quadrimaculatus* Say, the most important malaria vector in the southern and eastern United States. Information on the ecology of *Anopheles freeborni* Aitkin, the less known malaria vector of the West and the western representative of the "Maculipennis Complex," is less voluminous and not so readily available. The purpose of this paper is to summarize present knowledge of *Anopheles freeborni.*

Recent studies on the transmission of imported malarias show that *freeborni* becomes infected even more readily than *quadrimaculatus.* It shares with *quadrimaculatus* the doubtful "honors" of being the nearctic-anopheline most fond of human blood. *Freeborni* seeks the homes of man and the shelters of animals. It bites avidly at dusk and at dawn. From night to night it migrates from one shelter to another. Most of its traveling is done during the evening and in the morning hours. Precipitin test data verify this type of migration because they show slight correlation between potential hosts at the points where specimens are collected, and their previous blood meals.

FALL MIGRATION

This species is definitely attuned to life in a semi-arid region of seasonal rainfall. At the end of the dry autumn season, adults maturing late in September or early in October seem to be obsessed with "wanderlust." After mating, the females migrate for long distances by a process of infiltration. Some reach points as far as ten or twelve miles from their breeding grounds. They seek shelter in outbuildings, homes, cellars, and similar locations, apparently without regard to the presence or absence of potential hosts. Throughout the winter months they show considerable activity. They move about in their shelters and frequently fly to others. The writer has in mind a sheltered railroad bridge and a basement passage in the Sacramento Valley in California. All available specimens were collected every week during the winter, but these collections had little effect upon the size of succeeding catches.

WINTER HABITS

During their period of semi-hibernation, the mosquitoes are prone to bite if they are in warm shelters. They will even bite out in the open if the temperature is sufficiently warm. However, their attack is fitful, and can best be described as "nibbling." Usually the eggs do not develop as a result of these blood meals, the blood being utilized to build up the fat body. This results when captive females are kept in unheated rooms during the winter. However, if specimens are kept in heated rooms and fed occasionally, they will develop and lay eggs. If ideal temperature and humidity conditions are maintained (as in an insectary with temperature of 80°F. and 80% humidity) continuous breeding results. Apparently the cessation in oviposition is simply a reaction to climatic conditions and is not to be interpreted as true hibernation or a diapause.

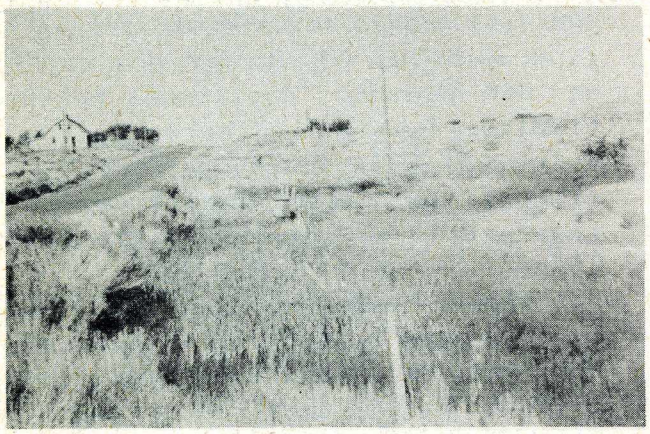
Winter "nibbling" in heated homes is conducive to malaria transmission. Laboratory infections have been produced in human beings when the mosquito was merely allowed to pierce the skin, then removed as soon as the first bit of

Courtesy of the David J. Sencer CDC Museum

blood moved up the proboscis. Winter biting of *freeborni* resembles the normal biting of *Aedes aegypti*. They attack the ankles of workers seated at desks and tables, suck blood for a few seconds, then, at the slightest movement of the worker, fly away without completing their feeding. They attack repeatedly, so their chances for infecting many persons are exceedingly good.

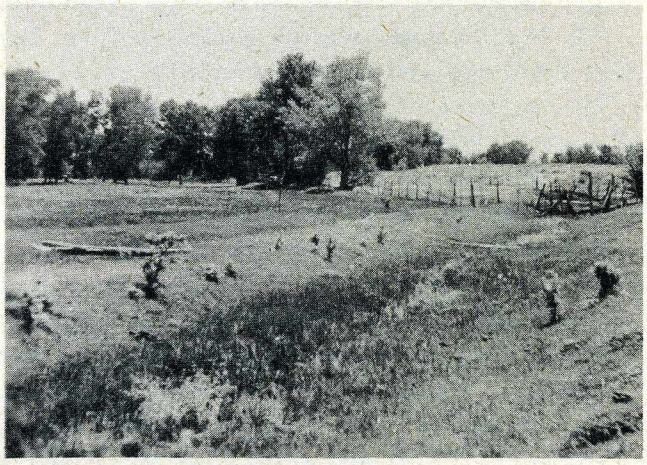
EARLY SPRING EMERGENCE OF FEMALES

During warm sunshiny days in February the females emerge from their winter shelters and bite viciously in full daylight. They resume their fall migration which was interrupted by rain and cold weather. Reports of their progress are recorded over their entire range. Sometimes these reports come from distances five or ten miles beyond areas where breeding has ever been recorded for this species. The fall portion of the migration is in the nature of an infiltration. Each day for a period of two to four weeks, observers notice a few more mosquitoes present in each area. In contrast to this, the spring emergence and distribution flight closely resembles a serious flight of salt marsh mosquitoes, both in numbers and in vicious biting during broad daylight. During this flight period, the eggs develop and are laid in all kinds of breeding places, many of which are entirely unfavorable to larval development. Within two or three weeks all the adult females have disappeared, and the species is represented entirely by larvae. Developmental time for the larvae of this generation varies. It depends mainly on the temperature, but usually requires about a month.



