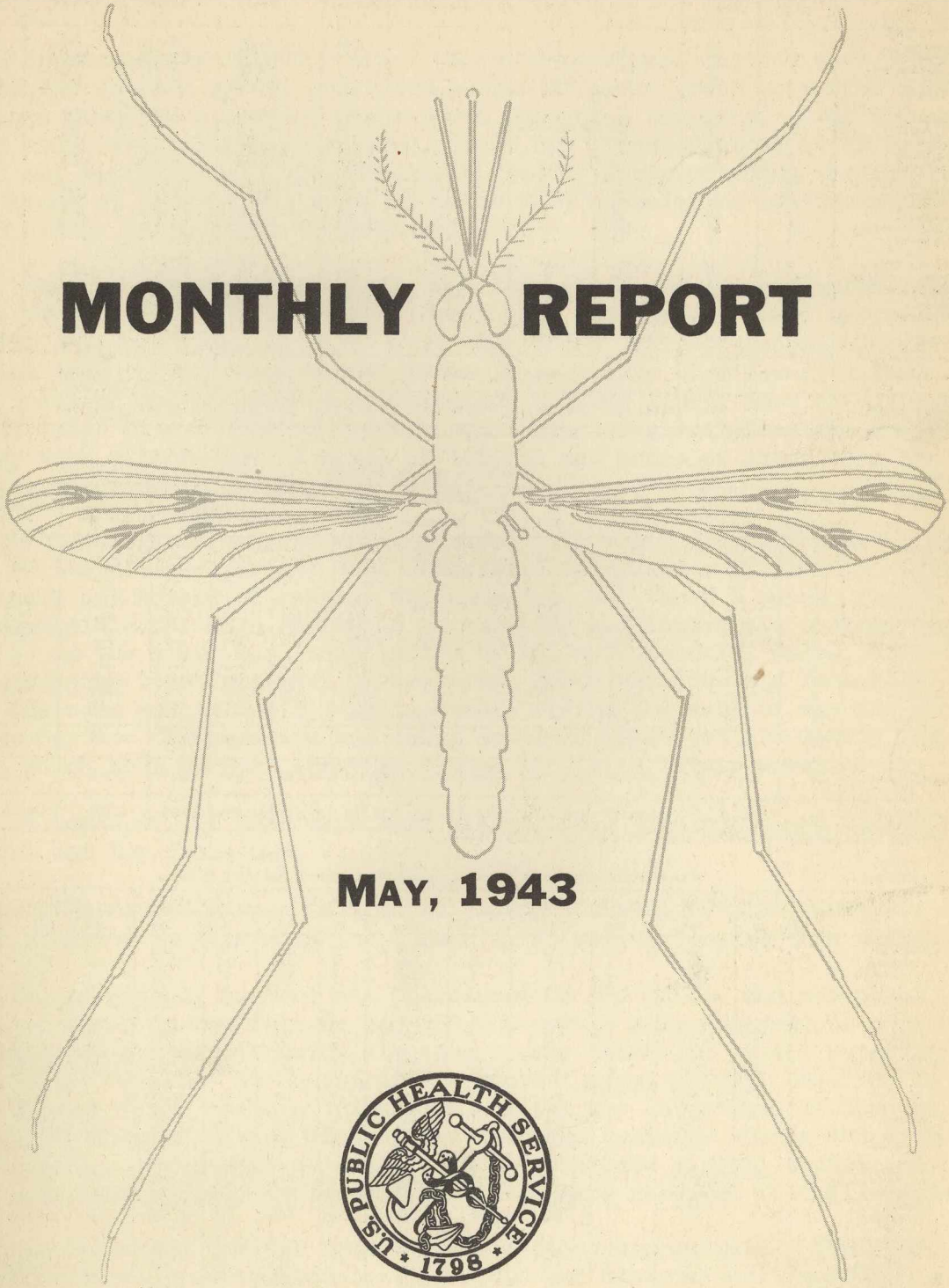
MALARIA CONTROL IN WAR AREAS



MONTHLY REPORT

MAY, 1943

FEDERAL SECURITY AGENCY
U. S. PUBLIC HEALTH SERVICE
ATLANTA, GEORGIA

TABLE I — MCWA LARVICIDE AND MINOR DRAINAGE PROJECTS — MAY 1 - 31, 1943

STATE	Areas in Operation	War Establishments Protected	LARVICIDAL WORK: Larvicide Used: Oil Gals.	LARVICIDAL WORK: Larvicide Used: Paris Green Lbs.	LARVICIDAL WORK: Surfaces Treated: Acres	OTHER WORK: Ditching: Cu.Yds. *	OTHER WORK: Ditching: Lin.Ft.	OTHER WORK: Cleaning: Lin.Ft.	OTHER WORK: Clearing: Acres	Total Man Hours	Total Men Employed
Alabama	5	58	---	---	---	1,239	5,962	16,450	1.9	7,254	44
Arkansas	15	56	7,789	532	499.5	23,377	24,885	101,633	44.2	26,540	153
California	4	10	7,961	---	957.8	---	4,466	3,200	2.1	4,190	27
D. C.	1	23	---	---	---	101	22,004	31,677	1.7	3,772	21
Florida	10	58	726	295	322.0	4,954	77,978	274,129	19.5	35,585	188
Georgia	11	85	---	938	1,289.4	869	18,243	125,750	72.4	25,609	137
Illinois	2	17	47	---	1.1	10	25	---	2.2	1,305	10
Indiana	1	15	---	---	---	110	550	---	0.9	1,632	11
Kentucky	4	41	---	---	---	186	1,974	78,002	8.9	8,261	56
Louisiana	8	56	66,572	1,411	6,717.2	6,269	46,852	87,917	90.9	80,683	430
Maryland	2	21	---	---	---	21,237	2,980	10,597	1.6	4,572	19
Mississippi	8	49	2,924	8	134.6	261	7,822	137,132	97.2	20,279	103
Missouri	3	22	33	4	5.3	500	500	17,300	52.4	4,314	25
North Carolina	10	65	6,317	---	252.3	4,472	29,736	331,876	74.0	37,585	193
Oklahoma	5	21	50	---	2.4	251	5,650	189,760	16.1	7,630	43
Puerto Rico	7	20	2,582	5,949	3,296.8	---	131,874	329,479	3.4	54,961	389
South Carolina	17	99	8,866	78	375.0	2,654	33,330	381,556	123.0	39,712	214
Tennessee	6	58	17,830	---	209.3	620	10,849	21,381	10.6	10,468	52
Texas	14	123	16,497	80	675.3	6,096	55,932	335,847	125.4	43,922	246
Virginia	4	73	1,292	---	21.3	1,221	41,252	56,132	53.6	27,476	170
Total	137	970	139,486	9,295	14,759.3	74,426	522,869	2,529,818	802.0	445,750	2,531
