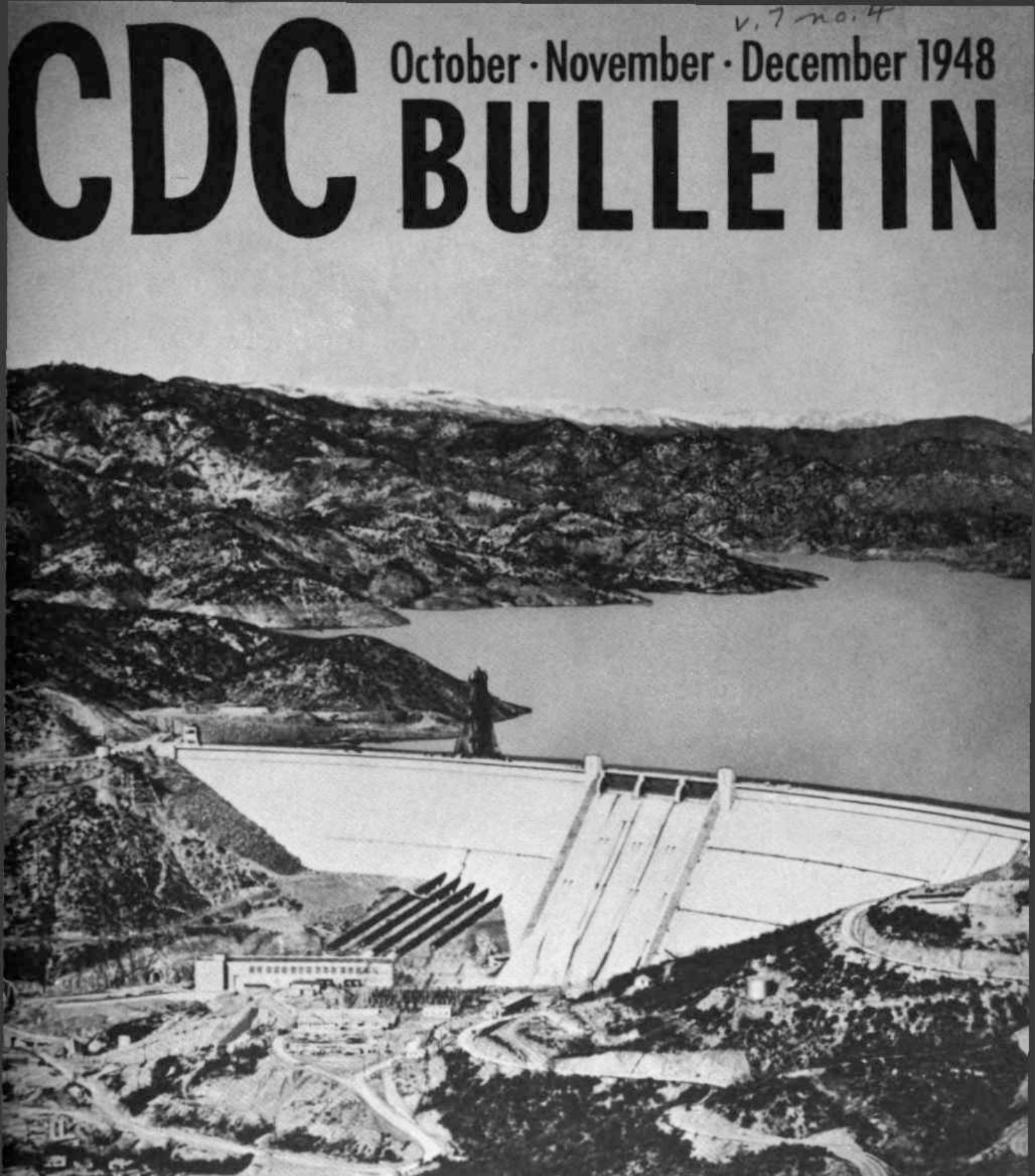
CDC BULLETIN

October · November · December 1948



FEDERAL SECURITY AGENCY
Public Health Service
Communicable Disease Center
Atlanta, Ga.

CDC BULLETIN

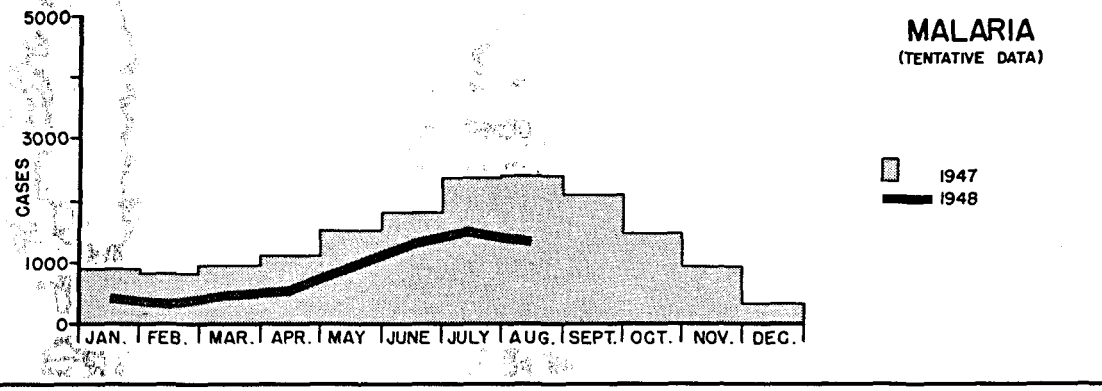
OCTOBER - NOVEMBER - DECEMBER 1948

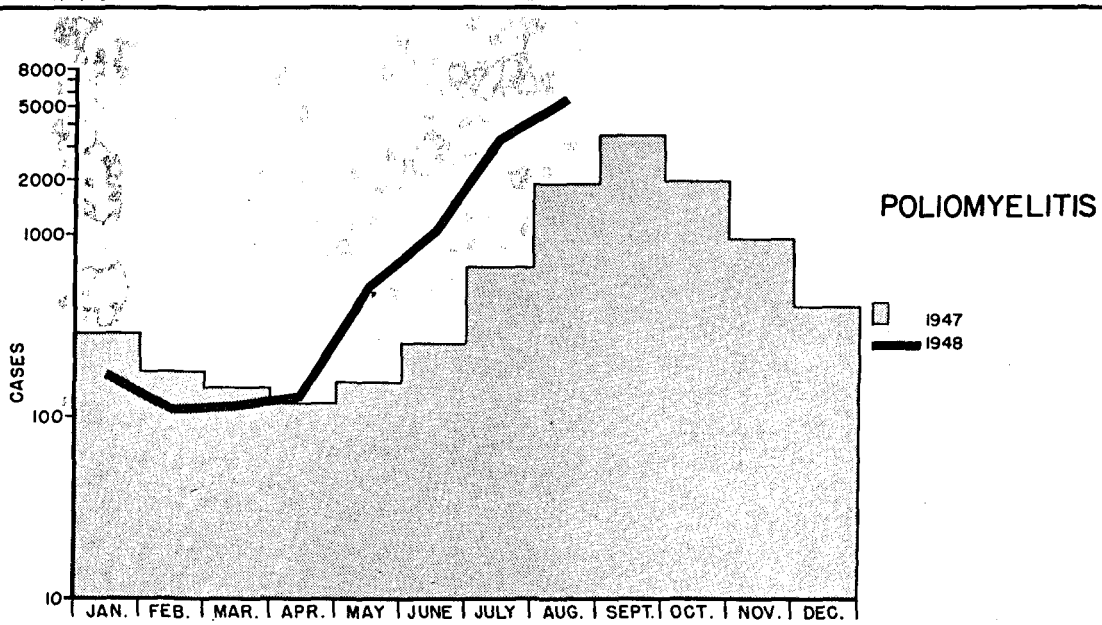
FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE
COMMUNICABLE DISEASE CENTER
Atlanta, Georgia

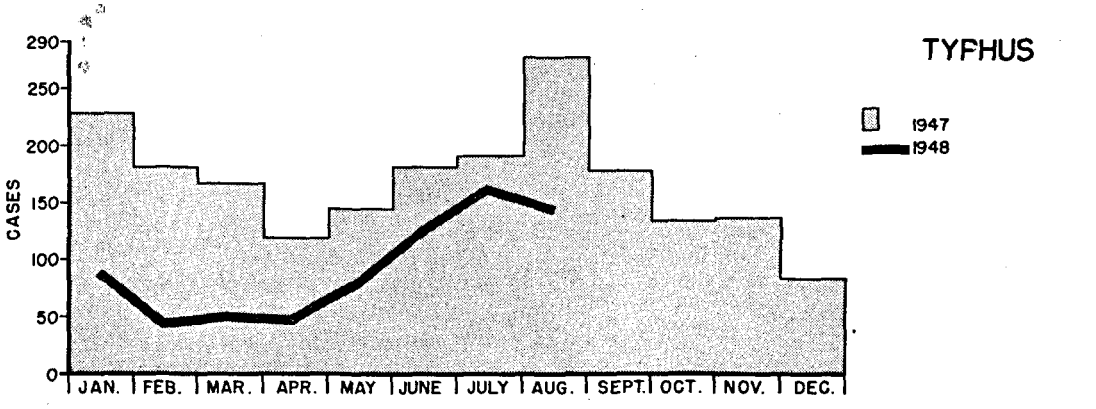
CONTENTS

MORBIDITY TOTALS FOR THE UNITED STATES *
MALARIA, POLIOMYELITIS, TYPHUS

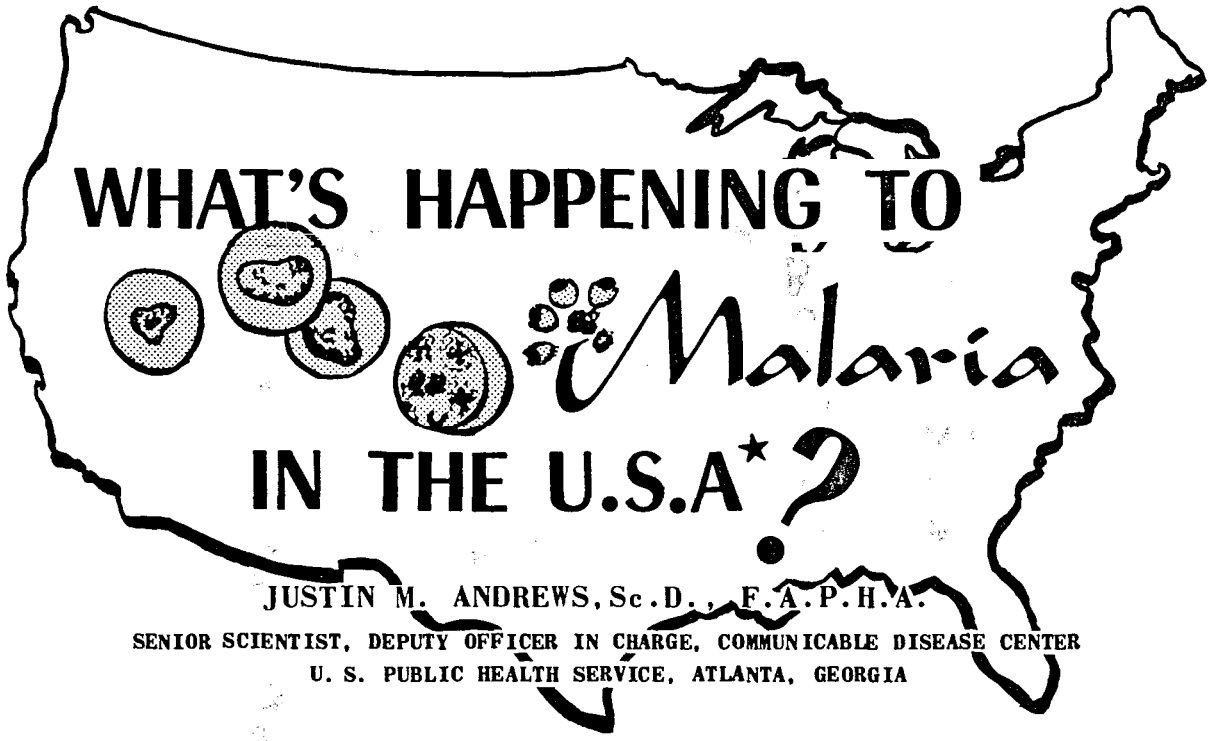
1947 - COMPLETE 1948 - AS REPORTED







FSA PHS-CDC ATLANTA, GEORGIA * FROM PUBLIC HEALTH REPORTS



WHAT'S HAPPENING TO Malaria IN THE U.S.A.*?

JUSTIN M. ANDREWS, Sc.D., F.A.P.H.A.
SENIOR SCIENTIST, DEPUTY OFFICER IN CHARGE, COMMUNICABLE DISEASE CENTER
U. S. PUBLIC HEALTH SERVICE, ATLANTA, GEORGIA

The general decline of malaria in this country is believed to have begun during the last quarter of the 19th century,[1,2,3] some years before it was known how the disease is transmitted. At that time, malaria virtually blanketed the eastern two-thirds of the nation, except for the Appalachian highlands, and extended up the Central Valley of California.[4] Its retreat has been interrupted, at least during the latter half of the intervening period, by resurgences in prevalence at such regular intervals that a five-to seven-year cyclicity in epidemic manifestations has been postulated.[4,5] The last of these periods of enhanced transmission took place during the mid-thirties of this century. By that time, the principal areas of endemicity had contracted to the coastal plains and lime-sink sections of the southeastern states and the flood-plain areas of the lower Mississippi and its main tributaries. Since this last upswing, 12 to 14 years ago, reported malaria prevalence in the U.S.A. has decreased steadily as shown in the accompanying graphs (Fig. 1). Making generous allowance for the traditional errors of ommission and commission in malaria reporting, it is evident that consistent declines in recorded morbidity and mortality, unprecedented in their magnitude and duration, have been in effect for the last decade or more. This downward trend is verified by the general testimony of residents and by special field studies[6,7] in areas where malaria has been highly endemic in the past.

What is the significance of this latest recession? Since 1935 there has been no reported increase in indigenous malaria cases or death rates in the country as a whole. This indicates that the regular wave-like pattern of malaria epidemicity throughout the nation is not an immutable phenomenon. If the negative slope of the last 12 years' experience can be continued or accelerated, it can mean nothing more or less than the ultimate extinction of

---

*Presented before the Georgia Public Health Association, June 10, 1947, and the American Society of Tropical Medicine and the National Malaria Society in Atlanta, Georgia, December 4, 1947.

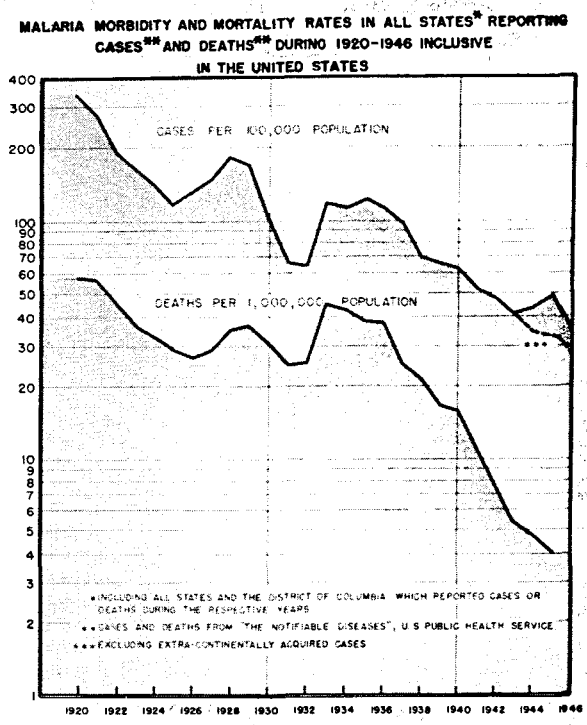


FIGURE 1.