Heavy *freeborni* Breeding in Ponded Area

It appears that this fall and spring migration is an adaptation for a species dependent upon breeding waters which constantly decrease in extent during the mosquito season. The migration allows the mosquitoes to retrace the path the species has followed the preceding summer as water became progressively scarcer. *Freeborni* shares this adaptation with *A. sacharovi*, its counterpart in the Balkans and Near East.



Seepage Area Breeding *freeborni*

SUMMER HABITS

The summer habits of *freeborni* also reflect the effect of its environment. In late May and early June the densities of adults build up to a high peak in the hot interior valleys. This is true later in the inter-mountain country. The life span of the adults decreases as the temperature increases and the relative humidity decreases (increase in saturation deficiencies). The result is a striking decrease in the actual number of adults present in any one place. Females seem to live long enough to oviposit, but not long enough to become infective with malaria parasites. This is undoubtedly the explanation for definite spring and fall periods of relatively high malaria transmission in the Central Valley of California.

Courtesy of the David J. Sencer CDC Museum

During the mid-season slump of adult *freeborni*, there is a slackening in larval rates. This may result from a failure of some adult females to oviposit, but is probably due to an increase in aquatic predators. This larval decrease does not correspond to the sudden decrease in adult densities. It is simply a smoothing off of the curve of increase in larval rates. As fall approaches and humidities become greater, the densities of adults respond immediately and the high points for the season occur in late September.

Active breeding ceases with the first severe frost. If there are no frosts, breeding stops about the middle of October. In California, the last males of the season are usually taken during the first or second week of November.

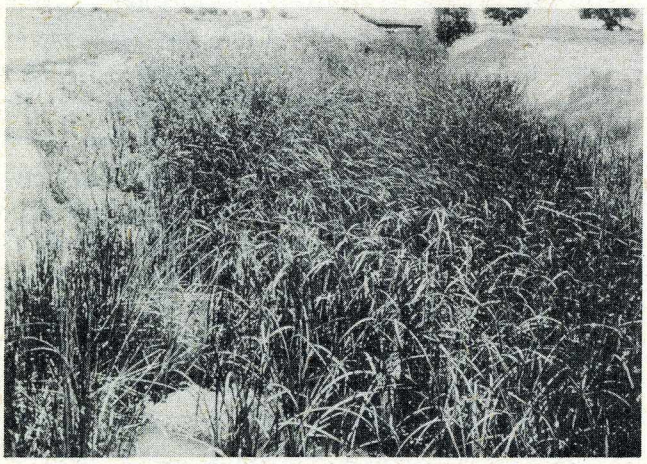
FLIGHT RANGE

The mid-season flight range, exclusive of migratory flights of overwintering females, is generally restricted to a mile radius. Males are seldom taken more than a quarter mile from their breeding places.

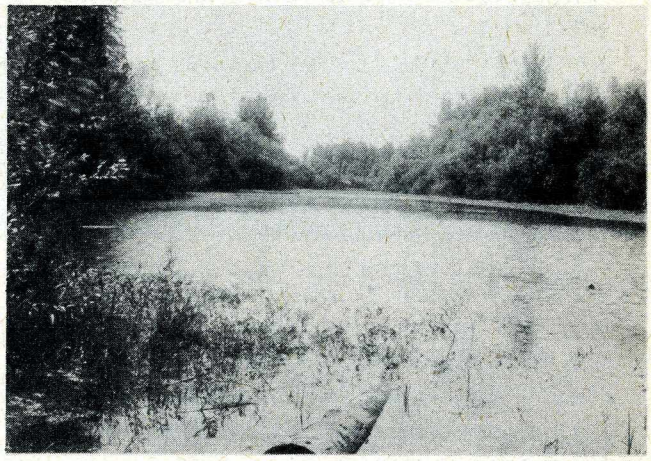
Like *quadrimaculatus*, the flight range is influenced by densities of breeding. Some authentic cases of flights from heavily infested rice fields extend for two and a half miles.