April Total	126	967	73,455	5,490	6,991.8	48,613	745,162	1,558,720	810.3	433,126	2,346
Total July 1 - May 31	---	---	1,652,549	109,680	155,547.7	123,039	5,082,779	17,634,901	10,759.9	4,524,103	---

* Total cubic yards of excavation often not shown on Progress Reports.

TABLE II — MCWA MAJOR DRAINAGE PROJECTS — MAY 1 - 31, 1943

STATE	No. of Projects	Clearing Brushing Acres	Channel or Ditch Cleaning Lin.Ft.	New Ditching: Hand	New Ditching: Lin.Ft. Mach.	New Ditching: Dynamite	New Ditching: Total Cu.Yds. *	Fill Cu.Yds.	Ditch Lining Placed: Sq.Ft.	Ditch Lining Placed: Lin.Ft.	Underground Drains Lin.Ft.	Water Surf. Eliminated Acres	Total Man Hours
Alabama	3	2.0	---	2,185	---	2,924	5,685	567	---	---	---	8.5	4,157
Arkansas	4	12.0	8,600	1,500	---	15,265	20,305	---	---	---	---	---	2,782
Florida	1	0.7	12,440	---	---	4,600	---	---	---	---	---	200.0	3,755
Illinois	1	5.4	7,680	---	---	---	---	---	---	---	---	---	1,220
Kentucky	3	---	---	3,400	---	1,825	2,598	---	---	---	---	35.0	2,796
Mississippi	2	1.6	---	2,368	---	---	2,164	600	---	---	---	3.0	7,318
North Carolina	4	20.1	73,863	15,347	4,795	---	15,252	629	---	---	---	61.6	21,882
Oklahoma	2	---	1,264	---	---	2,476	1,268	---	---	---	---	8.0	164
Puerto Rico	2	0.5	1,700	1,300	---	---	4,670	---	---	---	---	---	42,096
South Carolina	9	16.0	65,452	16,838	2,700	10,475	21,616	200	2,822	2,166	1,650	358.1	34,788
Tennessee	3	8.3	1,500	5,395	---	---	2,507	250	1,356	384	---	14.5	6,277
Texas	6	0.3	21,756	3,555	154	---	1,882	669	---	---	6	53.8	7,926
Virginia	2	1.4	1,688	---	---	7,490	4,800	---	---	---	---	---	3,002
Total	42	68.3	195,943	51,888	7,649	45,055	82,547	2,935	4,178	2,550	1,656	742.5	138,183
April Total	46	120.4	128,606	103,278	---	---	32,792	5,030	18,557	3,445	3,291	283.4	157,141
Total July 1, May 31,1943	--	1,131.1	1,693,695	608,891	7,649	45,055	413,449	57,613	22,735	5,995	4,947	2,210.4	1,143,753