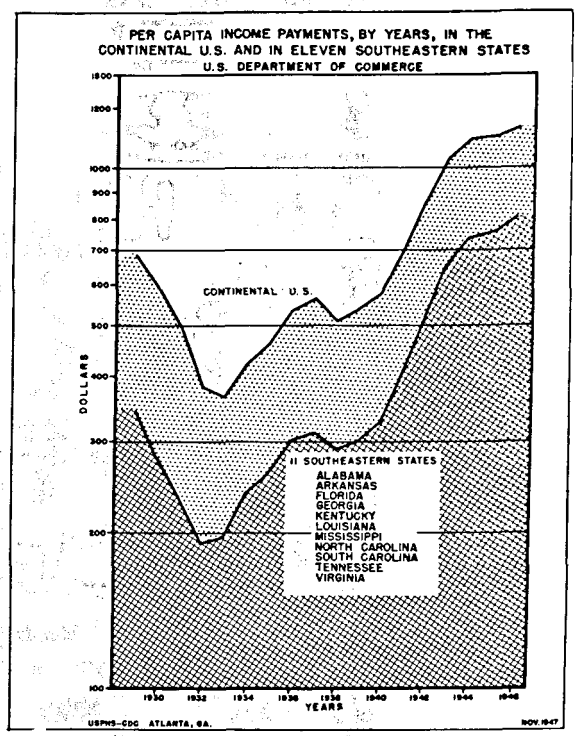


FIGURE 2.

malaria in the United States. To exploit this trend, it is important to determine its causes, if possible, while they are still in effect.

Is malaria being treated out of existence? Has it stopped relapsing or has man become generally refractory to infection? Have infectible anophelines become so few that transmission is not possible? Have these species lost their susceptibility to plasmodial parasitism — or their taste for human blood? Have all rural homes in the South been made secure against insects—and do their occupants remain indoors after dark so punctiliously that they are no longer accessible to mosquitoes? A brief review of these and other possible nullifying influences seems desirable: 1) to assess the evidence for or against their causal participation in the current malaria regression, 2) to judge the extent, if any, that these phenomena are due to purposeful control efforts, and 3) whether it would be wiser, in view of the present low level of malaria incidence, to stop all organized attempts at further malaria prevention as unjustified expenditures or to continue them with the hope and expectation that, within the foreseeable future, they will result in the total eradication of the disease.

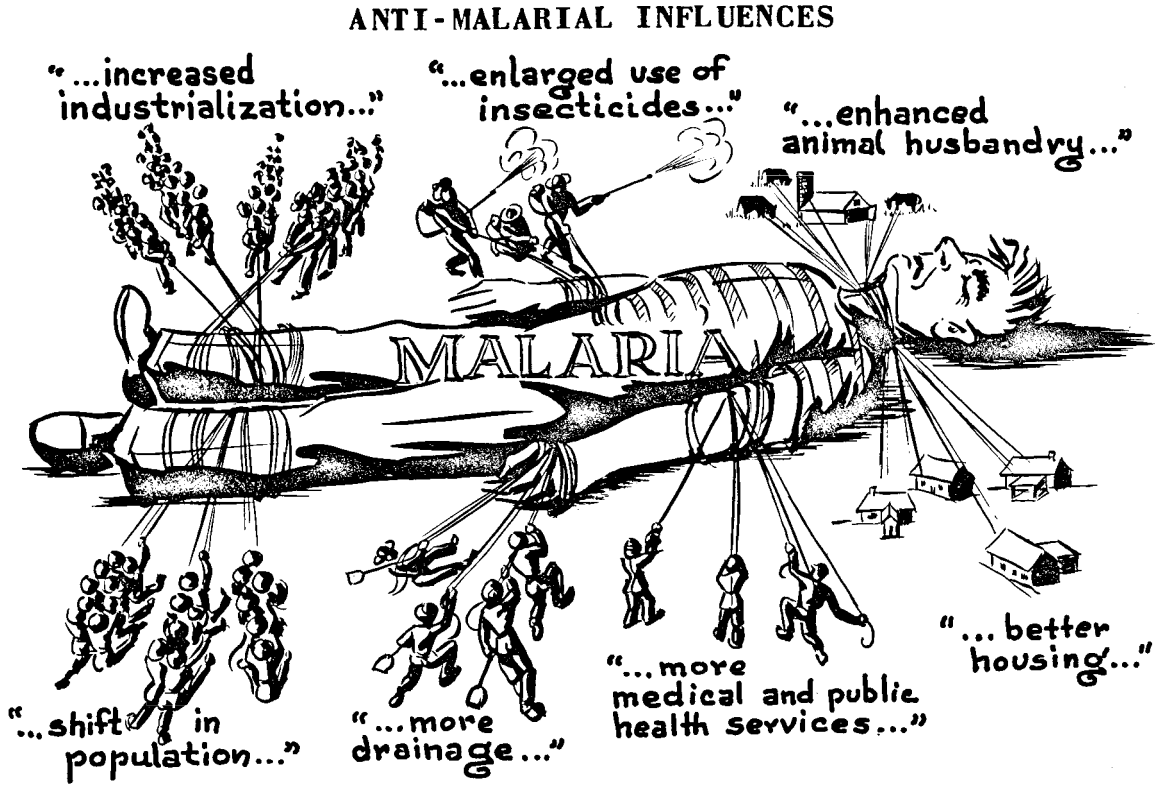
Economic improvement in the South — The South shared in the nation's present wave of prosperity which started its upward swing (see Fig. 2) at about the time malaria rates commenced their latest descent. In connection with this circumstance, it is pertinent to note that socio-economic progress was believed by various authorities[1,2,3,4,5] to be the prime determinant in the extinction of malaria in the Upper Mississippi Valley though they disagreed as to the most probable means by which it was achieved. Malaria is more firmly entrenched by environmental conditions in the South than it was in the North, nevertheless it seems probable that economic improvement is the basis for various pressures to which it is now yielding. Those which may be presumed to exert antimalarial influence include better housing, more medical and public health services, more drainage for agricultural and suburban development, enlarged use of insecticides in homes, enhanced animal

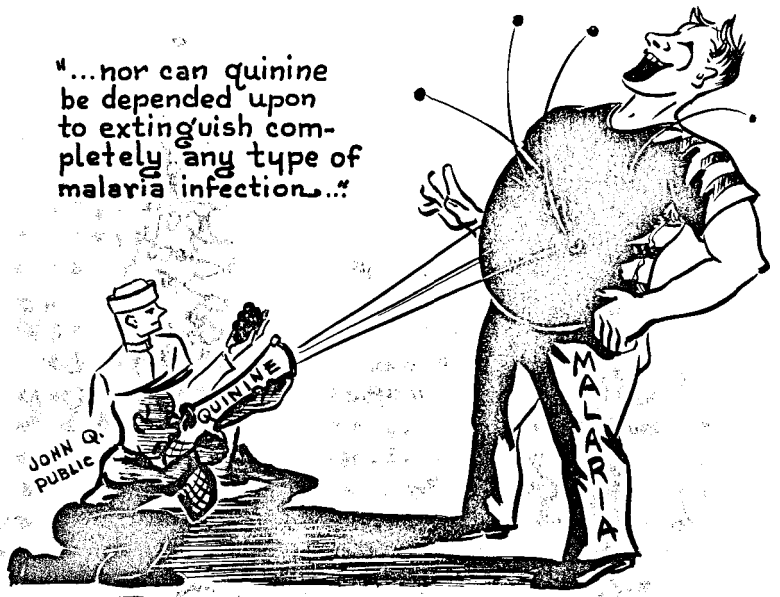
husbandry, and increased industrialization with its attendant shift in population residence from rural areas to or near metropolitan centers. Wartime and post-war shortages of materials and professional personnel have doubtless prevented the fullest elaboration of these forces against malaria.

Human susceptibility — Considering first the human factors which may have been involved in the present recession, there appears to be little reason for assuming that it is due to an American loss of susceptibility to initial infection or relapse. Well over a half million American soldiers and sailors,[8] including many from the South, acquired malaria overseas from 1942 to 1945, inclusive, evidencing no resistance to the numerous strains of plasmodia encountered. Some of the tertian infections imported subsequently are still relapsing after three years. Paretics and other recipients of induced malaria in this country appear to accept and react to blood- or mosquito-transmitted infections with old or new strains of parasites in recent years as their predecessors did before them according to observers whose investigations involve the extensive use of this procedure.[9,10,11,12] Furthermore, it was shown in 1947 that native cases of falciparum and quartan malaria in South Carolinian Negroes, with or without symptoms, were readily infective to insectary-reared and wild-caught *A. quadrimaculatus*, even though gametocyte densities were very low in some instances.[13]

Antimalarial medication — It is difficult to assess correctly the role of medication in the malaria decline. Since the days of "Sappington's Anti-Fever Pills", residents of endemic areas in the United States have consumed huge quantities of ethical and proprietary antimalarials with the object of treating or preventing malaria. It seems logical to expect that drugs which reduce parasite densities in man should diminish his infectiousness to mosquitoes at the same time but this effect has not always been sufficiently realized to be of significance in the prevention of malaria.

Thus while the world thankfully accords





memorable prominence in medical history to quinine for the relief it has given to countless millions suffering from malaria, it is now well known that the drug possesses no prophylactic properties, except the ability to effect the temporary suppression of symptoms, nor can it be depended upon to extinguish completely any type of malaria infection. Therefore, it is doubtful if quinine interferes perceptibly with the transmission of the disease. Certainly there appears to be no reason for believing that it contributed any more to the control of malaria in the South since 1935 than before that date.*

Quinacrine hydrochloride (atabrine) was introduced into general use in the South during the middle and latter years of the decade when the present malaria recession was just getting under way. Its early experimental application as a mass therapeutic and prophylactic among predominantly Negro populations with almost exclusively falciparum malaria was associated with encouraging reductions in spleen, parasite, morbidity and mortality rates.[14,15,16] Later observations in Panama,[17] led to the conclusions that atabrine was no more dependable than quinine for malaria control purposes when used in treating parasite positives discovered at monthly blood surveys. Critical tests[18,19] and general experience in malarious areas during World War II concurred in establishing that this drug, while not much more effective than quinine against vivax and quartan malaria, is virtually a specific against falciparum infection, its use in therapeutic or suppressive dosages resulting in a high percentage of non-relapsing cures of this and no other types of malaria. This unique characteristic plus the temporal association of atabrine and the recent malaria decline qualifies atabrine medication as one of the possible causes of the recession, without defining its actual importance.**

Population migration out of rural areas— Since 1935, there has been a notable migration from rural to urban surroundings throughout the United States. This was most marked during the first half of the present decade due, presumably, to military induction and to the attractions of higher wages and better living conditions in and near the more populous centers where materials and equipment for Defense and War Indus-

---

* According to Mr. Norman Taylor, Director, Cinchona Products Institute, Inc. (personal communication), this country, prior to 1939, used roughly four million ounces of quinine each year, the annual variation being within ten percent of this figure. Its consumption "over a period of years" did not increase with the population. There is no way of determining the actual proportion used as an antimalarial in the South but, on the basis of available distribution data, it was estimated at the Institute that about two million ounces were used for that purpose.

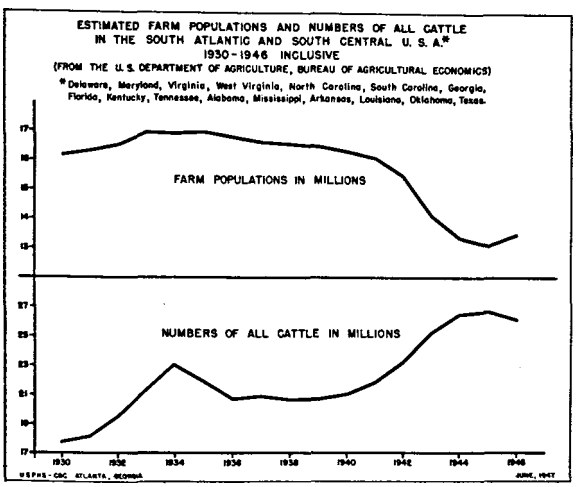
** Information regarding the distribution and consumption of atabrine in this country could not be obtained from its principal manufacturer as the output of this product for the last six years has been controlled largely by the Army, Navy, and Public Health Service and has been subject to use abroad as well as in the United States.

tries Programs were being fabricated.

From 1917 to 1940, there was a small but steadily increasing progress in the industrialization of the South as northern manufacturers shifted their factories to take advantage of more favorable labor conditions below the Mason-Dixon Line. From July 1940 to May 1944, the South received 24.4 percent of the $14,000,000,000 authorized by the War Production Board for manufacturing plants and equipment; this does not include the cost of plants whose post-war conversion to peacetime industry is doubtful.[20] During the same period, considerable numbers of Negroes travelled to the northern states to escape the effects of a waning cotton economy and with the hope of finding more productive and congenial surroundings.[21]

In many sections of the southeastern quadrant of this country, these events have resulted in transferring people OUT of rural areas where they might have had

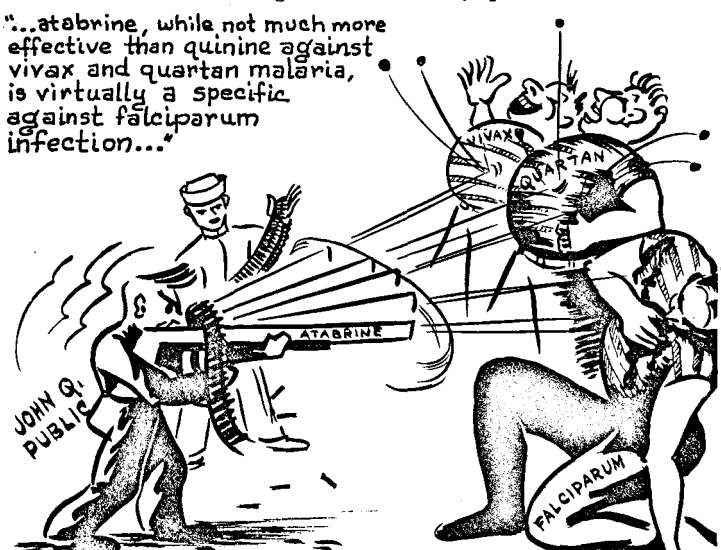
FIGURE 3.

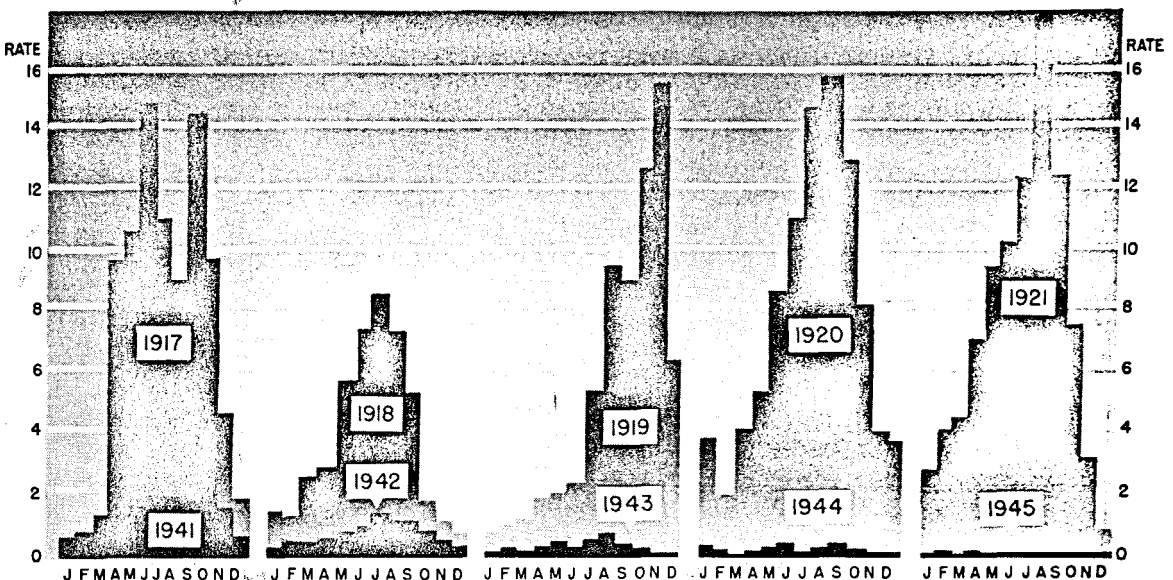


malaria and INTO urban situations where the chances of acquiring it were negligible. The total extent to which this phenomenon has taken place is not known at present but some idea of its trend is conveyed by the upper curve in Fig. 3, which indicates the progressive reduction in farm populations in the South Central and South Atlantic States from 1935 to 1945, inclusive. Thus it seems probable that a considerable depletion in rural population has occurred. This may have assisted materially in malaria reduction in the last five or six years.