BREEDING PLACES

Freeborni prefers permanent or semi-permanent water surfaces which are exposed to sunlight, but have some transient shade such as may be produced by floatage, emergent vegetation or algae. This species tolerates water that is warm to the touch, but not so hot as that in which *A. pseudopunctipennis* will thrive. It prefers clean, slightly alkaline water. If its distribution carries it to the sea, it breeds in slightly brackish water (salinity equal to 15% sea water). Within its inland range, it is often found in desert pools where the total salts and alkalinity exceed this standard. Normally, it avoids water polluted with sewage or other organic matter. However, if pollution exists in a pool, this does not necessarily mean that the species will not be found there. In general, it is true that if an option exists, the cleaner source is chosen. An example of this is the western rice-field areas on "hard pan" soil where there is no percolation, and the water becomes foul with decaying organic matter. These fields will remain completely free from *freeborni* during the entire growing season, but adjacent seepage pools of cleaner water will teem with larvae. Rice fields in permeable soils are a real menace. Water in these areas is freshened, and then *freeborni* breeds in great numbers.



Overgrown Ditch Breeding *freeborni*

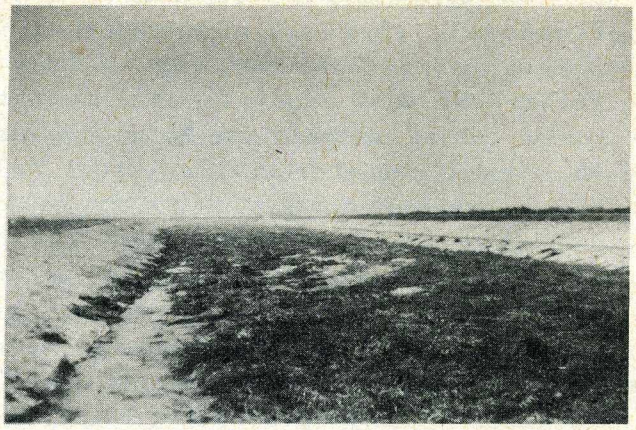


Margins of Willamette River Breed *freeborni*

This species may inhabit the same type of breeding places as *quadrimaculatus*, but few swamps, bayous and shallow ponds exist within its range. Therefore, it has adapted itself to seepage areas, vegetated borrow pits, hoof prints, carelessly irrigated fields, overflow areas from wells and pumps,

Courtesy of the David J. Sencer CDC Museum

Los Angeles River Before Clearing



Los Angeles River After Clearing

and the edges of streams and irrigation canals where sufficient vegetation occurs to afford protection from predators and stream action.

DISTRIBUTION

A. freeborni is found over the entire United States west of the Continental Divide, southern British Columbia, Baja California, Arizona, east of the Divide in Southern Colorado, New Mexico, and in the Rio Grande Valley at least as far south as El Paso. It has been reported from West Texas in a triangle having its apex at El Paso, its northern angle in Gaines County and its southern one in Val Verde County on the Rio Grande.

In recent years, repeated efforts to collect specimens at El Paso have been unsuccessful. However, the earlier El Paso collections have been verified from a study of larvae and of male terminalia. *Freeborni's* vertical distribution is recorded from below sea level in the edges of Death Valley, to 6,000 feet on Mt. San Jacinto, California, and over 7,000 feet in Utah.

DISTINGUISHING CHARACTERISTICS

Within its range, *freeborni* is apt to be confused only with other members of the *maculipennis* complex. Adult females are practically indistinguishable from *quadrimaculatus*, although in 1941, Aitkin pointed out that *freeborni* females have apically serrated truncate wing scales at the base of the cubitus vein, while those of *quadrimaculatus* are broadly rounded. *Freeborni* lacks the pale spot found in the fringe at the apex of the wing of *occidentalis*. The male terminalia are indistinguishable from *occidentalis* and *aztecus*, all three species having sharply pointed setae on the outer (dorsal) claspette lobes, whereas most of these are rounded in *quadrimaculatus*. The separation of *freeborni* and *aztecus* on other than geographical grounds might become necessary at some time. However, Vargas' suggestion that the latter has penetrated into the southwest and California has not been substantiated. *Aztecus* has unusually long wings, very long, narrow wing scales and a foxy red thorax.

Freeborni larvae are separated from those of *quadrimaculatus* by having closely approximated inner clypeal hairs, and by the absence of pigmented palmate hairs on the second abdominal segment. However, in August 1944, P.A. San (R) Melvin Goodwin collected larvae from San Juan County in the northwest corner of New Mexico, and these were similar to *freeborni* except that the inner clypeals were separated by fully three times the width of the tubercle. Larvae of *freeborni* are indistinguishable from those of *punctipennis*. Hence - a word of warning to collectors in the Rio Grande section where confusion may exist. If you collect "*punctipennis*" larvae, and they turn out to be "*quadrimaculatus*" adults, you have located specimens of *freeborni*.

Courtesy of the David J. Sencer CDC Museum

DIVISION NOTES

EMORY FIELD INVESTIGATIONS

The Emory University Field Station has submitted a report concerning the hydrology of anopheline breeding. It is part of a long range investigation of natural occurrence of malaria. This work, as well as that done previously, indicates a delicate balance between the factors which determine the existence of anopheline breeding areas. Areas involved are surface reservoirs which remain during the summer months.