* Total cubic yards of excavation often not shown on Progress Reports

TABLE III — MCWA PERSONNEL ON DUTY ON MAY 31, 1943 AND TOTAL PAYROLL FOR MONTH OF MAY — MAY 1 - 31, 1943

STATE	Commissioned: No.	Commissioned: Pay	Prof. & Sci.: No.	Prof. & Sci.: Pay	Sub-Prof. (1): No.	Sub-Prof. (1): Pay	C. A. P.: No.	C. A. P.: Pay	Custodial: No.	Custodial: Pay	Total: No.	Total: Pay	Percent of Total: No.	Percent of Total: Pay
Alabama	2	512	5	1,374	2	365	2	410	61	6,904	72	9,565	2.0	2.0
Arkansas	5	1,425	2	633	24	4,589	4	719	147	19,247	182	26,613	5.0	5.5
California**	2	513	--	81	5	998	2	440	23	3,454	32	5,504	0.9	1.1
D. C.	2	677	2	406	3	550	1	287	14	1,801	22	3,721	0.6	0.8
Florida	2	569	6	1,576	14	2,828	4	750	197	26,705	223	32,428	6.1	6.7
Georgia	1	285	5	1,075	31	5,482	6	769	101	13,117	144	20,728	3.9	4.3
Illinois	4	1,062	1	433	3	598	2	385	5	616	15	3,094	0.4	0.6
Indiana	1	285	1	264	--	24	1	146	11	1,439	14	2,158	0.4	0.4
Kentucky	2	570	3	861	16	2,494	3	556	47	6,403	71	10,884	1.9	2.3
Louisiana	8	2,318	7	2,077	39	7,442	5	996	387	50,081	446	62,914	12.2	13.1
Maryland	--	---	--	---	3	659	2	410	20	2,627	25	3,696	0.7	0.8
Mississippi	2	618	3	791	12	2,555	2	410	133	16,229	152	20,603	4.1	4.3
Missouri	3	904	1	264	8	1,565	1	152	14	1,852	27	4,737	0.7	1.0
North Carolina	5	1,274	8	2,521	10	1,913	3	565	312	38,766	338	45,039	9.2	9.4
Oklahoma	3	904	4	1,949	5	1,024	1	146	38	4,621	51	7,744	1.4	1.7
Puerto Rico	6	*	--	*	9	*	5	*	575	*	595	28,571	16.2	5.9
South Carolina	4	1,152	9	2,416	25	5,243	3	592	326	51,729	367	61,132	10.0	12.7
Tennessee	5	1,425	4	449	14	1,257	4	428	78	10,031	105	13,590	2.9	2.8
Texas	4	1,140	8	2,247	30	5,877	3	574	265	33,458	310	43,296	8.5	9.0
Virginia	2	570	2	688	11	2,038	3	560	176	19,743	194	23,619	5.3	4.9
Aedes aegypti														
Florida	--	---	1	319	33	6,508	2	310	25	3,611	61	10,748	1.7	2.2
Georgia	--	---	1	319	7	1,190	1	164	--	---	9	1,673	0.2	0.3
Louisiana	--	---	--	---	22	3,618	1	146	--	---	23	3,764	0.6	0.8
South Carolina	--	---	--	---	11	1,763	1	146	4	501	16	2,410	0.4	0.5
Texas	--	---	2	329	9	2,068	1	146	20	1,888	32	4,431	0.9	0.9
H.Q. & Dist. (2)	34	11,644	8	1,939	15	4,016	73	10,449	8	808	138	28,856	3.8	6.0
Total	97	27,865	83	22,111	361	66,664	136	20,676	2,987	315,631	3,664	481,518	100.0	100.0
Percent of Total	2.6	6.1	2.3	4.9	9.9	14.7	3.7	4.6	81.5	69.7	100.0	100.0		

* Figures not available
** Estimated same as April
(1) Includes Entomological Inspectors
(2) Includes Headquarters and District offices, malaria survey, special investigations and employees temporarily attached to Headquarters pending assignment to States.

MONTHLY REPORT
Malaria Control in War Areas
May, 1943

SYLLABUS

Approximately 15,000 surface acres of ponds and ditches were treated with 139,500 gallons of oil and 9,300 pounds of paris green as warmer weather this month produced a decided increase in Anopheles breeding. Over 800 acres of pond and ditch banks were cleared, 2,530,000 lineal feet of ditch were cleaned and approximately 523,000 lineal feet of minor ditching was completed. A total of 445,750 man hours of labor were expended on larvicide and minor drainage projects in May (Table I).

Two major drainage projects, one a dragline project at Jerome, Arkansas and the other a vertical drainage project just outside Jefferson Barracks in Missouri, were completed in May. Forty-two major drainage projects were in operation this month in 13 states (Table II). Nearly 20 miles (104,592 lineal feet) of new ditch were constructed, 196,000 lineal feet of ditch were cleaned, 1,650 lineal feet of underground drains were installed and 743 acres of water were eliminated. A total of 138,183 man hours of labor were expended on major drainage projects in May.

Entomological reports were received this month from 402 zones. In only 5 of the zones reporting were anopheline densities sufficiently high to indicate any hazard of malaria transmission. Of these 5 zones, floods were responsible for high counts in 2 instances and inadequate control was indicated in the other 3. As indicated by the occurrence of males, active quadrimaculatus breeding began in Kentucky, North Carolina and Tennessee during the week ending May 8, and in Kansas during the week of May 22. The Army Service Commands are now being supplied copies of the weekly M-7 reports which show current quadrimaculatus densities in war areas.

A total of 135 zone maps were planographed this month and copies were sent out for field use.

Arrangements have been made to employ somewhat over 90 Educators in as many counties to work with the Community Education Program this summer.