Anopheline susceptibility — Consideration must also be given to the possibility that changes in anopheline populations may have interfered with the transmission of malaria. Among such hypothetical factors, reduction in mosquito susceptibility to plasmodial parasitism due, perhaps, to environmental or cosmic influences would be of paramount significance if demonstrable. Such a phenomenon might be reasonably expected to manifest itself in insectary-reared as well as wild strains of mosquitoes. There is no published evidence to that effect with reference to the principal transmitting species in this country. Induced malaria for therapeutic and experimental purposes appears to have been transferred from one person to another by means of mosquitoes with comparable degrees of regularity throughout and prior to the period under consideration.[9,10,11,12] While most of the naturally induced malaria has been transmitted with the Boyd strain of *A. quadrimaculatus*, established in 1932,[22] other insectary stocks have been used and wild strains of this species have been brought into laboratories and their infectibility proved.[12,23,24]

Antilarval measures — Has the abundance of this transmitter diminished sufficiently during the last twelve years to account for the malaria reduction observed? During this period, efforts of considerable magnitude have been made by Federal, state and local health agencies and by private





MALARIA ADMISSIONS PER THOUSAND MEN PER YEAR FOR THE ARMY IN THE CONTINENTAL UNITED STATES WORLD WAR I — WORLD WAR II
(NOTE THE REDUCED MILITARY MALARIA EXPERIENCE IN THIS COUNTRY DURING THE LAST WORLD WAR)

FIGURE 4.

interests aimed at reducing anopheline densities both on a community-wide basis and within homes. Entomological evidence of success as a result of these endeavors is limited; their probable effectiveness must be inferred largely from the nature and scope of their physical accomplishments.

The U. S. Army's continental experience with malaria during World War I was severe enough (see Fig. 4) to require environmental control measures around southern cantonments. These activities had to be financed jointly from Federal and local resources, thus directing attention to the fact that local governments were unable to bear the costs of malaria control operations which, as then conceived, were mainly antilarval.

Thus, during the depression years which followed, Federal relief organizations (Civil Works Administration and Federal Emergency Relief Administration established in 1933, and the Works Progress Administration in 1935) were called upon to supply manpower for malaria control purposes. They completed a tremendous amount of drainage in 16 southeastern states. The exact total is uncertain as existing reports of accomplishment[4,25] are not in agreement, but from them it appears probable that something in the neighborhood of 32,000 miles of "average-size" ditches were constructed, draining 623,000 watered acres. Most of them were dug by hand labor—machine and dynamite excavation accounting for only a minor percentage — and a few hundred miles of the ditches were paved with concrete.

From the standpoint of good malaria control practice, these projects had serious faults. In the fulfillment of relief objectives, operations could be carried out 1) where and only for as long as the numbers of locally unemployed were large enough so that crews could be manned for malaria control drainage as well as for other relief labor projects desired by the community, and 2) where locally provided materials and equipment were available for matching against Federal funds.

These conditions tended to concentrate malaria control drainage projects in the more populous and wealthy counties, not necessarily the more malarious ones. Justification for locating work units was frequently based on nothing more than lay testimony of past malariousness. Drainage construction was restricted to new works, which meant that existing drainage-ways could not be maintained or improved with relief labor nor could it be used to keep in serviceable condition the ditches which it dug originally. In many, though not all instances, local governments have provided for the maintenance of the drainage facilities.

As the Defense Program gathered momentum in 1941, national unemployment declined and many of the WPA Malaria Control Drainage Projects were discontinued except in the neighborhood of military training camps. During 1942, these were taken over by the U. S. Public Health Service and, together with other environmental malaria control operations around areas of military or war industries significance, were continued during the war years as a cooperative works program of the Federal and various state health services concerned. Their efforts were coordinated by the Office of Malaria Control in War Areas, headquartered in Atlanta, Georgia.

During the period of maximal military training and industrial production, malaria control drainage, filling, and larviciding were accomplished by this organization around approximately 2,200 localities of military concern in 19 different states. Through 1945, these activities included clearing and cleaning, incidental to larviciding, of 37,000 watered acres and 96,700,000 linear feet of ditches; 5,700,000 gallons of oil and 73,000 pounds of paris green were used in larviciding 660,486 acres; approximately 10,900,000 linear feet of drainage ditch of varying cross-section were dug (90 percent of them by hand labor, 5 percent with dynamite, 3 percent by heavy machinery, and the other 2 percent were lined or tiled ditches); mechanical and hydraulic fill amounted 315,000 cubic yards.

This program was a great improvement over the preceding one from the standpoint of malariologic principle. Maintenance operations could be undertaken as readily as new construction. Local contributions were required only when adjuncts to drainage works such as concrete ditch-lining or culverts, tile, dynamite, etc. were desired. Early in the development of the War Areas Program, the policy was adopted of basing operations on potential malariousness, i.e., presence of infectible species of anophelines, rather than lay testimony of previous malariousness. Entomologic evaluations were made throughout the progress of the program to check operational accomplishments. These have been summarized in Fig. 5 and show 1) that malaria-carrying types of mosquitoes were less numerous within the zones where mosquito control activities, exclusively antilarval until calendar year 1945, were carried on than in adjacent unprotected areas, and 2) that anopheline abundance in uncontrolled areas

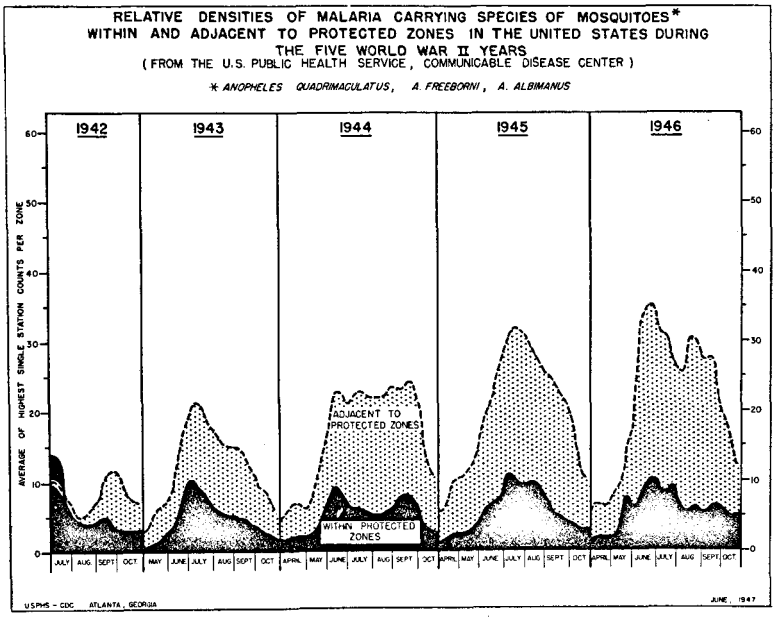


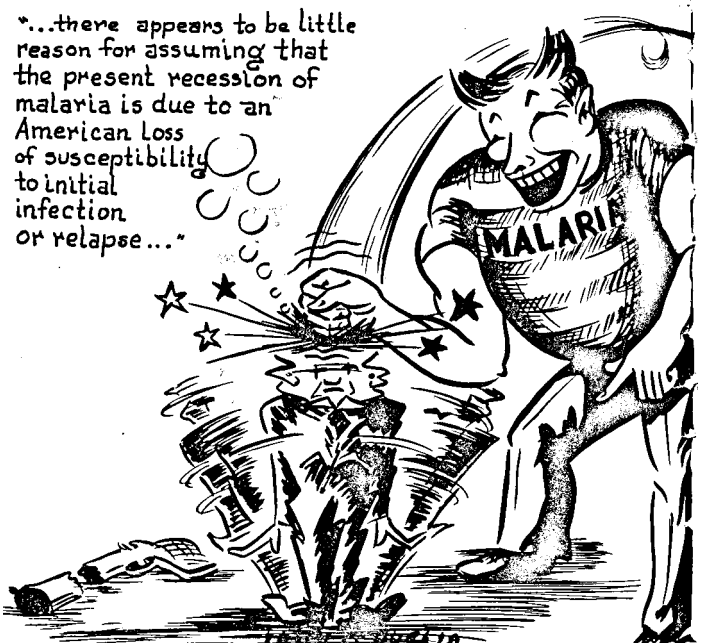
FIGURE 5.

was certainly no less, probably more, in 1946 than in 1942 when enumerative observations were commenced. Spleen and parasite surveys were also made for evaluative purposes but were not very meaningful because of their lack of sensitivity in the face of decreasing malaria prevalence. Community health education and information programs were developed to teach the lay public simple facts about the cause, nature, transmission, and prevention of malaria thus securing cooperation in effecting the objectives of the program.

The main malariologic shortcoming of this War Areas Program was that it was aimed only at the protection of military trainees and war workers. Thus it did not nullify foci of primary malaria endemicity unless they were near military training camps, maneuver areas, airports, shipyards, or the sites of war industrial or recreational facilities.

A third federally-sponsored program which may have exercised some effect on anopheline prevalence over a considerable portion of the South is that of the Tennessee Valley Authority. This organization was created in 1933. Since then it has constructed or acquired 26 artificial impoundments along the Tennessee River and its tributaries. At maximum normal operating level, these lakes cover nearly 600,000 acres and their total shore line extends well over 10,000 miles.[26] Much of the marginal area is within the limits of traditional malariousness where conditions favor the propagation of *A. quadrimaculatus*, a notorious impoundment breeder. The threat of enhanced malaria incidence was recognized early in the planning phase and, as an important element of the Health and Safety Department, a Malaria Control Division was activated. Its functions, at first investigational and operational, now consist of the development of the TVA malaria control program and the planning and appraisal of its execution in the field. The antilarval measures utilized include reservoir preparation and improvement, water-level management, larviciding, drift removal and herbiciding — all prosecuted on very large scales. The studies of the TVA Malaria Control Division and the operations performed by it or under its technical supervision appear not only to have kept malaria from becoming a major cause of morbidity in the Tennessee Valley but to have reduced to the point of public health insignificance the malaria prevalence which existed when construction was begun. It is interesting to note that, due to a combination of uncontrollable circumstances in the early spring of 1945, anophelism in the lower two-thirds of the Valley reached the highest level recorded in twelve years but without evidence of an accompanying increase in malaria prevalence.[7]

This incomplete catalog of federally-stimulated efforts at reducing anopheline production is impressive but the effect of these endeavors on malaria prevalence is hard to appraise. Their application extends over the period of malaria decline, a fact which should neither hastily be dismissed as fortuitous nor taken for granted to have causal significance. That malaria reduction occurred near many of these operation sites as a result of breeding-place destruction and antilarval measures is indisputable, but that these areas were sufficiently numerous, extensive, or malariogenically important to form a coalescent malaria depression throughout the South is hardly credible. Furthermore, malaria has diminished to a greater or lesser degree in



areas beyond the influence of the TVA and untouched by WPA or MCWA. Thus it is evident that other factors in addition to interference with anopheline production have been concerned in this phenomenon.

Measures against adult anophelines — In spite of active educational efforts, demonstration projects [27, 28, 29] and higher incomes, the amount and quality of domestic insect-proofing has increased significantly in only a few of the rural sections of the South where it would have its greatest effect as a malaria reductive measure.[30, 31] Doubtless, this is due to the excessively high ratio of insect-proofing construction and maintenance costs to the value of poorer type houses.[32, 33]

On the other hand, the use of domestic insecticides has increased prodigiously during the period under consideration. Data concerning the actual amounts packaged and sold are difficult to obtain as these are viewed by dealers as competitive information; however, certain regional distributors (serving the southeastern states) and national manufacturers were willing to disclose production trends in terms of annual percentage increase. According to the estimates of the former, the distribution of these products, commencing with 1931, increased each year by amounts which varied with different concerns from 20 to 40 percent until 1943, when output was crippled by lack of metal for containers and hand-sprayers. Compounded at the annual rate of 20 percent, this would represent an over-all increase of nearly seven and one-half times for this period.

One national producer wrote that the volume of his company's household insecticide distribution in the southeastern states increased 140.4 percent from 1935 to 1945 but he believes that this was due to the energetic advertising of his concern and that competitive business did not advance to that extent. However, one of his principal competitors supplies the following indices expressing in terms of percentage relationships, based on business done in 1939, the amounts of domestic insecticides distributed by his dealers in 13 southeastern states (figure for 1939 being taken as 100%).

Year	Percent	Year	Percent
1931	20.25	1939	100.00
1932	27.14	1940	85.07
1933	32.23	1941	89.23
1934	41.63	1942	147.08
1935	51.83	1943	159.59
1936	63.80	1944	139.50
1937	75.16	1945	140.36
1938	78.85	1946	55.84

This manufacturer is of the opinion that the sharp decrease in sales volume during 1946 was due to the large amount of "free" spraying which was done by local and Federal government agencies during that year.

These indications, while remarkable, do not tell the whole story because numerous small operators commenced domestic insecticide production during this period thus adding materially to the total made available to consumers. It is probably conservative to estimate that there were 10 to 20 times as much household insecticide used in the southeast during the early war years as in 1931 to kill mosquitoes as well as other domestic insects.

In 1945, the Office of Malaria Control in War Areas embarked on its Extended Program of Malaria Control. This consisted of the application of residual DDT to the interior surfaces of homes and privies in counties where substantial mortality from

malaria* had been reported during the period just before World War II. This was aimed at preventing the dissemination of malaria from home-coming veterans who had acquired infection overseas. From January 1, 1945 to September 27, 1947, nearly 3.2 million house-spraying applications were made in rural areas or small towns in 309 counties. The average number of sprayings per house varied from nearly two in 1945 to not quite one and one-half in 1947, when 875,534 different houses were treated.

Domestic insecticiding with residual chemicals such as DDT appears to be the most feasible single approach to malaria prevention now available in the South considering the special problems of house construction, the distance between homes in rural sections, and the economy of the inhabitants. Most anopheline mosquitoes bite only at night and as more people are within their homes than elsewhere during the hours of darkness, it follows that measures which prevent mosquitoes from entering houses or which destroy the insects after they are inside are of transcendent importance in preventing malaria transmission. It is probable that the insecticidal applications, both ephemeral and residual, made within the home in the last 12 years have accomplished more than any other one measure to reduce malaria transmission in the South.

Anopheline deviation — Another circumstance which may have been of considerable assistance in reducing the domestic density of anophelines is the expansion of cattle-raising in the southeastern states. The lower curve in Fig. 3 shows the estimated cattle population in the South Atlantic and South Central states from 1930 to 1946. Cattle husbandry has increased in the South as cotton cultivation has receded in importance and as rural labor has migrated out of the region. Longer grazing seasons than are available elsewhere in the country, less labor requirements, accessibility to eastern markets, and better protective techniques now available against cattle diseases spread by biting arthropods are said to be factors contributing to this development. The presence of more cattle is believed to be important, malariologically, because *A. quadrimaculatus* has a strong preference for cattle blood.[34] As these mosquitoes emerge from their breeding places and seek blood meals, they are less likely to enter human habitations in large numbers if they can satisfy their appetites more conveniently from cattle in the fields or in stables close to houses.