Investigations are in progress at Emory Field Station to determine resting places and the dispersal of anophelines in environments where DDT has been used as a control measure. Specimens are marked with water soluble dyes. When re-taken, they are destained with a solution of alcohol and glycerine before they are examined.

DENGUE FEVER REPORTED

Honolulu reported two confirmed cases of locally acquired dengue fever during the month of May. These were the first cases in several months.

AEDES AEGYPTI CONTROL

New Orleans has integrated *Aedes aegypti* control with general sanitation. This mobile unit has been transferred into a permanent organization and is now operated under the State and City Health Departments.

In Norfolk, Virginia, an *Aedes aegypti* program has been inaugurated. Asst. San. (R) James A. Morrow and Eng. Aide William T. Stephenson are assigned on a temporary basis to Norfolk for the purpose of recruiting and training locally hired inspectors who will work with the local unit.

NEW FILMS READY FOR DISTRIBUTION

"CRIMINAL AT LARGE" is a natural color cartoon film strip available either as a film strip or as a 16 mm. motion picture film with a sound track. Production number of the motion picture film is MCWA-TE-4-012; of film strip, MCWA-TE-5-004. In this film, Sam Snipe, a reporter, is told to get the story of the most dangerous female in the world. He gets the story and learns the facts about the malaria mosquito and the transmission of the disease. The film is available for unrestricted distribution.

"GENERAL INSPECTION AND CONTROL ACTIVITIES AT THE AREA LEVEL", a black and white silent film strip, shows the activities of malaria control crews in the field. It is available for unrestricted distribution. Production number is MCWA-TE-4-012.

PROPOSED HANDBOOK SERIES

The committee for the proposed handbook series recommended: (1) that there be two sizes of handbooks - a field size, and a larger office size; (2) that the professional division involved be responsible for technical content and for informing the Training and Education Division of the purpose of each handbook; (3) that final decisions regarding style and organization of books should rest with the Training and Education Division.

IN-SERVICE TRAINING AND ORIENTATION

Ten trainees and three visitors attended the 35th In-Service Training and Orientation Course in May. Visitors included Med. Dir. J.W. Mountin, Chief of the States Relations Division; Senior Surgeon C.D. Head; and San. Eng. Robert P. Low.

MAP SERIES COMPLETED

The May issue of the Field Bulletin completes the series of anopheline distribution maps. All points from which specific records are available are included. However, the shaded areas frequently bridge gaps in our existing records if it seems likely that the species occurs in the intervening areas. These maps were prepared to show generalized distributions, and may serve as a basis from which additional extensions in the range of anopheles species may be recorded.

Courtesy of the David J. Sencer CDC Museum

HEADQUARTERS NOTES

NEW ASSIGNMENTS

New assignments include: Jr. Asst. Eng. (R) Vincent J. Roggeveen to Arkansas; Asst. Eng. (R) Wallace R. Frank to the Savannah Laboratory; Asst. Eng. (R) Verdon L. Dix to Tennessee; Jr. Ent. Leon G. Lungstrom to District 7, Kansas; Educator Thomas R. Harris to the Training and Education Division in Atlanta; Jr. P.H. Eng. Wm. R. Schmidt to the Savannah Laboratory; and P.A. Surgeon O.W. Yeager to Manning, South Carolina.

TRANSFERS

Transfers include: P.A. San. (R) L. Edward Perry from District 8 to Headquarters; Asst. Eng. (R) John R. S. Hill from Gulfport, Miss., to Columbia, S.C.; Asst. Eng. (R) Sam G. Segal from Herrin, Ill., to Louisville, Ky.; Asst. San. (R) H. Page Nicholson from Norfolk, Virginia, to Savannah, Georgia; and P.A. San. (R) Paul Weinstein from In-Service Training Section to the Professional Relations Section.

NEW COMMISSIONS

Newly commissioned officers during the month of May include: Asst. Eng. (R) Henry K. Hickey assigned to Miss.; Jr. Asst. San. Eng. (R) Robert C. Levy to Miss.; Jr. Asst. San. Eng. (R) Harry T. Crohurst, unassigned; Jr. Asst. Eng. (R) Gordon H. Jaehnig to Miss.; and Asst. Eng. (R) Ross W. Buck to Illinois.

AREAS REOPENED

The Greenville and Grenada air bases in Mississippi have been reopened. MCWA control is now in progress in these two areas.

EXTENDED CONTROL PROGRAM PROGRESS

Tennessee and Alabama have completed their first spraying of houses on the extended malaria control program. This includes the spraying of more than 12,000 houses in Tennessee, and 17,000 in Alabama.

SPOT MALARIA CONTROL IN NORTH CAROLINA

Spot malaria control is part of the North Carolina State Board of Health summer program. This program is an attempt to prevent the introduction of new strains of malaria into the population by discharged servicemen who have case histories of malaria. Prior to this, the state program was limited chiefly to war areas. Present control efforts are directed toward specific cases in non-war areas where the diagnosis of malaria is proved either by positive blood smears, or by the military service record in cases of discharged servicemen. A limited amount of DDT is set aside and used specifically for spraying homes in which such persons live. If the supply of DDT is insufficient for all positive cases, the spraying will be limited to the homes of discharged servicemen.