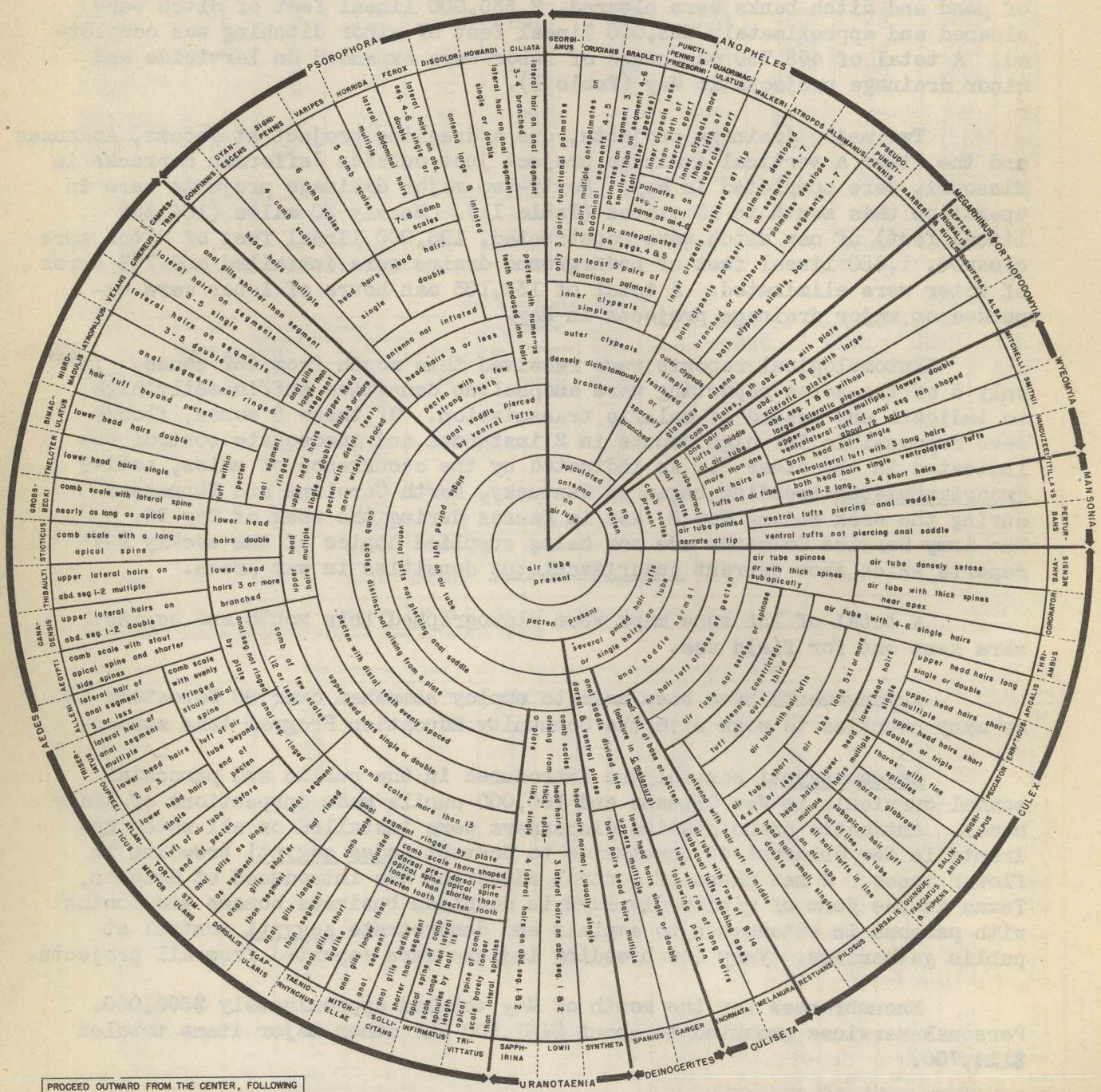
Aedes aegypti control was introduced in the public and parochial school curricula in New Orleans and 100,000 pupils made inspections of their homes. Automatic phenothiazine dispensers were installed on all water hydrants in New Orleans' 45 cemeteries to prevent Aedes aegypti breeding in flower vases. A new phase of control education was introduced at Houston, Texas in the form of window displays in downtown business houses and booths with persons in attendance to explain and demonstrate aegypti control at public gatherings. Very low breeding indices were reported from all projects.

Encumbrances for the month of May totaled approximately $596,000. Personal services amounted to about $481,500 and other major items totaled $114,700.

A KEY TO THE MOSQUITO LARVAE
OF THE
SOUTHERN UNITED STATES

by

GEORGE H. BRADLEY, STANLEY B. FREEBORN & EUGENE J. GERBERG



PROCEED OUTWARD FROM THE CENTER, FOLLOWING THE ALTERNATIVE CHOICES ARRANGED IN THE CONCENTRIC CIRCLES. BY PROCEEDING INWARD FROM THE CIRCUMFERENCE THE DISTINCTIVE CHARACTERS OF ANY SPECIES MAY BE DETERMINED

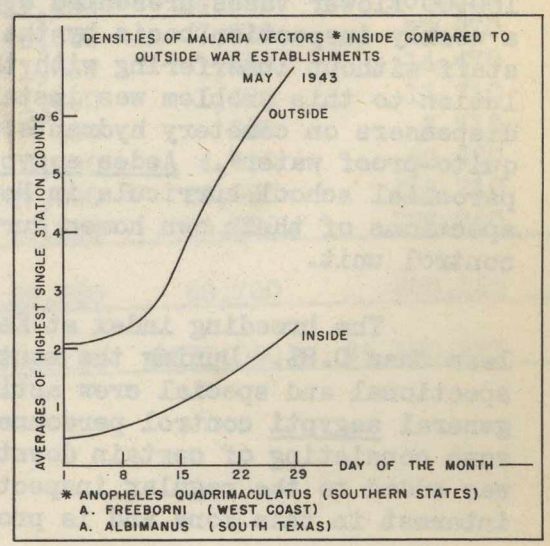
MALARIA CONTROL IN WAR AREAS
U. S. PUBLIC HEALTH SERVICE