The trends of the two graphs in Fig. 3

*In calendar year 1946, counties were approved for Extended Program operation if the average annual malaria mortality rate during 1938 to 1942, inclusive, was 10 or more per 100,000 population. In 1947, the base was broadened to include rates down to 5 per 100,000. Counties with evidence of current malaria morbidity were included both years.

indicate that the decrease in the farm population of the South occurred while the cattle population was on the increase. This suggests that the antimalarial influence of these two circumstances may have been compounded by their contemporaneous development.

DISCUSSION AND SUMMARY

Until medical and public health practices in the reporting of malaria cases and deaths are improved to the point of being more dependable measures of the actual morbidity and mortality due to this disease, certain reservations must be entertained concerning its real status and shifts in prevalence. It does appear to be diminishing, however, and on the basis of the foregoing, the following tentative deductions seem to be justified. Certain of these, derived from information collected over broad regional expanses, deserve more searching and precise investigation in restricted study areas to determine the nature and extent of their local impact on the incidence of malaria.

It appears that there has been no essential deterioration in the potentialities of the parasite-host-vector system of malaria transmission in the United States during the last twelve years. The infectivity of the various species of Plasmodium capable of parasitizing man and transmitting mosquito remains unimpaired. It seems more likely, therefore, that the malaria recession can be explained in terms of quantitative rather than qualitative changes.

The widespread efforts at AREAL reduction of anophelism in the South by antilarval measures have depressed and possibly extinguished malaria endemicity in certain localities but it is doubtful that these programs were primarily responsible for the regional decrease. The reduction of DOMESTIC densities of anophelines by the use of insecticides, as a result of deviation by cattle, and to a lesser extent by insect-proofing of houses is held to be a more important and uniformly extensive causal factor.

Other circumstances contributing to the general decline are 1) population movements from rural areas in the South where malaria could be acquired to urban centers in the South or to other parts of the country where malaria does not occur, and 2) improved antimalaria medication.

Economic advance has undoubtedly stimulated the development of most of these factors. A depression might be expected to send people out of the cities back to the country where unimproved housing would quickly deteriorate in the absence of maintenance. Money would not be spent for household insecticides and the most effective antimalarials. Under such conditions, malaria could again become a public health hazard of great prominence.

If malaria can be eradicated in this country and its reintroduction prevented or controlled — and this possibility is viewed as reasonable — [8,35,36,37,38,39,40] economic depressions could have no malariogenic effect. Malaria prevalence and transmission have reached new lows. Control techniques are more effective today than ever before, though doubtless their efficiency can be still further improved. These considerations constitute compelling motives for taking advantage of our present strong position. They offer a challenge to national, state, and local health agencies to combine in effecting the complete annihilation of the "world's greatest scourge" [38] in the United States.

REFERENCES CITED

1. BARBER, M. A.
1929 — The history of malaria in the United States. Public Health Reports, 44: 2575-2587.

2. BOYD, MARK F.
1941 — A historical sketch of the prevalence of malaria in North America. Amer. J. Trop. Med., 21: 223-244.

3. ACKERKNECHT, E. H.
1945 — Malaria in the Upper Mississippi Valley, 1760-1900. Supplementary Bulletin, History of Medicine. 142 pp. Baltimore.

4. WILLIAMS, L. L., JR.
1941 — The anti-malaria program in North America. A symposium on human malaria. Amer. Assn. Advanced Sci., pp. 365-371. Washington.

5. FAUST, ERNEST CARROLL
1945 — Clinical and public health aspects of malaria in the United States from an historical Perspective. Amer. J. Trop. Med., 25: 185-203.

6. WATSON, R. B., C. C. KIKER, and A. D. HESS
1945 — A review of malaria studies and control in the Tennessee Valley in 1945. J. Nat. Mal. Society, 5: 193-205.

7. GOODWIN, MELVIN H., JR.
1948 — Observations on the recession of malaria in an area of Southwestern Georgia. (In Press).

8. ANDREWS, JUSTIN M.
1948 — World War II and the malaria problem. (In Press).

9. YOUNG, M. D., T. H. STUBBS, J. A. MOORE, F. C. EHRMAN, N. F. HARDMAN, J. M. ELLIS, and R. W. BURGESS
1945 — Studies on imported malarias: 1. Ability of domestic mosquitoes to transmit vivax malarias of foreign origin. J. Nat. Mal. Soc., 4: 127-131. See also later publications in this same series by these same and associated authors.

10. BOYD, MARK F.
1947 — A review of studies on immunity to vivax malaria. J. Nat. Mal. Soc., 6: 12-32.

11. COATNEY, G. ROBERT, W. CLARK COOPER, MARTIN D. YOUNG, and SOL B. McCLENDON.
1947 — Studies in human malaria. I. The protective action of sulfadiazine and sulfapyrazine against sporozoite-induced falciparum malaria. Amer. J. Hyg., 46: 81-104.

12. ALVING, A. S., B. CRAIGE, JR., L. EICHELBERGER, T. N. PULLMAN, R. JONES, JR., and C. M. WHORTON
1947 — Pentaquine (Sn-13,276): A new drug effective in preventing relapse in vivax malaria. (In Press).

13. YOUNG, MARTIN D., NEWTON F. HARDMAN, ROBERT W. BURGESS, WILLIAM C. FROHNE, and C. W. SABROSKY.
1948 — The infectivity of native malarias in South Carolina to *Anopheles quadrimaculatus*. (In Press).

14. SECKINGER, D. L.
1933 — Atabrine and plasmochin in the treatment and control of malaria. Amer. J. Trop. Med., 15: 631-649.

15. WINCHESTER, M. E.
1936 — Individual chemoprophylaxis against malaria. South. Med. J., 29: 1029.

16. WINCHESTER, M. E.
1938 — Atabrine prophylaxis in malaria; report of third year's investigation. Amer. J. Trop. Med., 18: 625-640.

17. CLARK, HERBERT C., H. W. KOMP, and D. N. JOBBINS
1941 — A tenth year's observations on malaria in Panama, with reference to the occurrence of variations in the parasitic index, during continued treatment with atabrine and plasmochine. Amer. J. Trop. Med., 21: 191-217.

18. FAIRLEY, N. H.
1945 — Chemotherapeutics, suppression, and prophylaxis in malaria. Experimental research undertaken by medical research teams in Australia. Trans. Roy. Soc. Trop. Med. and Hyg., 38: 311-365.

19. BOYD, MARK F., and F. F. KITCHEN
1945 — On the employment of quinacrine hydrochloride in the prevention of malaria infections. Amer. J. Trop. Med., 25: 307-315.

20. THOMPSON, WARREN S.
1947 — Population. The growth of metropolitan districts in the United States: 1900-1940. U. S. Government Printing Office. Washington.

21. MURRAY, FLORENCE
1947 — The Negro handbook, 1946-1947. 392 pp. New York.

22. BOYD, MARK F.
1932 — Successful cage rearing of *Anopheles quadrimaculatus*. Sci., 76: 370.

23. BOYD, MARK F.
1939 — On the susceptibility of *Anopheles quadrimaculatus* to *Plasmodium vivax* after prolonged insectary cultivation. Amer. J. Trop. Med., 19: 593-594.

24. YOUNG, MARTIN D., TRAWICK H. STUBBS, JOHN M. ELLIS, ROBERT W. BURGESS, and DON E. EYLES
1946 — Studies on imported malarias: 4. The infectivity of malarias of foreign origins to anophelines of the southern United States. Amer. J. Hyg., 43: 326-341.

25. 1936-41 — Annual reports of the Surgeon General of the Public Health Service of the U. S.

26. 1946 — Facts about major TVA dams.

27. COOGLE, C. P.
1928 — The screening and mosquito-proofing of tenant houses. Mississippi State Board of Health, Bulletin 2.

28. MELENEY, H. W., and J. A. CRABTREE
1934 — Results from screening rural houses in Lake County, Tennessee. South. Med. J., 27: 552.

29. KIKER, C. C.
1941 — Housing with special reference to mosquito-proofing for mosquito control. A symposium on human malaria. 308-315. Amer. Assn. Advance. Sci. Washington.

30. WATSON, R. B., and HELEN C. MAHER
1941 — An evaluation of mosquito-proofing for malaria control based on one year's experience. Amer. J. Hyg., 34: 86-95 (Sec. C).

31. WATSON, R. B., and MARGARET RICE
1941 — Further observations on mosquito-proofing for malaria control. Amer. J. Hyg., 34: 150-159 (Sec. C).

32. U. S. PUBLIC HEALTH SERVICE and TENNESSEE VALLEY AUTHORITY
1947 — Malaria control on impounded water. U. S. Government Printing Office. (In Press).

33. KIKER, C. C., and H. E. BREEDLOVE
1941 — Mosquito-proofing for malaria control from the standpoint of construction and maintenance costs. Amer. J. Hyg., 34: 95-102. (Sec. C).

34. KING. W. B., and C. G. BULL
1923 — The blood feeding habits of malaria-carrying mosquitoes. Amer. J. Hyg., 3: 497-7.

35. SAWYER, WILBUR A.
1944 — A proposed program to prevent the spread of malaria in the United States from infected individuals returned from abroad. J. Nat. Mal. Soc., 3: 61-68.

36. MOUNTIN, J. W.
1944 — A program for the eradication of malaria from continental United States. J. Nat. Mal. Soc., 3: 67-74.

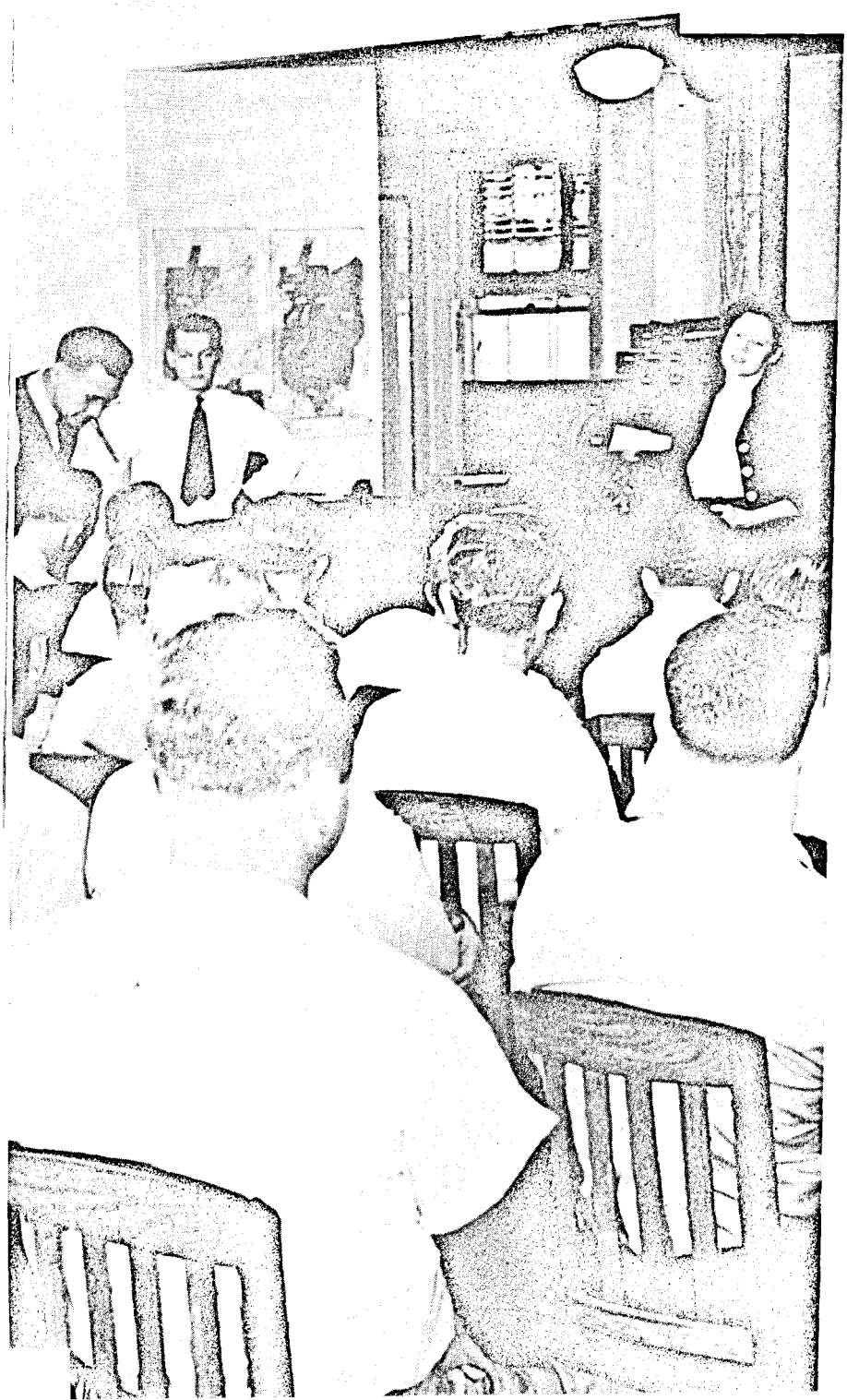
37. RUSSELL, PAUL F., LUTHER S. WEST, REGINALD D. MANWELL
1946 — Practical malariology. 684 pp. Philadelphia.

38. SIMMONS, JAMES S.
1944 — American mobilization for the conquest of malaria in the United States. J. Nat. Mal. Soc., 3: 7-11.

39. 1944-Minutes-1943-National Malaria Society. J. Nat. Mal. Soc., 3: 151-154.

40. ANDREWS, JUSTIN M. and WESLEY E. GILBERTSON
1948 — Blueprint for malaria eradication in the United States. J. Nat. Mal. Soc. (In Press).

COLUMBUS, GEORGIA PUBLIC HEALTH TRAINING CENTE



Since its organization, the Communicable Disease Center has continued and expanded Training Division activities. The organization and development of the Public Health Training Center in Columbus, Georgia, as pictured in the following reports provides a typical example of this expansion to meet the needs for trained personnel.

In 1945, the first field training station in typhus control was organized in Atlanta in cooperation with state and local health departments. Since then, over two hundred new workers in the field of rodent-borne disease have received practical field work in regularly scheduled courses.

This practical field training proved so productive in developing new workers for these two fields of environmental sanitation that it was decided to establish a regional station which would afford field experience to graduate sanitary engineers.

Dr. J. W. Mountin, Bureau of State Services, and Sanitary Engineer Director Mark D. Hollis, Executive Officer in Charge, Communicable Disease Center, authorized the Training Division to proceed with the organization

• A review of activities and reports compiled by Ellis S. Tisdale

SANITARY ENGINEERS

SENIOR SANITARY ENGINEER
CHIEF, TRAINING DIVISION, CDC, ATLANTA, GEORGIA

of such a field training center at Columbus, Georgia in 1946. This authorization came after an invitation was received from the Georgia Department of Public Health and the Columbus-Muscogee County Health Department to establish the training center at Columbus.

On July 31, 1946, three officials — the Health Officer of the Columbus-Muscogee County Health Department, the Deputy Director of the Georgia State Health Department and the present author as Chief of the Training Division, CDC, U. S. Public Health Service — signed an agreement which provided for joint participation of state city-county health departments with CDC in the operation of a field training center for sanitary engineers.

In general the agreement was as follows:

Establishment of a field training area in sanitary engineering at Columbus-Muscogee County, Georgia — understanding concerning participation and cooperation between Federal, state, and local health departments.

To meet the need for practical field training in sanitary engineering, the Training Division, CDC, U. S. Public Health Service, has selected and will develop Columbus-Muscogee County as a sanitary engineering training area. It is planned to develop an accredited training program there because of the general excellence of the public health department, under the direction of Dr. J. A. Thrash, Health Officer, and J. A. Willman, Sanitary Engineer. Good facilities with respect to water filtration, sewage treatment works, stream sanitation studies, garbage disposal, milk and food sanitation are available.