In carrying out this program, local health officers contact medical practitioners in their areas, notify them of the program, and request that they report immediately all cases of malaria to their local health departments.

Wherever a case of malaria is reported, a thick blood smear is obtained from the patient either by the physician or by local health department personnel. Smears are taken before the treatment for malaria is started. The smears, together with completely addressed report cards, are mailed to the Division of Epidemiology, State Board of Health, Raleigh, N.C. A smear is requested from discharged servicemen when the disease is in its active stage. However, if symptoms are absent, a statement certifying that service-records for the patient show a case history of malaria is signed by the health officer and is accepted in place of a smear. By following through with the spot control program, it is hoped that the number of cases of malaria in North Carolina will be greatly reduced, and that the introduction of new strains will be checked.

Courtesy of the David J. Sencer CDC Museum

CARTER LABORATORY NOTES

ANOPHELINE LARVICIDES: Carter Memorial Laboratory field investigations suggest that DDT used either as a dust or a fuel oil emulsion is more efficient than paris green for controlling anopheline mosquito larvae. Inspections made 24 to 48 hours after treatments with either DDT dusts or oils, averaged 95 to 97% mortality of larvae in the plots tested. Inspections a week later indicated the elimination of 49 to 69% of the larval population based on the pre-treatment count. Inspections 24 to 48 hours after dusting with paris green indicated a 65% reduction of the larvae with no further reduction at the end of a week.

EFFECTS ON AQUATIC ORGANISMS: Studies of larvicidal dusting in experimental areas using DDT at the rate of .1 lb. per acre indicate, to date, that surface insects have not been killed in significant numbers.

Aquatic areas treated with a DDT by-product at the rate of .1 lb. per acre showed no appreciable mortality of surface organisms. At .4 lb. the same material showed significant mortality of surface organisms and was toxic to some deeper forms. At 1 lb. per acre, nearly all forms, including fish, crayfish and tadpoles were destroyed.

TYPHUS CONTROL INVESTIGATIONS: DDT as a control for rat ectoparasites is being investigated in several Savannah business establishments. A 10% DDT dust is used in rat runs, burrows, holes leading into double walls and floors, and places suspected of harboring rat nests. A comparison of ectoparasites taken from rats caught 5 to 11 days after dusting operations with those caught before, indicated a general reduction of more than 99% of all fleas, 73% of lice, but only 68% of mites present on the rats.

INSECT PREMISE SANITATION: Investigations for determining the value of DDT in food and milk establishments aim primarily at the control of houseflies. Results of tests now in progress indicate that excellent control may be expected for periods varying from two to several months. One complete treatment of the interiors of a dairy and adjacent outbuildings with 2½% DDT emulsion is sufficient to give practical control for several months. In establishments with poor sanitation the complete residual treatment must be supported by controlling fly breeding in the area with periodic applications of ½% DDT emulsion as a cover spray. In pasteurizing plants, DDT used as a 5% residual spray gives good results, especially if occasional larviciding is done. In restaurants, flies are controlled by a residual spray of 7½% DDT emulsion. Highly varnished surfaces may be harmed slightly by the spray.

RESIDUAL SPRAYS: Preliminary results showed a rapid loss in DDT toxicity applied to surfaces covered with 7-day dried paints, gloss enamels and spar varnishes. Mud surfaces lost all toxicity 48 hours after they were sprayed. Standard DDT - xylene emulsion caused some staining on high grade blue wall paper, and on certain high gloss blue and green enamels.

HOST PREFERENCE STUDIES: Tests for determining host preference of *Anopheles quadrimaculatus* in a South Carolina test area show that blood from 15.9% of the 378 females collected in unscreened houses reacted positively to human antisera, while only .5% of 1260 specimens taken from stables showed a positive reaction.

DEVELOPMENT OF EQUIPMENT: A portable light weight power sprayer utilizing a 3½ gpm. rotary pump was assembled and placed on test for application of residual DDT sprays.

Courtesy of the David J. Sencer CDC Museum

LITERATURE REVIEW

THE MOSQUITOES OF NEW JERSEY AND THEIR CONTROL. By Thomas J. Headlee. 1st Edition, pp. vii-326. New Brunswick. Rutgers University Press. 1945. Price $4.00

In this book, the author points out that he has treated the subject matter in such a way as to be valuable to the teacher, the student, those engaged in practical mosquito control and also to the lay reader. The first part deals with the classification, description and biology of mosquitoes found in New Jersey, and the second with mosquito control.

One feature of the book is a table summarizing distribution records for more than thirty light traps which were in simultaneous operation each season for about ninety days. Total catches of each trap for the ten year period beginning in 1932 and ending in 1941 are shown. Unfortunately, these data are not summarized in such a way that seasonal occurrence and relative densities of various species are revealed.