MONTHLY REPORT
Malaria Control in War Areas
May, 1943

With the advent of warmer weather in May, larvicidal operations were resumed in most southern states. Consumption of larvicide oil increased from 73,500 gallons in April to 139,500 gallons in May, and paris green from 5,500 pounds to 9,300 pounds. The acres of water surface treated more than doubled from 7,000 in April to nearly 15,000 in May. The use of power sprayers and dusters is being stressed to help solve the problems of the manpower shortage and an expanding control program. Data on the larvicidal and minor drainage work are presented in Table I.

Major Drainage - Two major drainage projects were completed this month. These were a dragline project at Jerome, Arkansas and a vertical drainage project just outside Jefferson Barracks in Missouri. Vertical drainage was used on the Jefferson Barracks project for the first time in the MCWA program. All previous efforts to drain this ten acre sinkhole, that has constituted a disease hazard and a source of annoyance for many years, had failed. The effectiveness of the vertical drainage construction was demonstrated soon after completion of the project when the vertical shaft very satisfactorily carried away the run-off during several heavy rains. Local Army officials cooperated in this project by loaning heavy equipment that could not be obtained elsewhere. Progress of the major drainage program is shown in Table II.

Entomology - During May, regular entomological reports were received from 402 zones. Reports are not yet being received from many of the more northerly zones where breeding has not yet begun. In all but five of the zones reporting, anopheline densities were sufficiently low during May to indicate the absence of any hazard of malaria transmission. Of the five zones where high densities occurred, floods were responsible for greatly enlarging breeding areas in two cases and in the remaining three zones, inadequate control work was indicated. During the present mosquito season it is planned to show progressively each month the effect of the control work on mosquito densities by means of a graph, the first installment of which is shown here. It may be noted that low average densities occurred both inside and outside during the month, but that those outside increased at a greater rate than those inside. The occurrence of male anopheline mosquitoes, which indicates that active breeding has begun in an area, was reported in Kentucky, North Carolina, and Tennessee during the week ending May 8, and in Kansas during the week of May 22.



During the month, plans for supplying Army Service Commands with information on the current status of MCWA work were completed.

Maps of the areas under survey and control have been supplied showing locations of adult mosquito index stations in relation to the war establishment being protected. Copies of the weekly M-7 reports of mosquito densities will be sent as received.

A comparative study of the number of adult anophelines collected in a regular animal bait trap and a bait trap thatched with cattail and saw grass is being made at Camp Tortuguero, Puerto Rico. Collections made the first week indicate that the more natural, thatched animal bait trap collects four to five times as many anophelines as the regular, painted stable trap with wooden walls. In view of the scarcity of finished lumber, plywood and galvanized sheet metal ordinarily used in construction of the sidewalls and roof of the traps, this study has particular interest under war conditions.

Maps - Maps for 135 zones were planographed this month and copies were sent out for field use. Of these, 45 maps submitted by Texas and 8 by Alabama required only inking and minor correcting by this office in preparation for planographic reproduction.

Community Education Program - A representative of the Office of Field Activities in Health Education visited the various states to make arrangements for the employment of teachers for summer work on the Community Education Program. Somewhat over 90 of these Educators will be employed in as many counties.

In-Service Training Program - The first basic course in the in-service training program was held in May. This one week course included material which could best be presented in class room fashion. Supplementary field training, more particularily suited to small groups or individuals, will be provided later.

Aedes aegypti Control - New Orleans' 45 cemeteries with an estimated 100,00 flower vases presented a problem entirely too large to be handled on a weekly inspection basis by the small inspection-correction Aedes aegypti staff without interfering with the regular premise inspections. The solution to this problem was installation of automatic phenothiazine larvicide dispensers on cemetery hydrants so that vases are now being filled with "mosquito-proof water". Aedes aegypti control was introduced in the public and parochial school curricula in New Orleans and over 100,000 students made inspections of their own homes during the month, reporting the results to the control unit.

The breeding index at Key West, Florida was forced down to a little less than 0.8%. During the month, a sound movie was made here of all inspectional and special crew activities and office organization for use in general aegypti control personnel training. In Miami a new special military zone consisting of certain downtown buildings owned or leased by the Navy was added to the regular inspection program. The Navy has shown particular interest in this zone and is providing corpsmen for inspectional work.

At Savannah, Georgia the breeding index climbed slowly to a little over 2% by the end of May. Unusually high temperatures stimulated breeding to a point where the incompletely staffed control unit could not prevent a gradual increase.