A standard course, 12 weeks in length, will be devoted to practical field work in sanitary engineering. From time to time other short courses will be developed. The training area will be available to graduate sanitary engineers and other professional and sub-professional sanitation personnel from other states and foreign countries. No tuition will be charged. It is understood that sponsoring agencies, which may be states or agencies such as Institute of Inter-American Affairs or Rockefeller Foundation, will pay stipends and living expenses of trainees. Preliminary negotiations with the Columbus Health Department authorities indicate their willingness to assist in the administration and direction of the training activities . . .

1. Administrative Direction. Dr. J. A. Thrash, Columbus-Muscogee County Health Officer, will be director of the training program in sanitary engineering which is proposed for the Columbus-Muscogee County Area. It is understood that Sanitary Engineer J. A. Willman of the Columbus-Muscogee Health Department will direct the sanitary engineering phases of the work, assisted by personnel assigned by the U. S. Public Health Service. All administrative matters concerning both the U. S. Public Health Service and the Training Area will be addressed to or routed through the Director of the Training Area and the Chief of the Training Division, CDC, or their designated representatives. The State Health Department will be kept informed of developments in the training program.

2. Personnel — Equipment. The Training Division of the CDC, U. S. Public Health Service, will detail two professional workers to Columbus to serve as instructors for the training program. Their job is to absorb the main teaching load and handle practically all the details of the training activities. A secretary will be assigned to handle the office work. Laboratory equipment will be provided so that the trainees may carry out all the necessary tests in connection with public water supplies, sewerage, sewage disposal, stream pollution control, and milk and food sanitation. A small water laboratory will be equipped at the water works and a larger one, for all standard sanitary engineering laboratory work, will be equipped in quarters provided by the City-County Health Department. A laboratory technician will be provided by the Public Health Service to facilitate stream sanitation studies. The local health department will provide necessary quarters and utilities for the training activities.

3. Consultants for Training Program. In order to recompense the members of the Columbus-Muscogee County Health Department for services rendered in connection with the training program, it is agreed that Dr. Thrash, Mr. Willman, and other assistants who participate actively in the training program will be appointed as consultants to the training program. They will be paid by the U. S. Public Health Service on an hourly basis for the time devoted to the training activities.

August 2, 1946 — /s/
J. A. Thrash, M. D., Health Officer
Columbus-Muscogee County Health Department

July 31, 1946 — /s/
Guy Lunsford, M. D., Deputy Director
Georgia State Health Department

July 30, 1946 — /s/
Ellis S. Tisdale, Senior Sanitary Engineer
Chief, Training Division, C.D.C.
U. S. Public Health Service
(For the Officer in Charge)

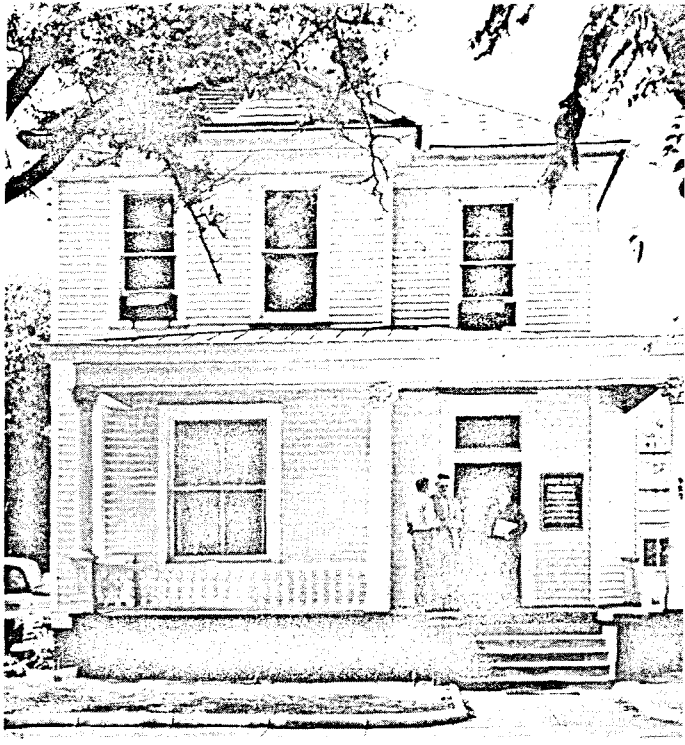
In the following months, the U.S.P.H.S. staff selected to operate the station was assigned to Dr. Thrash who was in administrative charge of this new training center. Sanitary Engineer C. D. Spangler was selected to head the sanitary engineering training staff. Professor John M. Henderson of Columbia University, New York City, accepted appointment as consultant to guide the training activities from the standpoint of their correlation with academic studies of graduate sanitary engineers.

Professor Henderson has emphasized certain aspects of the need for regional field training centers for sanitary engineers such as the role they can assume in speeding the transition of the sanitary engineer graduate into a productive member of the public health team. He estimates that through field training of three months, properly organized and conducted, a period of one to three years can be saved in making new personnel more immediately productive for public health service.

As a result of his consultant studies during the 1947 season's operation of this training center, he makes the following comments in a report on field experience observations at this new field training center at Columbus, Georgia:

VALUE OF FIELD EXPERIENCE AS A SUPPLEMENT TO ACADEMIC TRAINING GIVEN IN GRADUATE SCHOOLS OF PUBLIC HEALTH.

The great need for field experience is in the training of general practitioners in public health — health officers, engineers, and nurses with local health departments. In some specialities it is possible for a large measure of the requisite field experience to be obtained in conjunction with academic training, since academic training tends to be more vocationalized



State Health Department Engineer Eggert on a visit to the Field Training Station at Columbus, Georgia.

in character, and field training facilities can be feasibly provided by the institution in conjunction with local health departments. This is exemplified by courses for medical clinicians in tuberculosis, venereal disease, etc., where clinic practice can be adequately scheduled within the academic curriculum.

General practitioners, on the other hand, require comprehensive training. To provide this breadth of scope the academic institution must confine its training to principles, largely ignoring techniques. Moreover, even if time were available, it would not be feasible for any single academic institution to provide the elaborate mechanism and bear the heavy expense involved in establishing comprehensive field training facilities for relatively small numbers of students in each of the several basic professions. Provision of such facilities demands one central agency serving all graduate institutions in public health.

Organized, supervised field training possesses many advantages over field training acquired by job experience in public health. Since engineers completing graduate academic training may or may not possess prior experience in public health practice, field training should be considered separately as to its applicability to each group.

For the individual without prior experience, there exists a wide gap between the sheer knowledge acquired and the arts and techniques of applying this in practice. Until the latter have been gained, the individual is not a productive member of the public health organization. Few, if any, local health departments possess staffs of sufficient size and aptitude to provide the quantity and quality of supervision needed for the rapid and adequate "breaking in" of the inexperienced professional employee. As a result, the apprentice employee not only is non-productive for an inordinate length of time, but the character of his professional competency, once achieved, will reflect any weakness inherent in the local program to which he is assigned. Thus there is a tendency to perpetuate local inadequacies in health work.

The above discussion assumes that the organization to which the apprentice is assigned contains at least one other member of his basic profession. The typical local health department employing an engineer, however, often has only one such position in its table of organization. Moreover, this position may be at the head of a staff and the incumbent may be required to immediately supervise and direct a number of inspectors and sanitarians. Inexperienced engineers are so manifestly unsuitable for such assignments, and the shortage of experienced personnel available for appointment is so urgent, that a dislocation in personnel placement will occur. The large health departments with engineering staffs containing positions of junior responsibility then attract new candidates at the expense of smaller departments which are devoid of any engineering services at all.

In contrast, supervised field training of an intensive character, carefully planned, compresses into three months' time a normal

Training officers planning the three-months field activities at Columbus, Georgia.

experience equivalent of one to three years, thus making available new candidates who are immediately productive. In addition to the practical experience acquired, an essential value of field training is the instilling of confidence in the young engineer by giving him a sense of proficiency before he launches into practice. This is of great importance at this stage of his career. After-benefits may accrue throughout his professional life.

During his customary one to four years of experience, the engineer with prior experience who returns to an academic institution for postgraduate training usually will have acquired competency in the practice of one to two of the dozen recognized fields of environmental sanitation. Interest in graduate education by the engineer in local health work generally is toward obtaining more comprehensive training -- an exposure to fields of environmental sanitation in which he is not yet qualified. To establish competency, field application of this newly acquired knowledge is indicated. This can best be obtained by attendance at an organized field training course, since only in such a program is the desired range in field of practices and of geographic locations available.

The decision of the U. S. Public Health Service to set up and operate an acceptable field training program for public health engineers had its roots in two factors: 1) the dire shortage of qualified personnel to fill existing vacancies, and 2) the essential need for field experience to supplement academic training in the production of competent public health engineers.

Lack of existing field training facilities was another fundamental consideration. In this respect the field training of engineers poses a problem in marked contrast to that of the sanitarian and the nurse, being far more complex in character. As stated in a recent committee report of the American Public Health Association[1]: "The engineering profession is parallel and not subordinate to the medical...there being no quarrel with the medical executive tradition." The responsibility of the public health engineer to render competent service in not one or two, but many of the numerous specialized fields of environmental sanitation; the professional technologies involved; his largely independent responsibility for administering work lying outside the physician's field of professional competence; and the smaller number of engineer trainees by comparison with medical health officer, sanitarian and nurse trainees, all tend to discourage state health departments from establishing acceptable field training

[1]Report on Committee on Municipal Public Health Engineering. American Journal Public Health XXXVII (7): 901-6, (p. 903) July 1947.

stations for engineers. Thus there are far fewer established field training facilities for engineers than for any other profession or sub-profession basic to the local health department.

This situation has impressed the Public Health Service and others with the need for establishing training facilities which would serve groups of states. Such regional centers on the one hand should serve a sufficient area to justify an adequate quantity and caliber of personnel in charge of field training. On the other hand, the regional, rather than the national, training center will best orient the trainee in the underlying social, economic, and epidemiologic conditions indigenous to the geographic area in which he will practice, which conditions so greatly modify local health department procedures.

The first regional training center was established at Columbus, Georgia in 1947, graduating the first class in September of that year. While Columbus is the central headquarters, the training area encompasses over 10,000 square miles of terrain lying in two states. This area contains three principal sub-centers in addition to the main headquarters, and over 200 communities ranging in population from 100 to 250,000 which may be visited to obtain diversified experience in the total regional range of problem and practice in environmental sanitation...

TYPE OF TRAINING.

The character of training provided comes under the heading of Supervised Field Experience, which has been defined as follows:[2] Planned instruction, observation, and active participation in a comprehensive organized public health program as an integral part of or a sequel to formal academic training in public health.

Greatest emphasis is placed on active participation; the student group is divided into teams of two men, each accompanying a member of the local health department on his appointed rounds. By a system of rotation, the entire program of environmental sanitation is participated in by each team in each of several local health departments. Independent problems are also assigned where feasible; these are performed by the individual student or team. The training staff briefs the team before each mission and queries the members on their return. Frequent group discussions are scheduled when points in question are clarified and improvements in prevailing practices by the trainees and local health department personnel are brought out.

Observation and participation assignments by groups larger than the team are arranged exceptionally when team visits are unnecessary or infeasible. Didactic instruction can be dispensed with since field training not only follows graduate academic instruction but is given immediately after the close of the academic year.

The local health departments in the training area are not subsidized by special funds accruing by virtue of the field training activities, thus avoiding an artificial environment. In quality and adequacy these local units cover a wide range, aiding the student in acquiring a perspective; but sufficient experience is obtained by the trainee in the better organizations to foster the development of competent practitioners.

Planned instruction is provided by the training staff composed of personnel possessing breadth and length of experience in local health work and advanced academic training in public health. Beyond this, each has a specialized proficiency in two or more sanitary fields.

Training Officer in Charge C. D. Spangler gives the following general outline of the three-month field training program at the Public Health Training Center:

GENERAL OUTLINE OF THREE MONTHS FIELD TRAINING PROGRAM AT PUBLIC HEALTH TRAINING CENTER.

The trainee in public health engineering

---

[2]Report of Committee of Professional Education, American Public Health Association on Field Training of Public Health Personnel. American Journal Public Health XXXVII (6): 709-14 June 1947.

reports to the training center, a two-story wooden dwelling house converted into offices, class and conference rooms, and a chemical and bacteriological laboratory. Here the training staff, consisting of two sanitary engineers, a sanitarian, a clerk, a laboratory technician, and a "handy" man, is stationed. In addition to the water and milk laboratory here, a small laboratory has been built at the Columbus water filtration plant for use of the sanitary engineering trainees.

In general, the first week of the training program is given over to general orientation of the work of the local, state, and Federal public health services.

During the second, third, and fourth weeks, when the field assignments primarily cover work in water filtration, sewage treatment, and stream sanitation, the laboratories are used extensively.

The fifth and sixth weeks are devoted to milk production and pasteurization and to food sanitation. Here, as in the field of water treatment, the trainees have ready access to the farms, the milk plants, and the dairies to carry out practical assignments each day.

During the seventh and eighth weeks the trainees are assigned to nearby Fort Benning and to Albany where sanitary land fill, insect and malaria control, and rural sanitation practice are given. The Training Division of CDC makes available automotive equipment to enable the trainees to carry out their daily assignments.

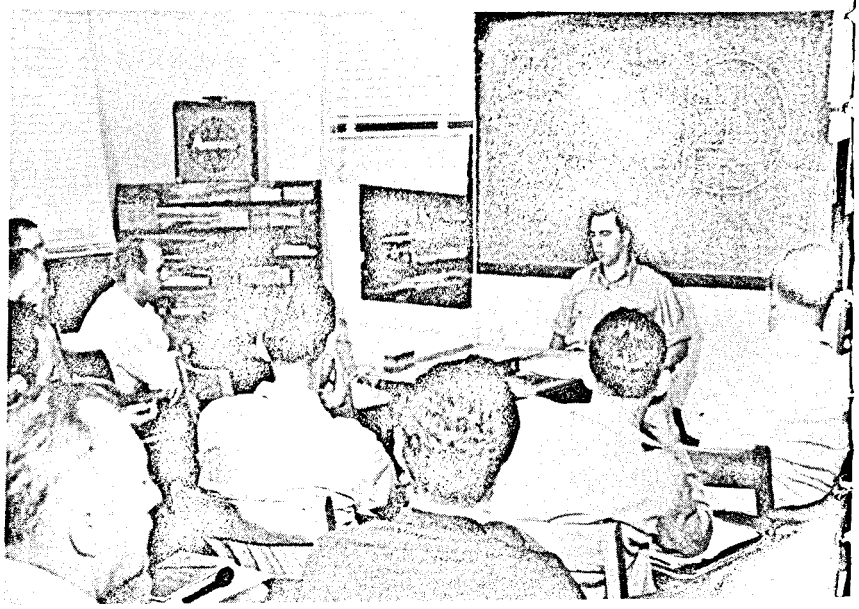
On each Friday afternoon during the course all the trainees assemble at headquarters for a discussion and briefing on the work for the following week. Saturday mornings are reserved for discussions and the showing of motion pictures and film strips.

Since trainees are teamed up in groups of two for daily assignments with a change of team mates taking place each week, each man gets an opportunity to work with each other trainee on some phase of the field work.

It has proved quite advantageous to have the training station headquarters separate from the operating health department, but near enough for convenient conferences. The training stations are located just across the street from the County Court House where the Health Department staff has its headquarters.

The U.S.P.H.S. officers absorb practically all the teaching load. An arrangement has been worked out to have certain regular health department staff members appointed as consultants to the training staff. They are paid on an hourly basis when they act in the capacity of instructors for the trainees on field work.