One hundred and ninety-eight pages are used for the description, characteristics and habits of both the adult and larval forms of nearly every mosquito which has been found in New Jersey. But practically the entire chapter on Mosquito Biology was taken from Dr. John B. Smith's 1904 report, and little attention has been given to the results of more recent investigations. The illustrations are also from Dr. Smith's earlier work.

The nomenclature used by Dr. Headlee does not conform to most recent usage. Lists are given to show the scientific names according to Howard, Dyar and Knab; New Jersey Agricultural Station Bulletin 348; and Robert Matheson. Lists of scientific and common names are given according to John B. Smith and according to this book. It seems that an up-to-date list of synonyms under each species would have been of greater value.

Dr. Headlee presents an interesting account of the history of mosquito control in New Jersey since the beginning of this century. He points out that a number of persons had given serious thought to the mosquito problem in New Jersey before the beginning of the century, but 1900 marks the year when money was set aside for preliminary investigation of the problem.

According to the author, the laws relating to mosquito control extend over the period from 1902 to 1927. The most outstanding and active laws passed by the New Jersey Legislature relative to mosquito control are sections of the Laws of 1912 and 1927. Powers granted in these acts provide for the prosecution of practical mosquito control work by county units which are financed from public funds, and whose activities are supervised by the New Jersey State Agricultural Experiment Station. In addition, research procedure and leadership are provided. Experience indicates that these two acts provide a basis for efficient prosecution of mosquito control in New Jersey.

Dr. Headlee points out that probably the most important economic effect of mosquito reduction has been the increased value of vacation lands along the seashore. Tables are presented to show the remarkable increase in value in certain counties. It is also shown that as a result of mosquito control work, malaria has been practically eliminated from sections where formerly one hundred or more cases were experienced in a single year.

This book is interestingly written, and no doubt will be welcomed by mosquito control workers, particularly those in New Jersey. For others, its value would have been greatly enhanced if more biological and actual control results achieved by Dr. Headlee and his co-workers had been included.

D.E. Harding

Courtesy of the David J. Sencer CDC Museum

Table II

MCWA Expenditures And Liquidations By Major Items

April 1945

	Continental U. S.	Percentage of Total	Puerto Rico	Percentage of Total
.01 Personal Services	$ 510,211.14	68.92	18,655.29	92.04
.02 Travel	23,825.83	3.22	186.98	.92
.03 Transportation of Things	5,279.24	.71	------	------
.04 Communication Services	1,954.35	.25	12.70	.07
.05 Rents and Utilities	2,295.86	.31	------	------
.06 Printing and Binding	928.99	.13	------	------
.07 Other Contractual Services	3,740.58	.51	------	------
.08 Supplies and Materials	83,197.76	11.24	1,401.41	6.91
.09 Equipment	108,857.18	14.71	11.75	.06
Total	$ 740,290.93	100.00	20,268.13	100.00
Expenses other than Personal Services	230,079.79	31.08	1,612.84	7.96