Breeding indices in Texas remained near 1% or lower. In Brownsville, the first aegypti larvae found in a period of 79 days were discovered May 28. A new phase of control education was introduced at Houston in the form of window displays in the downtown business houses and booths with persons in attendance to explain and demonstrate control at public gatherings. Approximately 3,000 Corpus Christi public school pupils made inspections of their home premises and turned in correctly filled report blanks. The work in San Antonio has been primarily concerned with educational activities and eradication of mother foci with spot check inspections to determine breeding conditions.

Personnel and Encumbrances - In accordance with the limited manpower ruling, tentative personnel ceilings were established for each state. Studies are being made by District engineers and entomologists in an attempt to revaluate MCWA projects. It is planned to reduce labor on less important projects and to stress operations on the more important ones. Table III summarizes data on the number of employees and the payroll by states for the month of May.

Table IV
MCWA Encumbrances by Major Items

	May	April	March	Total July 1 - May 31
.01 Personal Services	$481,520	$489,560	$487,380	$4,340,770
.02 Travel	25,890	21,480	14,990	169,520
.03 Transportation	5,570	3,000	7,820	27,870
.04 Communications Services	1,250	1,030	1,200	14,470
.05 Rent	1,800	1,650	1,520	14,710
.06 Printing and Binding	750	400	680	2,710
.07 Other Cont. Services	7,170	4,690	4,420	59,400
.08 Supplies and Materials	56,290	47,090	28,090	413,710
.09 Equipment	15,990	10,210	30,980	127,760
Sub-total other than Personal Services	114,710	89,550	89,700	830,150
Total	$596,230	$579,110	$577,080	$5,170,920

THE MCWA PROGRAM IN PUERTO RICO

Few readers are acquainted with Anopheles albimanus, the malaria vector in Puerto Rico, or with other malariological, social and economic aspects affecting the MCWA program in this insular possession. But many are familiar with malaria problems in continental United States, and with the principal domestic vector, A. quadrimaculatus. For this reason the malaria problem and MCWA control operations in Puerto Rico are presented on a comparative basis, where possible.

A. albimanus flies farther and larvae develop in a wider range of aquatic situations than does A. quadrimaculatus. Larval production in significant quantity may be found in both fresh and brackish water (up to 50% or more of sea water salinity). Abundant production occurs not only in ponds, swamps, marshes and ditches, but also in the edges of running streams, hoof prints, cart tracks, seepage areas and ground pools. Breeding places in the states in which A. quadrimaculatus, A. stropos, A. crucians, A. punctipennis (temperature excepted), Aedes sollicitans, Aedes taeniorhynchus, and Psorophora are found, are, in general, suitable for A. albimanus production. Usually, a 2 mile radius of mosquito control is adequate, but occasionally this must be extended to 2-1/2 or even 3 miles to reduce to safe limits trap collections at the center of the circle. Since the area of a circle increases with the square of the radus, MCWA project control zones in Puerto Rico are generally four times as large as in the States.

Malaria in Puerto Rico is more prevalent than in the States. The tropical latitude, abundant precipitation, impermeability of the soil, the practice of irrigation, population congestion, low economic levels and other ecological factors favorable to the malaria vector and malaria transmission all contribute to this condition. The mortality rate for Puerto Rico in 1941 was 124.9 and the total number of malaria deaths was 2,380. The average malaria mortality rate in those municipalities (counties) in which MCWA projects are operating was 170 per hundred thousand.

Malaria is transmitted every month of the year in Puerto Rico and larviciding must be continuous. While prevalence of the disease and A. albimanus vary seasonally, civilian morbidity reported in the lowest month is 40% of the annual monthly average.

In Puerto Rico, tactical and strategical considerations control the selection of locations for military bases. As a result, less consideration can be paid to environmental health hazards than in locating training camps. In Theater of Operation areas, military forces are also more widely dispersed, and bases and positions are smaller and more numerous. As a result, only a minority of the military positions in Puerto Rico are protected by MCWA anti-anopheline projects, although a majority of the military population affected by malaria hazards is protected.

The mosquito proofing of barracks and quarters by the Army and Navy, and auxiliary measures such as the spray killing of adult mosquitoes in barracks and quarters, use of repellents, head-nets, mosquito bars and gloves, are essential in Puerto Rico. Aside from the limited use of suppressive drug treatment in special situations, they constitute the only anti-malaria measures feasible for small coastal military positions affected by large acreages of A. albimanus breeding places. Mosquito proofing is also essential in the larger bases protected by MCWA projects, as it was Earle's * experience that the average overnight collections of A. albimanus in animal baited traps had to be brought below one to interrupt malaria transmission in an unscreened town. To accomplish this by larviciding and drainage often would require an area-wide reduction of over 99% in albimanus production. The safe animal bait trap index can be increased many times where effective mosquito proofing is practiced, thus making anti-larval work justifiable within economic limits. At present, due to anti-anopheline project operations, limited rainfall and improved mosquito proofing practices, the Army malaria rate has been sharply reduced. Most of the residual malaria now occurring is among troops unprotected by mosquito-proofing (on night guard duty) or by anti-larval measures (isolated operating positions) or both.