As a result of the first three-months course one important conclusion was reached, namely — that it was absolutely essential for the field training staff to act with the full confidence of the operating staff and have ready access to all facilities within the training area. This includes the city water plant, the government-owned sewage disposal facilities at Fort Benning, the privately-owned pasteurization plants in the city, and where possible, privately-owned restaurants, industrial plants, and the many other facilities. Also, it was clear that there were many advantages in using malaria, fly control, and rural sanitation facilities at Albany and taking advantage of the typhus and rodent control



Training officer briefing class before day's field work.

program being carried out in Atlanta by the City Health Department. Thus, several areas, in addition to Columbus, are needed to afford the necessary field experience for sanitary engineer trainees. The entire time of the six full-time persons on the training staff was taken up in giving adequate field instruction to the 17 public health engineers in training. The small amount of time spent by the operating health department staff in no way interfered with their duties. In fact, it added to the *esprit de corps* of the entire health department to have the training program in operation.

Training Officer Spangler further set forth in his report the following elements in the 1947 training course.

COURSE CONTENT TO ACCOMPLISH OBJECTIVES OF FIELD TRAINING.

Certain basic assumptions concerning prospective trainees were made as follows: that the engineers would be Sanitary Engineers and would have a relatively broad academic background in the field of public health. They should have a good knowledge of the following subjects:

(1) Public water supplies
(2) Public sewer systems and sewage treatment methods
(3) Stream pollution
(4) Public health administration and vital statistics
(5) Epidemiology
(6) Bacteriology
(7) Environmental sanitation
(8) Insect and rodent control
(9) Food and milk control

It was presumed that the sanitary engineering trainees would benefit by a course covering the following subjects:

(1) Water plant operation
(2) Sewage treatment plant operation
(3) Food control
(4) Milk control
(5) Insect control
(6) Rodent control
(7) Garbage and refuse disposal
(8) Swimming pool operation
(9) Rural water supplies
(10) Rural sewage disposal
(11) School sanitation

Accordingly, a proposed outline of the course was drawn up as follows:

I. Water
  A. Rural water supplies
    1. Wells — dug, drilled, driven, and bored
    2. Springs
    3. Cisterns
    4. Small pressure systems
  B. Municipal water supplies
    1. Surface — complete treatment and reservoirs
    2. Ground — water softening and iron removal
    3. Distribution system
    4. Cross-connections

II. Sewage
  A. Rural sewage disposal
    1. Privy
    2. Septic tank system and cesspools
    3. Small Imhoff tank and sand beds
  B. Municipal sewage disposal
    1. Dilution
    2. Imhoff tank — trickling filter — fixed and rotary
    3. Primary settling—trickling filter (separate sludge digestion)
    4. Biofiltration and Aerofilter and Accelofilters
    5. Activated sludge
    6. Chemical treatment
    7. Collection system
  C. Stream pollution and industrial wastes

III. Garbage and refuse disposal
    1. Incinerator
    2. Sanitary land fill
    3. Dumping
    4. Hog farm
    5. Collection systems

IV. Swimming pools
    1. Fill and draw
    2. Recirculation
    3. Natural bathing areas

V. Ice plants

VI. School sanitation — air borne con-

taminants — ultra violet

VII. Industrial hygiene and safety — heating, lighting, and ventilation

VIII. Housing, building codes and plumbing. Rural and urban surveys

IX. Food and meat. Food handlers and shellfish

X. Milk — producers and pasteurizing plants — cost figures

XI. Insect and rodent control — malaria and typhus

XII. Administration, organization and functions of engineering activities in state and local health departments. Public health education — promotion programs. Operation of rest of health department.

SUBJECTS AND TIME DISTRIBUTION

Water	2	Weeks
Sewage	2	"
Garbage & refuse	1/3	"
Swimming pools	1/3	"
Ice plants	1/3	"
Schools	1/2	"
Industrial hygiene	1/2	"
Housing, etc.	1	"
Food	1	"
Milk	1	"
Insect and rodent	2	"
Administration	1	"
TOTAL	12	"

In working out the details of the actual course schedule, it was believed that trainees would have previously had sufficient academic instruction so that they would be able to receive field training experiences with very little preliminary discussion on the part of the training station staff. It is felt that it is far more desirable for men to work in small groups of only two or three men each rather than in large groups. Accordingly, the bulk of the field work is set up on an eight weeks basis. Each week encompasses a separate unit. It is planned to have two or three men on each team with a total of eight teams in the field at once, with each team working on a different week's activities. Before the men engage in this team work, one week is spent with the entire group in a general orientation of the local health department and of the training course itself. The final three weeks of the twelve-weeks course are spent with the group all together doing things which could be done better in a large group rather than in teams. Since the men's backgrounds, both in previous experience and in training, are different, it is desirable to switch team mates whenever possible so that the men can have an opportunity to work closely with as many of the trainees as possible, instead of working with the same team mate for the entire eight weeks.

TRAINING FACILITIES — STAFF QUALIFICATIONS — BUDGET

The headquarters office of the Training Center is a two-story frame structure. This building, with essential utilities, was made available by the City-County Health Department.

Available space in this building consists of one room, 16′ x 16′, which serves as the office for the teaching staff; a smaller drafting room and auxiliary office; a large classroom, seating 25 trainees; a conference room, seating 20 persons; a laboratory for class work; and a laboratory preparation room.

The Training Division, Communicable Disease Center, U.S.P.H.S., has provided the training staff consisting of two graduate sanitary engineers and one graduate sanitarian. The training officer in charge has completed postgraduate work in public health and bacteriology, and has served in state health department district offices both in the mid-west and in the south. He has had experience in the U. S. Public Health Service in the west for several years, which brought him in close contact with local health department administration. Each sanitary engineer has had extensive experience in water and sewage treatment, insect and rodent control, and public health administration. The sanitarian is well qualified by training and

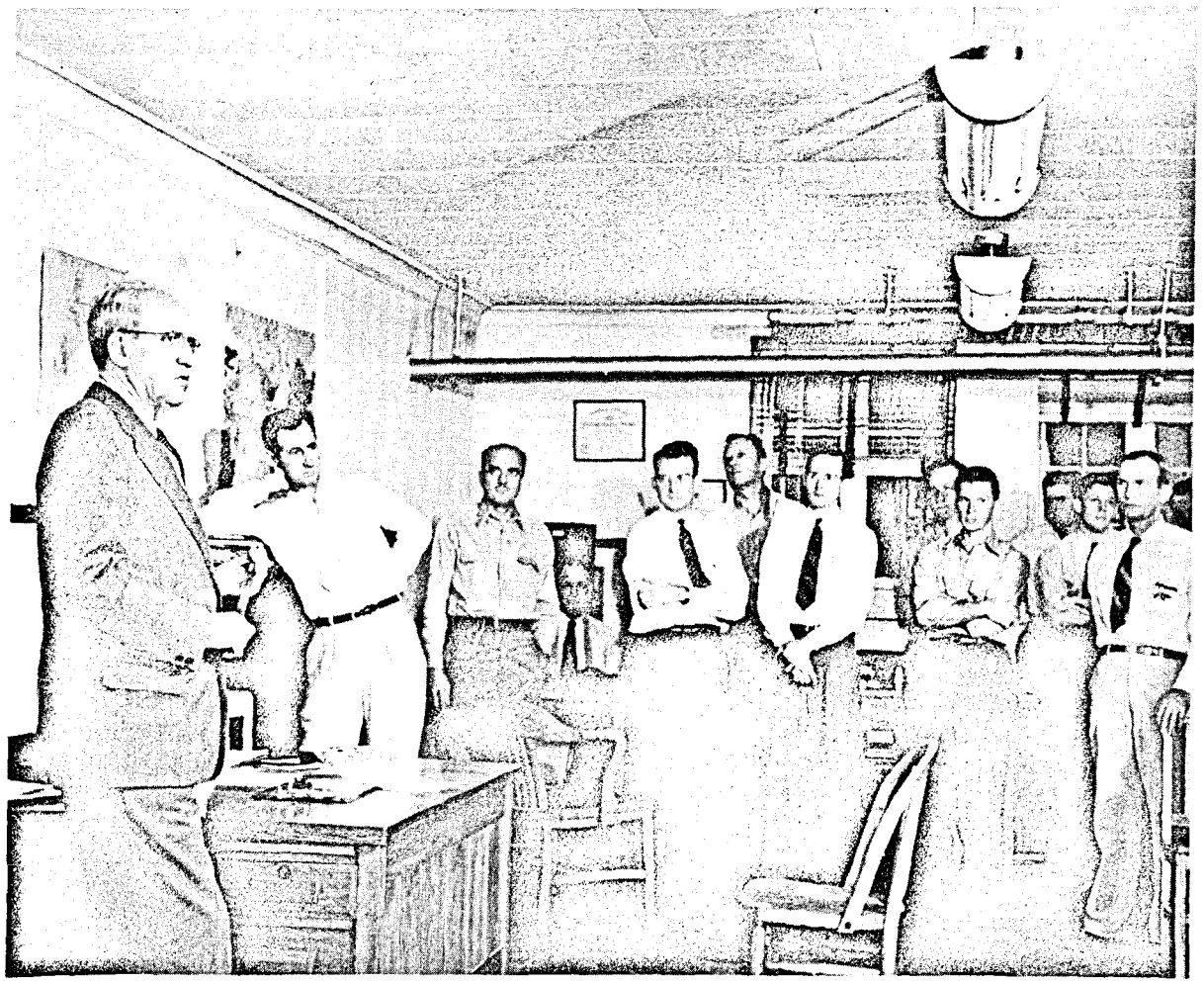
practical experience in milk and food sanitation activities.

The training officers utilize the staff in the operating health department program, from time to time, as consultants and for supervisors to trainees. These persons are paid for their services on an hourly basis, in accordance with a schedule approved by the state and local health departments.

Assistance in handling the daily routine operation of the training center is given by three additional employees assigned by the U.S.P.H.S. — an experienced laboratory technician, a secretary, and a general mechanic. The latter is responsible for all equipment used in the training activities, including spraying equipment, motors, boats, and cars to transport trainees; and for demonstrations in connection with privy construction, pipe work at water works, and similar activities.

In addition to the summer training program for 17 graduate sanitary engineers, two three-months field training programs for sanitarians were operated during the spring and fall months. The fall class included 22 sanitarians from seven states. Operating a spring and fall sanitarian course and a summer sanitary engineering field training course reduced the unit cost of field training and kept the training load on a fairly even basis.

Training station director orienting class during first week at Columbus.



DAILY SCHEDULE OF SANITARY ENGINEERING

WEEK		A	B	C	D	E
DATES		June 23 — 28	June 30 — July 5	July 7 — 12	July 14 — 19	July 21 — 26
SUBJECT		**Registration & Orientation**	**Municipal Water Supply**	**Privy Water Supply Industrial Hygiene**	**Sewage & Small Water**	**Food Sanitation**
MONDAY	A. M.	Registration. Personal Interview. Housing	Survey of Plant and Laboratory at Columbus Water Plant	Pit Privy Project	Ft. Benning Sewage Plant	Inspections with Sanitarian A
	P. M.					Inspections with Sanitarian B
TUESDAY	A. M.	Quiz. Course Orientation & Schedules	Filters	Field trip to Hamilton, Manchester, Wm. Springs Foundation on water and sewage treatment plants	Stream Pollution	Inspections with Sanitarian C
	P. M.		Details of operation			Inspections with Sanitarian D
WEDNESDAY	A. M.	County, State & Federal Health Organizations.	Mechanical equipment at Columbus Water Plant	Field trip to Ft. Benning, Phenix City and Opelika on Water and Sewage Treatment Plant	Buena Vista & Ellaville Water Plants. Richland, Lumpkin Water Plants and Septic Tank	Individual Inspections
	P. M.	Visit Local Health Dept.				
THURSDAY	A. M.	Conference with Nursing Supervisor	Field trip to Greenville & Fairburn Water Plants & Water, Sewage & Swim. Pool in Newnan	Industrial Hygiene Survey	Industrial Waste Survey	Individual Inspections
	P. M.	Field visits with Nurses				
FRIDAY	A. M.	Review of Principles of Sanitation	Report of Surveys and Laboratory	Industrial Hygiene Survey & Report	Industrial Waste Survey continued	Submit Reports
	P. M.	Briefing and discussion	Briefing and discussion	Briefing and discussion	Briefing and discussion	Briefing and discussion
SATURDAY	A. M.	Films and discussion	Talks by trainees Films and discussion	Talks by trainees Films and Discussion	Talks by trainees Films and discussion	Talks by trainees Films and discussion

TRAINING COURSE AT COLUMBUS, GEORGIA

F	G	H	I	J	K	L
July 28 — Aug. 2	Aug. 4 — 9	Aug. 11 — 16	Aug. 18 — 23	Aug. 25 — 30	Sept. 1 — 6	Sept. 8 — 12
Milk Sanitation	**Refuse Disposal Schools Swimming Pools Ice Plants**	**Malaria Control (Albany)**	**Typhus Control (Atlanta)**	**Housing and Sanitary Survey**	**Roundtable Discussions**	**Summary**
Inspect Dairy Farms with Milk Inspector	Inspect Sanitary Land Fills	Starting of Drilled Well	Introduction to Typhus Control	Health and Housing	LABOR DAY	Roundtable Discussion on Garbage and Refuse
	Inspect and report of Ice Plants	Residual Spray operations	Rat trapping and poisoning	APHA Appraisal Form		
Inspect Dairy Farms	Swimming Pool Inspections	Septic Tank Installations	Rat Bleeding and combing	Sanitary Survey of Small Community	Milk Grading Programs & Dairying Problems	Establishment of County Sanitation Program
Observe milking			Rodent Control Program			
Inspection of Short-time high temperature Pasteurization Plant	Observe Columbus Insect Control Program	Entomological Control of Insect Control Programs	Rat Proofing	Survey continued Report	WATER Plant Operators	Continued
Inspection of Holding Method of Pasteurization	School Survey Continued	Larvicidal Operations	Estimation and DDT dusting in field	Housing Programs & Legislation	SEWAGE Plant Operators	Course Review
		Finish Drilled Well		Urban Redevelopment		Examination
Laboratory and Reports	Report of School Survey	Resume of Insect Control and Program Planning	Cost Studies	Abattoir Inspections. Rabies Control	Health Education	Review Exam. & Course
Briefing and discussion	Briefing and discussion	Return to Columbus	CDC Activities. Return to Columbus	Plumbing & Building Codes, Shell Fish		
Talks by trainees Films and discussion	Talks by trainees Films and discussion	Talks by trainees Films and discussion	Talks by trainees Films and discussion	Talks by trainees Films and discussion	Review of weeks work	

Relationship Between Water Impoundment and Mosquito Breeding in California

Senior Assistant Scientist Richard P. Dow
and
Arve H. Dahl*

Impounding water serves two main objectives: flood control and water conservation. The former restrains excess flow due to storms or the melting of snow; the latter conserves water where it may be used for human consumption, irrigation, or industry. A single reservoir may serve one or both objects in varying degrees.

TOPOGRAPHY AND PRECIPITATION

The principal factors affecting the natural distribution of surface water are topography and precipitation. In both respects, conditions in California are quite different from any occurring in the East.

The topography of the greater part of California can be described in very simple terms by excluding those sections east of the Sierra Nevada Range and south of the Tehachapi Mountains. The remainder consists essentially of a long narrow basin surrounded by mountain ranges. The floor of this great trough — the Central Valley — is about 50 miles wide and almost 500 miles long and is drained by two rivers and their tributaries. The Sacramento River, flowing south through the northern part of the valley, is joined in the Delta near Stockton by the San Joaquin, which, with its tributary, the Kings, drains the southern end of the valley. From its junction with the San Joaquin, the Sacramento passes west through the Coast ranges at sea level and enters San Francisco Bay. The contours of this entire basin are so regular that very few lakes or marshes are produced. Most of the rainfall drains directly into the ground or follows the watercourses to the sea.

---

*S. A. Scientist Richard P. Dow was recently California State CDCA Entomologist, and Arve H. Dahl is Chief, Bureau of Vector Control, and CDCA Director California State Department of Public Health.