Table III

MCWA Personnel And Total Payroll

April 1945

State	Commissioned		Prof. & Sci.		Sub-Prof. (1)		C. A. F.		Custodial and Per Hour		Total		Percent of Total	
	No.	Pay	No.	Pay	No.	Pay	No.	Pay	No.	Pay	No.	Pay	No.	Pay
Alabama	4	1,173	2	527	24	4,370	2	354	65	8,009	97	14,433	2.59	2.69
Arkansas	10	3,038	5	1,282	40	7,266	6	1,117	355	43,603	416	56,306	11.11	10.50
California	4	1,099	---	---	4	872	3	623	15	2,223	26	4,817	.69	.90
District of Columbia	1	332	---	---	---	---	1	233	---	---	2	565	.05	.11
Florida	9	2,708	6	1,741	54	9,847	8	1,333	154	19,510	231	35,139	6.17	6.56
Georgia	9	2,716	3	791	64	11,061	7	1,167	84	10,421	167	26,156	4.46	4.88
Illinois	5	1,330	1	203	---	---	1	164	---	---	7	1,697	.19	.32
Indiana	1	284	---	---	2	139	---	---	---	---	3	423	.08	.08
Kentucky	4	1,183	2	547	12	1,805	3	513	38	4,457	59	8,505	1.58	1.59
Louisiana	11	3,192	4	1,256	48	9,575	7	1,269	283	36,101	353	51,393	9.42	9.59
Maryland	1	248	---	---	2	385	1	274	11	1,482	15	2,389	.40	.45
Mississippi	9	2,707	7	1,860	41	7,030	6	1,308	126	14,897	189	27,802	5.05	5.19
Missouri	2	714	1	160	14	2,576	---	---	116	12,441	133	15,891	3.55	2.96
North Carolina	6	1,811	5	1,561	10	1,882	4	732	145	18,638	170	24,624	4.54	4.59
Oklahoma	4	1,210	2	477	15	2,918	1	164	67	8,363	89	13,132	2.38	2.44
Oregon	---	---	---	---	2	203	---	---	---	---	2	203	.05	.03
South Carolina	11	3,212	6	1,729	45	8,859	12	1,701	387	47,641	461	63,142	12.31	11.78
Tennessee	4	1,296	2	638	15	2,620	4	730	89	10,670	114	15,954	3.04	2.98