* Earle, W. C. XXX Sth. Med. J. 946-950 Sept. 1937

Before work was started on the MCWA program, agreement was reached with the Insular Health Department that anti-anopheline projects around military bases should be operated directly by the Public Health Service. Various factors peculiar to Puerto Rico contributed to this decision. Also, due to the major malaria hazards affecting military bases proper, it was considered unwise to dissipate MCWA efforts by extending the program into recreational and industrial areas. As a result, the extra-reservation projects have been operated essentially as sanitary utilities of the Posts and Bases, and the MCWA program has consequently operated more as an arm of the Army and Navy than as a civilian service. Resultant integration with the Army and Navy in the joint planning of intra- and extra-reservation malaria control activities, the constant availability to the program of Army materials and equipment possessed by the Post Engineers, combat engineer units and the District U.S. Engineers Office and the furnishing of office space, quarters and mess facilities to resident supervisory personnel have been vital contributions to the success and efficiency of the program.

The first MCWA project was begun April 1, 1942, and 11 projects are currently operating for the protection of 18 military establishments, indluding 6 principal reservations. Two projects protect combined Army and Navy Bases and the remainder serve the Army. They are supplemented by 3 WPA malaria drainage projects operating in extra-reservation areas under MCWA sponsorship and technical supervision. (These were initiated in 1941 under Insular Health Department sponsorship and will operate to June 30, 1943 or later). WPA forces approximate 900 men working 130 hours monthly and MCWA forces total approximately 600 men working 190 hours monthly. Larviciding work at some of the military bases was started on a limited scale by the Insular Health Department as far back as 1940, and equipment and some personnel of that Department were temporarily assigned to MCWA at the beginning of the program.

At first, all MCWA projects were restricted to larviciding and minor drainage, but, with further development of the program, major drainage has been undertaken as well. As labor is plentiful due to widespread unemployment and the shortage of materials and equipment is particularly acute in Puerto Rico, hand labor is used to the greatest possible extent on major drainage construction. Also, in order to further conserve materials, equipment and funds during the War emergency period, it has been a policy to practice larviciding and minor drainage wherever effective control can be realized by these methods. Major drainage is undertaken only where other methods are found inadequate. Another reason for this policy is the temporary life of some reservations and the uncertain life of all. Accordingly, larviciding is first practiced throughout the entire control zone long enough to determine whether this measure alone is effective in reducing the adult albimanus population to safe limits in the barracks and quarters areas. If this cannot be realized, those few breeding areas which are not being controlled effectively are scheduled for drainage, with larviciding continued for the remainder. While Paris green has been found effective in a great majority of the situations, inherent limitations of this method as well as the personal equation have prevented reduction of the anopheline population to safe limits in a few. These instances are described below:

Two important breeding areas were inaccessible to ground crews. These were muck-bottom mangrove swamps in which laborers could not walk, the water was too shallow for boats, the area too large for power dusting from the shoreline, and no airplane was available for dusting. In two others involving large grassy marshes, the size of the areas was so great it was inevitable that some of the water surface would be "missed" or inadequately dusted each week. In addition, due to the close proximity of the breeding places to barracks and quarters and the large anopheline production, a larva "kill" of even 90% would not reduce the number of residual anophelines to a safe limit.

In another marsh, an unusually thick stand of "Para" grass impeded effective dusting as the grass was invariably wet during early morning hours when the air was quiet. While it is presumed that the dust particles eventually reached the water surface, larvae collections indicated an uneven dust coverage. In another case, heavy anopheline production was occurring in a mixed mangrove-cattail (brackish type) swamp of nearly 200 acres. The stand was too dense and too high for the dust cloud to penetrate horizontally for more than a few feet. Clearing lanes were cut at 50 foot spacing and power dusters carried through the lanes on hand barrows, but with only limited effect. Since A. albimanus breed-

ing is increased by sunlight, clearing the entire area would have intensified breeding so greatly as to nullify the increased effectiveness of larviciding. Airplane dusting was resorted to as a temporary measure, but it was judged desirable to drain the area. This has necessitated a large pump installation, as the swamp is from zero to one foot above sea level.

In still another case, flat pasture lands with thousands of cattle tracks and minor ground pools were within one-eighth to one-half mile of a major air base. Seepage supplementing rainfall maintained water continuously in these shallow depressions during the wet season. From ten to twenty A. albimanus larvae could be collected in a small dipper. Here it was felt that drainage was essential, as residual emergence under larvicidal control was sufficient to maintain a malaria hazard.

Paris green is the principal larvicide used by MCWA in Puerto Rico. It is applied by the following equipment units in active use on projects: 203 rotary hand blowers, 8 3/4 H.P. power dusters, one 5 H.P. power duster, and an Army airplane furnished intermittently and part time. Air floated hydrated lime and calcium carbonate are used as diluents for the Paris green. Calcium carbonate is preferred for use with power dusters and hydrated lime in the hand dust guns and airplane duster. Dust mixes used by ground crews vary from 5% to 10% by weight, while a 20% by weight mix has been used so far in airplane dusting. Dust used on the larger larvicidal projects is mixed on the project with power dust mixers, directly connected to 5 H.P. electric motors. About 10% of the dust used on the island (by the smaller projects) is mixed in steel drums which are mounted eccentrically and turned by hand.

Puerto Rico is in the trade wind zone, and a strong breeze blows during most of the daylight hours. As the breeding areas are extensive, it is very difficult to complete the dusting of open marshes in the early morning before the breeze becomes too strong. As far as possible, project dusting schedules are planned to cover open areas early in the morning and protected places (including ditches, streams and mangrove swamps) later in the day.