The mean annual precipitation is quite different in many parts of California. The driest area is probably Death Valley, in southeastern California, with an average of 1.69 inches at Greenland Ranch. The highest average, taken from a long record, is 79.70 inches at Upper Mattole, Humboldt County, but this is surpassed by a mean annual rainfall of 109.43 inches, based on six to seven years of observations at Monumental Mine, Del Norte County. Both of these localities are in northwestern California near the coast. In the Central Valley, the average rainfall at Sacramento is 18.12 inches (length of record, 98 years), and at Fresno the average rainfall is 9.52 inches (length of record, 66 years). The decrease in annual rainfall toward the southern end of the San Joaquin Valley is even more pronounced at Bakersfield.

In spite of the great variation in amounts of precipitation in different parts of California, the annual distribution follows a similar curve throughout the state. Thus, as a general rule, the period of greatest precipitation occurs in all sections of the state during the same part of the year. Regardless of total quantity of rain and snow, and regardless of locality, the greatest amounts of precipitation occur during the winter.

MONTHLY PRECIPITATION AND TEMPERATURE AT SACREMENTO, CALIFORNIA

	AVERAGE PRECIPITATION (1849-1946)	AVERAGE TEMPERATURE (1878-1946)
Jan.	3.64 in.	45.7 F.
Feb.	3.05	50.4
Mar.	2.63	54.6
Apr.	1.47	58.8
May	0.69	63.8
June	0.13	70.0
July	0.02	74.1 (max.)
Aug.	T (min.)	73.3
Sept.	0.22	70.2
Oct.	0.79	63.0
Nov.	1.83	53.7
Dec.	3.65 (max.)	46.4 (min.)

CLIMATE AND VEGETATION

Since the wetter months are usually December through March, it is important to relate the effect of this distribution to the growth of plants. This subject cannot be considered except in relation to temperature. Sacramento will serve as an example for the present discussion.

In the accompanying table, it is seen that the lowest average temperature occurs in the month of maximum precipitation. Conversely, the hottest and driest months are July and August, respectively. This situation is typical of the entire Central Valley.

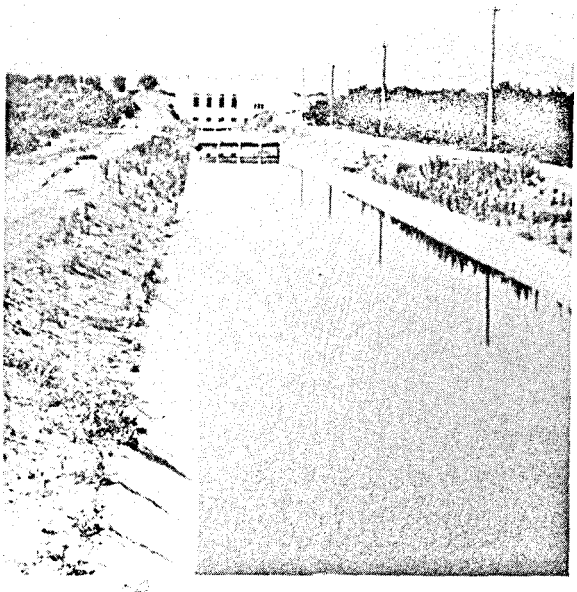
Much of the arable land in California is now under irrigation. During the long, dry summer in which relatively few native plants produce flowers, parched conditions prevail throughout the Valley. In the fall, if there is sufficient rain, all the pale yellowish grasslands suddenly turn green, but there are still only a few herbs in flower. Then the advent of colder temperatures retards the growth of vegetation to such an extent that, despite the rain, only a few plants blossom before March. This period is followed by an extraordinary burst of flowering which diminishes toward summer with the increasing drought.

On watered land, however, and in the few places where there is sufficient moisture, the vegetation takes full advantage of the long period of warmth, and the results of irrigation are spectacular. In view of the nationwide distribution of California produce, it is needless to emphasize this point.

MOSQUITO BREEDING IN NON-IRRIGATED LAND

It is important to consider mosquito breeding under natural conditions, that is, on non-irrigated land, before discussing it in relation to irrigation. Good examples of such territory are found in those areas south of Fair Oaks in Sacramento County, and east of the Fairfield Army Air Base in Solano County. In such localities — which may be assumed to be typical of the greater part of the Central Valley before there was extensive use of irrigation — larvae of

all, or almost all, of the inland species may be found during April. The aquatic stages of each species, which are then very numerous, occur in such temporary habitats as treeholes and ponds resulting from winter rains. As rainfall decreases, all breeding places diminish in area and their total water surface is reduced to a very small fraction of that to be found during the spring. Certain habitats such as treeholes and vernal ponds occurring in grasslands, now cease to exist. Though some small streams become mere trickles of water or a series of isolated pools, most of them dry up completely. Even large ponds with tules and cattails may withdraw from their marginal vegetation, leaving muddy shores with shallow, turbid water. There is little or no fresh growth of emergent aquatics in such ponds, and also less protection from wavelet action. Thus, aside from reduction of water surface, other conditions are less favorable for mosquito breeding. By September, the population of aquatic stages is extremely low.



The Contra-Coastal Canal, serving an industrial and agricultural region, is concrete lined.

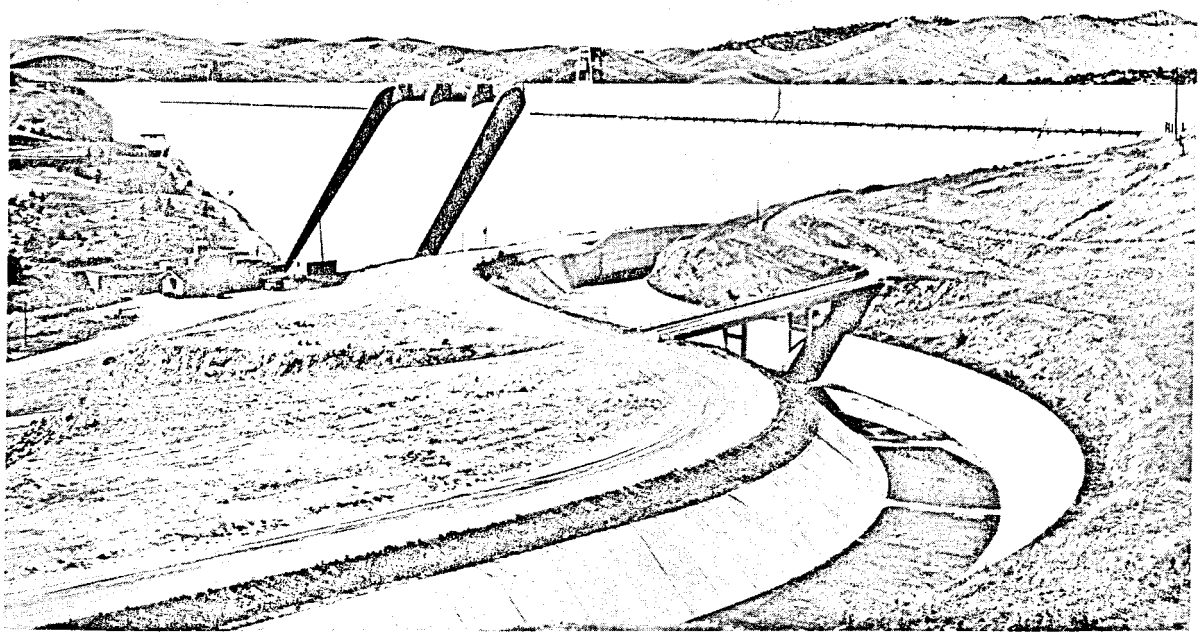
METHODS OF IRRIGATION IN CALIFORNIA

In contrast to the non-irrigated lands just discussed, most irrigated lands in the Central Valley produce mosquitoes in huge numbers throughout the summer. Before considering the nature of breeding places, it is desirable to mention the sources and use of irrigation water. Though many areas are still irrigated by wells, the general experience in California has been that the supply of ground water is not replenished in sufficient quantity to supply permanent needs. For example, the Federal Bureau of Reclamation states that almost 50,000 acres in the southern San Joaquin Valley were abandoned "because wells went dry or because deeper pumping became economically prohibitive." As far as surface water is concerned, the potential sources are much greater. Because of the great productivity of the Central Valley, it is economically feasible to construct huge dams and canals a few hundred or more miles in length.

Dams are generally located in the foothills, often in steep-sided valleys. The canals carrying water to agricultural land are usually well designed structures, generally concrete-lined. Also, within irrigation districts many main ditches are lined. Extending beyond such ditches there are occasional systems of underground piping. Most of the water, however, runs in open ditches on the surface of the ground. Tail end water from both private lands and irrigation systems is sometimes turned into a natural drainage channel but it is generally released into the nearest roadside ditch or most convenient depression. Only in exceptional cases is water reused.

MOSQUITO BREEDING IN IMPOUNDMENTS

Of all the waters used for irrigation purposes, those contained within impoundments and lined ditches are the most free from mosquito breeding. In large reservoirs and ponds used for storing water pumped from wells, the scarcity of mosquitoes is probably best explained by fluctuation in water level. This ebb and flow produces conditions unfavorable for



Typical of the dams and drainage canals of the Central Valley Project is Friant Dam, near Fresno, which stores San Joaquin water. Shown in the foreground is Friant-Kern Canal.

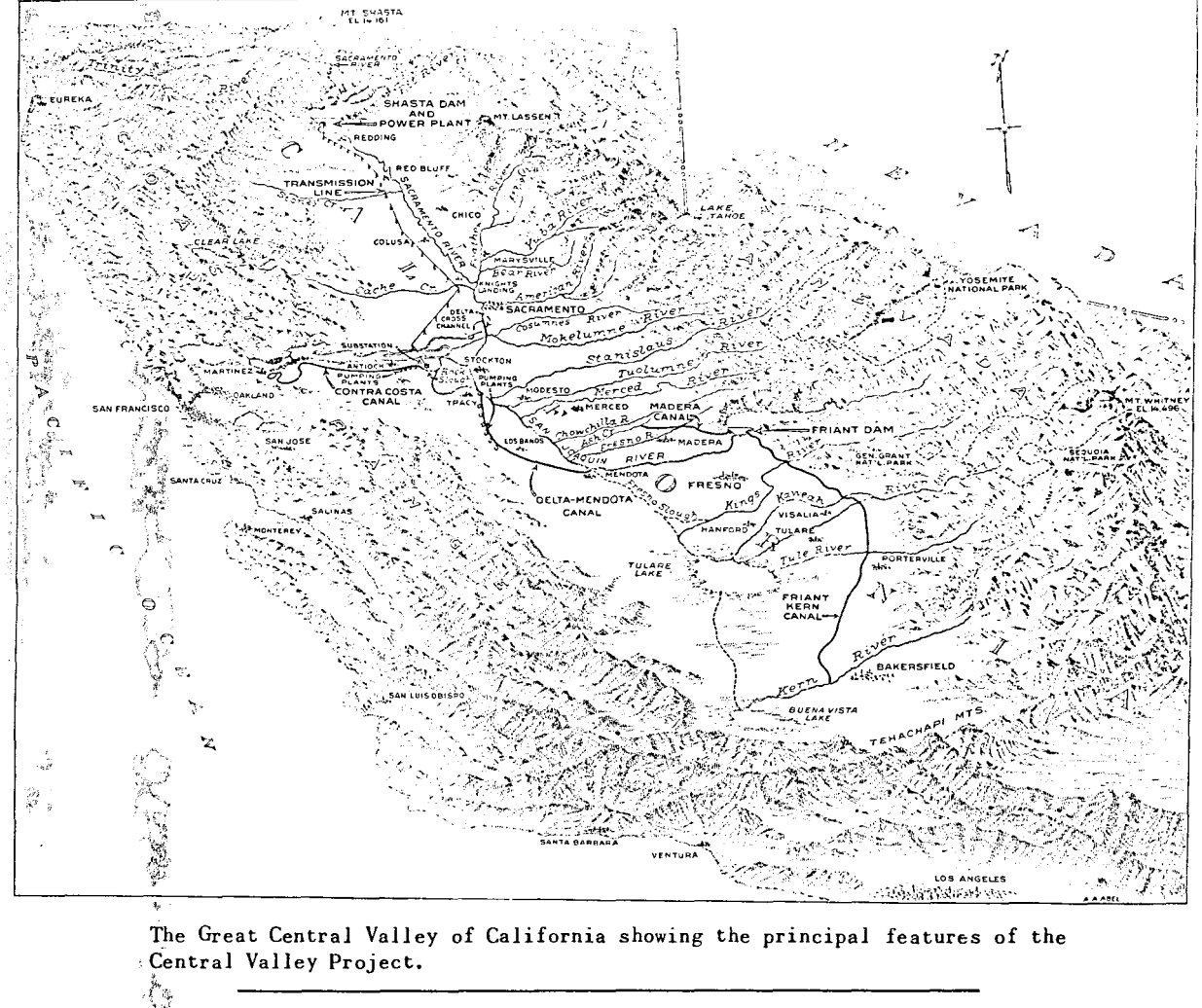
aquatic vegetation. Without plants, especially the emergent types, other forms of aquatic life are less abundant. In such open water, the immature stages of mosquitoes are exposed to the full effect of wind and to attacks of fish and other predators. Excessive wave action occurs along the shores of the larger reservoirs where motorboats are used.

Because of the seasonal character of rainfall in California, the ponds of irrigation reservoirs reach their highest levels in the spring. Those impoundments located on streams which drain alpine areas may continue to receive water from melting snow until July. The effect of the snow melt in building up the water level, however, may be more than offset by withdrawal of water for irrigation. After the early part of the summer, the reservoirs are gradually lowered until fall, by which time mosquitoes have ceased to breed in significant numbers. With the clearing practices now in use, the shores of impoundments remain very clean and provide only occasional habitats suitable for mosquito breeding.

The situation is less favorable in respect to flood control dams where the residual pond may remain fairly constant in level. (The present Hogan Reservoir provides a good example.) It is felt, however, that if the current demand for water continues, strong pressure will be exerted to develop all possible sources for irrigation purposes.

MOSQUITO BREEDING CAUSED BY CANALS

As noted above, there is a marked decrease in rainfall toward the southern end of the San Joaquin Valley. To offset this differential in precipitation, the Central Valley project of the Bureau of Reclamation is constructing huge gravity canals to carry water southward from more abundant supplies. One is the Friant-Kern Canal supplied by the reservoir of Friant Dam and extending 160 miles to the Kern



The Great Central Valley of California showing the principal features of the Central Valley Project.

River near Bakersfield. Another is the Delta-Mendota Canal which will be filled with water pumped from the San Joaquin Delta near Stockton and will terminate in Mendota Pool, one hundred miles away. Both canals start at elevations of 100 feet or more above the floor of the valley, and following the contours of the foothills, cross many natural drainage channels.

The obstructed flow of the natural streams, which are seasonal in character, is usually directed into the canal or passed underneath through culverts. Even if these structures are carefully designed, they are likely to require regular maintenance. There are also problems caused by the disposal of borrow material, but most important is the misplacing of culverts, leaving relatively permanent pools. From preliminary field observations there appear to be instances where ranchers have influenced construction to provide just such water for their stock.

MOSQUITO BREEDING ON IRRIGATED LAND

The great abundance of mosquitoes in the Central Valley bears witness to prodigal use of water for irrigation. Many breeding places could be corrected by careful leveling and good drainage, but the summer heat is so great that a tremendous quantity of water is necessary to produce good crops. It is not surprising, therefore, that when only a small percentage of the total supply is mismanaged, many unnecessary breeding places created. Though a long-range educational program would help to correct the present careless irrigation practices, no immediate results could reasonably be expected. As long as water is

plentiful, there will continue to be over-irrigation under the present regulatory provisions.