Texas	7	1,925	4	1,333	64	10,749	10	1,601	245	30,527	330	46,135	8.81	8.61
Virginia	2	616	2	696	10	2,029	3	602	100	13,027	117	16,970	3.12	3.16
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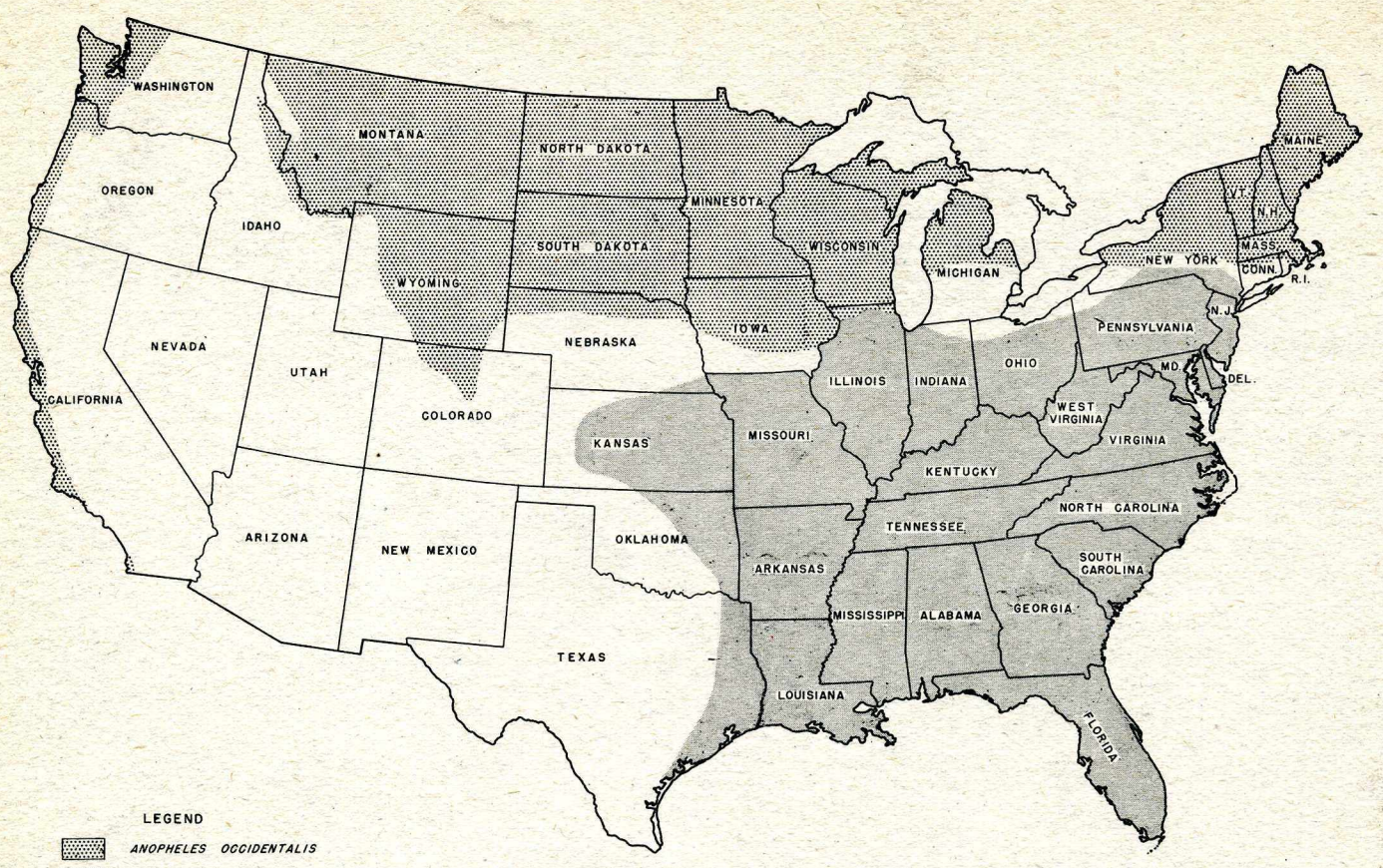
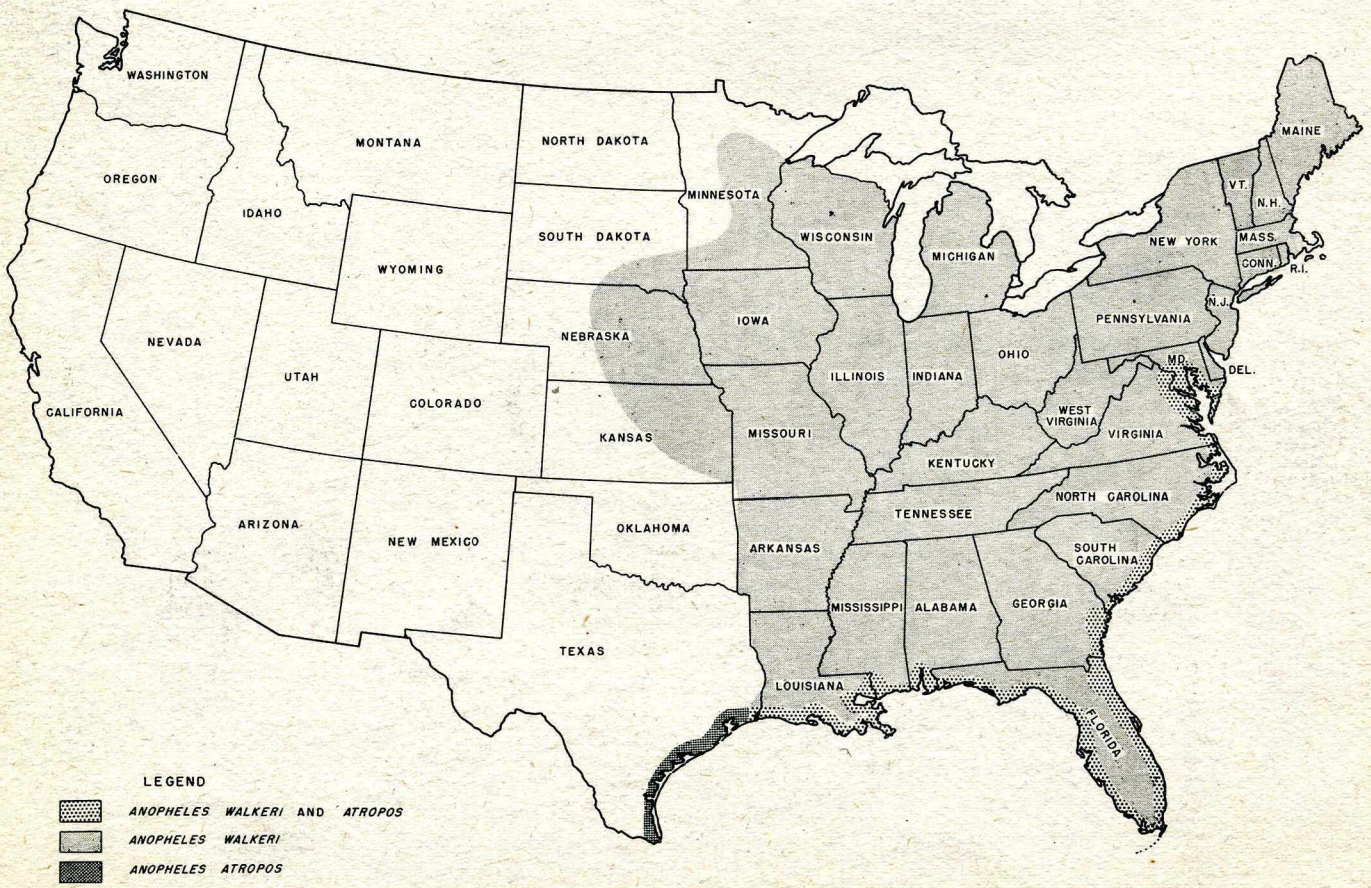
Alabama	1	283	---	---	8	1,523	1	146	---	---	10	1,952	.27	.36
Florida	---	---	---	---	20	3,588		73	---	---	20	3,661	.53	.68
Georgia	3	912	---	---	6	1,164	---	---	---	---	9	2,076	.24	.39
Louisiana	1	284	---	---	7	1,357	1	164	---	---	9	1,805	.24	.34
South Carolina	---	---	---	---	6	1,207	1	164	---	---	7	1,371	.19	.26
Texas	4	1,135	---	---	28	5,266	2	311	4	658	38	7,370	1.01	1.38
Hq. & Dist. (2)	66	22,287	11	2,898	31	5,301	139	24,617	47	6,278	294	61,381	7.85	11.45
Mobile Units	6	1,902	3	748	4	625	3	622	8	1,023	24	4,920	.64	.92
Puerto Rico	7	2,114	2	529	7	1,460	6	1,225	298	13,328	320	18,656	8.54	3.48
Honolulu T.H.	4	1,262	---	---	6	1,655	3	616	21	3,594	34	7,127	.90	1.33
Total	196	60,973	68	18,976	589	107,332	235	41,823	2658	306,891	3746	535,995	100.00	100.00
Percent of Total	5.23	11.38	1.82	3.54	15.72	20.02	6.27	7.80	70.96	57.26	100.00	100.00		

(1) Includes Entomological Inspectors

(2) Includes Headquarters and District Offices, malaria survey, Imported Malaria Control, special investigations, and employees temporarily attached to Headquarters pending assignment to states

Courtesy of the David J. Sencer CDC Museum





ANOPHELINE DISTRIBUTION MAPS

Courtesy of the David J. Sencer CDC Museum