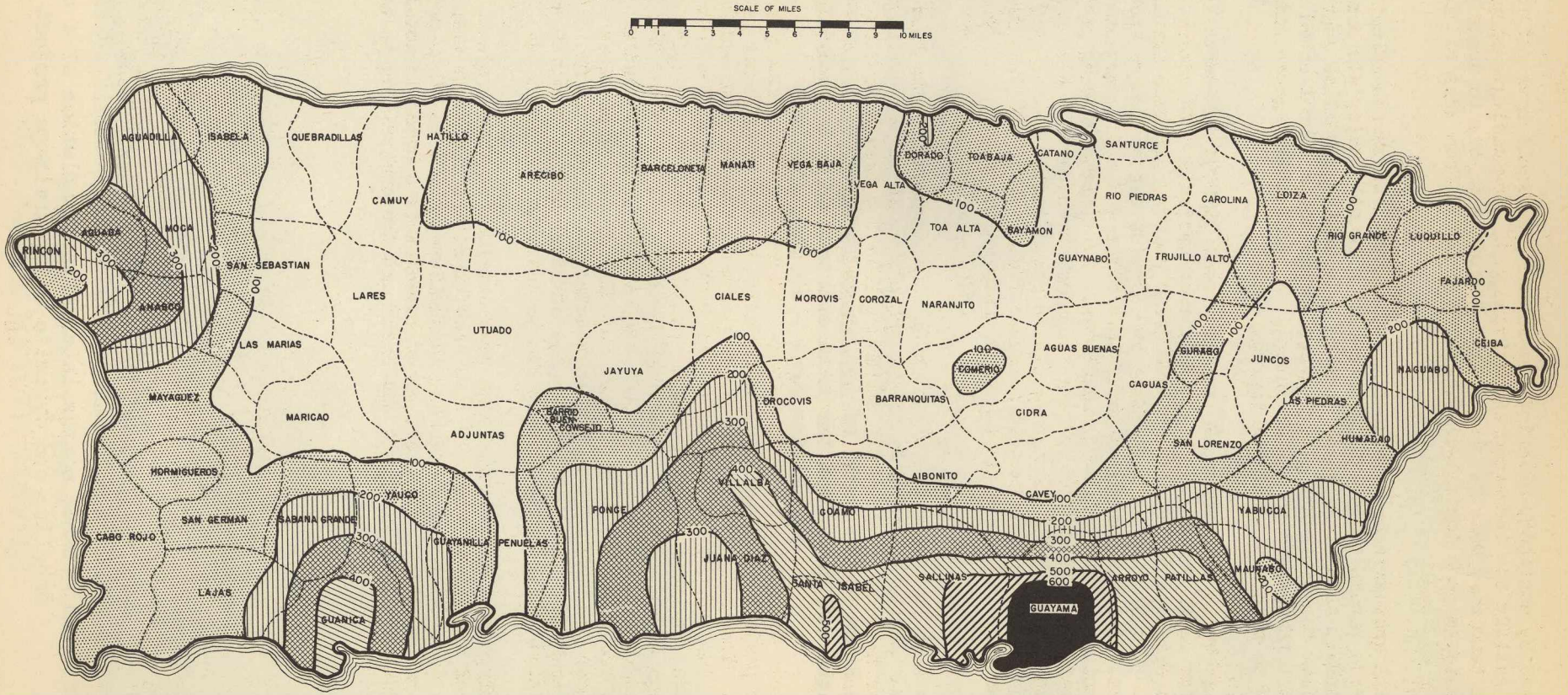
The Earle animal baited trap is used extensively, and as many as 22 traps are installed on one project. Horses are the preferred bait, but when not available, calves or cows are used. The bait is led into the trap shortly before dusk and removed early the next morning. The trapped mosquitoes are collected as soon as the bait is taken out before ants and lizards eat them. The highest overnight collection was 3,280 A. albimanus. By placing traps in the principal breeding zones as well as in the barracks and quarters area, it is possible not only to estimate the effectiveness of control work and the residual malaria hazard affecting military groups, but also to determine those areas in which antilarval work should be intensified. Interpretation of results is facilitated by assembling weekly collections on a lettersize mimeographed sheet having a map of the control area that shows the location of each trap in relation to barracks and quarters.

Recently, excellent results have been obtained at some projects with light traps. In some parts of the island they are more sensitive than the Earle trap to variations in the anopheline population and catch more anophelines, while on other projects the experience has been less satisfactory. A paper, which covers this subject in detail, is being prepared by Assistant Entomologists (R) Pratt and Pritchard for publication in the Public Health Reports.

MALARIA DISTRIBUTION - PUERTO RICO

MORTALITY PER 100,000 POPULATION

BASED ON MALARIA MORTALITY AT PLACE OF DEATH 1931-39, AND CENSUS OF 1935



JULY 1941

PREPARED FROM MAP FURNISHED BY
SCHOOL OF TROPICAL MEDICINE, DEPT. OF PUBLIC HEALTH

Wards Brake - 233 acres of Anopheles quadrimaculatus breeding area located 600 feet from the main entrance of a West Coast Japanese Relocation Area - Jerome, Arkansas

Wards Brake - three months later after completion of a combination dragline and dynamite major drainage project