To obtain uniform irrigation in pastures, the flow of water is controlled by CHECKS which are ridges of earth thrown up at regular intervals. The intervening depressions (also called CHECKS) are flooded periodically. Though the heat hastens evaporation of water, it also speeds the development of mosquitoes. Where the ground is irregular, small puddles of water produce a hatch of flood water *Aedes* with each irrigation.

On crop land, similar mosquito production occurs in furrows, especially at the low end of fields. In strawberry cultivation, which represents an extreme case, beds are separated by deep troughs which are dammed at short intervals. Most of the water in such depressions disappears too quickly for mosquitoes to complete their aquatic stages, but the few puddles which persist are sufficient to keep the adult population at a high level.

Additional problems may be summarized as follows: stagnant ditches on private land; roadside ditches receiving excess water; natural drainage channels which would normally be dry; rising ground water tables; lack of agricultural drainage; and with increased supplies of surface water, additional acreage of flooded crops such as rice.

All in all, regardless of first impressions, the Central Valley proves to be a surprisingly wet area. When the mosquito breeding potentialities of this irrigated land are fully recognized, the support needed for state and local mosquito control agencies will assume its vital and fundamental proportions in this area.

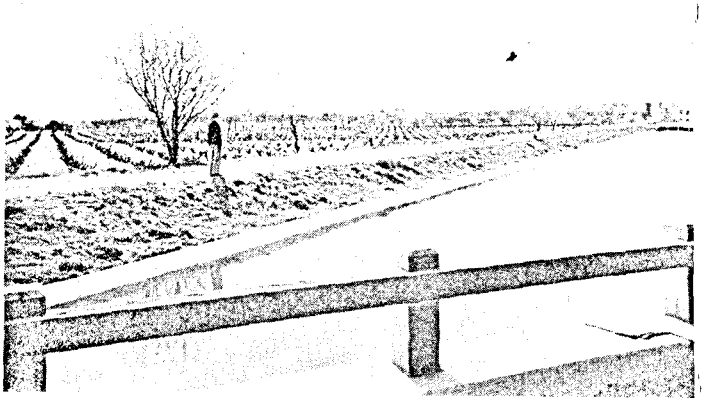
MOSQUITOES IN RELATION TO DISEASE

In the southeastern states malaria is the principal mosquito-borne disease. It was once common in California, occurring locally in severe epidemics. At the present time, however, in spite of large numbers of war veterans who have had recurrent attacks of foreign infections, there appears to be a minimum of local transmission. On an economic basis, malaria in California has become too scarce to locate.

On epidemiological evidence, *Anopheles freeborni* has been considered the principal vector of malaria in California. In recent years the disease has occurred mainly in the Central Valley. In the past, however, malaria was common in the foothills of the Sierra Nevada, notably when that area was highly populated by gold-seekers. Since *Anopheles punctipennis* is common in that region, it has been thought to be of significance as a vector. Besides *A. freeborni, A. punctipennis* therefore deserves consideration in relation to existing and proposed impoundments located in the foothills.

Quite a different situation exists with regard to mosquito-borne encephalitis. It occurs throughout the Central Valley, but is not common beyond the limits of irrigated land. There were 1,383 human cases reported to the California State Department of Public Health in the years 1936-1945. Totals for 1946 and 1947 were 161 and 126, respectively. Encephalitis, in addition to being difficult to control, has a very high fatality rate ranging, according to our reported records, from 20 to 58 percent.

The epidemiology is still incomplete, but culicine mosquitoes, especially *Culex tarsalis*, are known to carry and are able to transmit the virus. Since the only practical preventive measures lie in the field of mosquito control, it is important to consider the figures for the last two years in relation to the wide and rapid



Canals such as the Contra-Coastal Canal (right) near Oakley, California, create an increased mosquito breeding potential by interfering with natural drainage.

expansion of California mosquito abatement agencies since World War II. When the disease has been more fully studied, it should be possible to estimate the hazard of infection with more certainty. In the meantime, it is necessary to adopt the working hypothesis that all culicine mosquitoes are potentially dangerous.

DISCUSSION

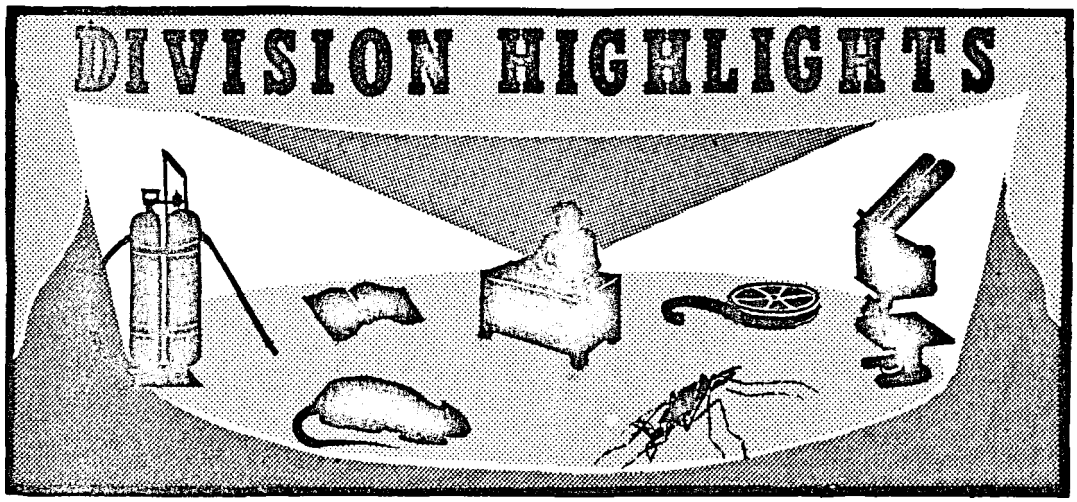
A somewhat paradoxical relationship between impounded water and mosquito breeding is now seen to exist in California. Where water is stored, usually in the foothills, the populations of men and mosquitoes are generally so small that there is little opportunity for spread of a mosquito-borne disease. Where water is used, however, the populations of both men and mosquitoes are proportional to the amount of irrigation, and increase with the extent and intensity of that irrigation. Man-made mosquito sources in the Central Valley include; unlined irrigation ditches; depressions in pastures and in fields of cover and hay crops; furrows and low places in tracts devoted to produce; roadside ditches receiving waste and excess water; natural ponds and drainage channels which would normally be dry; and finally, of course, urban problems including sewer farms where mosquito breeding is very intense because of the high content of organic matter. To this list of breeding places resulting directly from normal use of water must be added special problems created by seepage from irrigation ditches, and the interference with natural drainage produced especially by major canals. Thus there is an increased potential for mosquito breeding with the construction of each new dam and the formation of each new irrigation district. Since there is also an increased potential for the transmission of disease, it is pertinent to discuss the question of responsibility and to determine, as far as possible, what agencies should assume control of this threat to public health.

Country-wide interest in this subject has been largely focused on the problem of anopheline control in reservoirs built for flood control and hydroelectric plants. Accordingly, there has been developed a working agreement between the U. S. Engineers Department and the U. S. Public Health Service, whereby the latter agency makes preliminary surveys of the proposed impoundment areas and submits estimates of the cost of maintaining anopheline control. The Engineers are charged with providing this control in all their reservoirs.

No such national policy has been established with respect to irrigation dams and canals which are planned and constructed by the Federal Bureau of Reclamation. What is more important, there appears to be no real appreciation of downstream problems resulting from irrigation. The tremendous projects now proposed or in operation in various arid or semi-arid sections of the West will unquestionably create many mosquito problems. To a large extent, these will be noticed by the public on the basis of mosquito annoyance. In view of the fact that encephalomyelitis is already widespread in many parts of the West, it is conceivable that there will be not only a rise in the incidence of this disease in horses, but also of the human mosquito-borne encephalitides. Furthermore, in numbers, if not in actual percent, this rise is likely to attract wide attention.

Since it takes a long time to organize and bring to a point of efficient operation any mosquito control agency, there is a very definite lag in the application of preventive measures. Consequently, one of the best lines of attack on encephalitis in both horses and man is to prevent over-irrigation at the outset.

Recognition of hazards involved in increased use of water for irrigation should lead to careful planning of all new construction, and the formulation of regulations to forestall the misuse of water supply. When all ramifications of this problem are considered, it appears that definitive agreements between the various agencies concerned should be drawn up and put into effect as rapidly as possible.



Epidemiology Division

Virus Branch

ENCEPHALITIS INVESTIGATIONS. In connection with the encephalitis investigations program, 14 human bloods, 5 animal bloods, 3 human nasal washings, and one lot of mosquitoes were collected during June, in Tennessee. In Louisiana, 15 wild bird bloods were collected the latter part of June. Assistant Surgeon Lindsay K. Bishop, at the request of Dr. D. G. Gill, Alabama State Health Officer, investigated three deaths in north Alabama, which had been reported as due to encephalitis. An autopsy of one case revealed that death probably was due to coronary occlusion. In another case, the possibility of respiratory paralysis was considered, while a third case fitted the group of milder encephalomyelitis recently attributed by Howitt, Bishop, and Kissling to Newcastle's virus.

Malaria Branch

MALARIA STUDIES. After two surveys in areas of heavy case reporting, no positive slides have been reported this year by the Arkansas State Laboratory. Reported malaria for the entire state has been approximately halved over last year and the seven-year median. One county which last year reported more than 389 cases, has reported fewer than 20 cases this year. This change is thought to be due both to improved reporting and to actual decrease in transmission.

Texas has reported 563 cases of malaria this year.

DRUGS OBTAINED. Five crates of antimalarial drugs, including atabrine, quinine, and totoquine were secured from the Maritime Surplus Commission. Letters were sent to the health officers of the southeastern states to ascertain whether they could use the drugs. So far, two states, North Carolina and Oklahoma, have replied in the affirmative.

Typhus Investigations

The typhus investigations project at Thomasville, Georgia, was placed on a surveillance status in the fall of 1947. The data accumulated from this study are being prepared for publication in the near future. In brief, however, these data support the following statement:

> By applying 10 percent DDT in pyrophyllite to rat runs and harborage in a county-wide type program, and without the aid of other rodent or rodent ectoparasite control measures, murine typhus fever incidence was reduced significantly in Thomas and Brooks Counties, Georgia. (This does not preclude the efficacy of 5 percent DDT powder, but the 10 percent product was used exclusively in the investigation.)

In contrast with levels observed in an untreated county, satisfactory county-wide control of *Xenopsylla cheopis* and *Leptopsylla segnis* was obtained by the county-wide treatment mentioned above.

A significant reduction in the prevalence of typhus complement fixing antibodies in the rat population closely followed and was probably a result of the ectoparasite control which had been obtained.

Liponyssus bacoti (tropical rat mite) and *Polyplax spinulosa* (rat louse) populations on rats were only slightly reduced in the treated counties.

DDT dusting operations, as executed, disturbed the normal ecology of rat ectoparasite populations in a variety of ways and, by so doing, altered the epidemiological picture of murine typhus fever, thereby reducing the prevalence of the disease in rats and man.

Laboratory Division

Parasitology Training

A 52-hour course in Medical Parasitology was presented to a class of 56 medical students and seven medical technicians at Emory University, Georgia, between March 24 and May 12.

Eight hundred fifteen sets of slides prepared for the regular Extension Service included *Plasmodium falciparum; Trypanosoma cruzi; Endamoeba histolytica; Culex tarsalis;* and *Anopheles quadrimaculatus*. Test materials for the special extension service, sent to Mississippi technicians as part of a training program, contained *Endamoeba coli, Giardia lamblia; Endamoeba histolytica* and *Endolimax nana*.

Teaching materials were received from the Army Medical School and from the Collection Laboratory in Puerto Rico. Malarial slides were prepared in Milledgeville, Georgia, and one set of *T. cruzi* slides was prepared in Atlanta. Upon request, malarial blood films were sent to Florida and to the Dominican Republic for use in training programs.

Diagnostic Service

Neutralization tests were performed on human sera from eight states. No protection was demonstrable in 36 specimens against Eastern Equine Encephalomyelitis, 21 specimens against Western Equine Encephalomyelitis or four specimens against lymphocytic choriomeningitis virus. Four of 11 sera neutralized St. Louis virus; these came from Louisiana, Georgia, Mississippi, and West Virginia.

Two hundred forty-three sera of birds, horses, cows, and dogs were tested for neutralizing content against Western Equine Encephalomyelitis, Eastern Equine Encephalomyelitis, and St. Louis Virus. Sera of seven birds and one dog showed Eastern Equine Encephalomyelitis antibodies, sera of 24 out of 100 birds, 8 out of 14 horses, 2 out of 4 cows, and 2 out of 6 dogs protected against Western Equine Encephalomyelitis virus.

Four of 21 stool specimens inoculated into monkeys resulted in the recovery of poliomyelitis virus. These four specimens furnished a new (Texas) strain of virus for the laboratory.

The Nixon virus, from a fatal human case of encephalitis at Birmingham, Alabama, was apparently a herpes virus.

RICKETTSIAL SEROLOGY UNIT. During the quarter, 219 human sera, mostly from the southern states, were submitted for routine diagnostic complement fixation and Weil-Felix tests. Sixty of these sera (27.3 percent) were positive against murine typhus antigen. Seven sera gave positive reactions with spotted fever antigen; one patient's serum showed antibodies of diagnostic level against Q fever antigen. No sera had diagnostic titers for rickettsialpox. The Weil-Felix test with 209 of the sera yielded 39.2 percent positive against OX19 and 5.3

Diagnostic Service	State or Local P. H. Labs.	CDC Clinic	Presbyt. Baby Clinic	Emory Univ.	Total
Feces					
Exam. for Intestinal Parasites	43		93		136
Bacterial Culture		2			2
Blood					
Exam. for Malaria		2			2
Routine Clinical	1	88			89
Urine					
Routine		79			79
Culture		1			1
Exudate					
G. C. Smear		1			1
Arthropods					
Identification	2,650			4	2,654

Survey	No. of Slides Examined	No. Positive	Remaining at End Quarter
Lab. Evaluation Survey (Miss.)	65	0	—
South Carolina	4,073	0	1,933
Dominican Republic	100	3	500

positive against OX2 antigen.

Complement fixation tests with murine typhus antigen, using 5308 rat sera from various surveys, gave positive reactions in approximately 10 percent of the tests.

MYCOLOGY SECTION. The Diagnostic Service identified 13 strains of pathogenic fungi from 95 cultures and specimens received during this quarter. One strain of *Monosporium apiospermum* was isolated from a human mycetoma of the foot.

Histological slides, lantern slides and culture materials have been nearly completed for use in the first training course covering laboratory diagnosis of mycotic diseases.

Engineering Division

Typhus and Plague Control

During May and June a special half-time training program in rodent control was attended by six new employees of the Typhus Control Branch. These personnel were scheduled for assignment to the District 8 office, Utah and Colorado in connection with plague activities. Additional rat control programs are proposed for New Mexico, Wyoming, and Washington.

In cooperation with the Sanitary Laboratory at Georgia Tech several tests for qualitative and roughly quantitative determination of 1080 in water were developed. In June, a sample involved in an actual human poisoning case in New York was found to contain 1080.

Typhus Branch representatives participated in the Southern Branch APHA meeting at New Orleans, the National Sanitation Clinic at Ann Arbor, and two Training Division programs; and were visited by Dr. Macchiavello of Peru, Dr. Baldwin of Australia, and Mr. Davis of South Africa. Visits were also made to four state typhus programs and the Technical Development

COMMUNICABLE DISEASE CENTER

SUMMARY OF TYPHUS CONTROL OPERATIONS

December 28, 1947 — March 27, 1948

States	Residual Dusting				Rat Poisoning							Rat Proofing			Man Hour Summary		
					Food Baits				1080 Water								
	Counties Reporting	Premise Dustings	Pounds per Prem.	Man Hrs. L & LF* per Prem.	Counties Reporting	Premise Poisonings	Pounds per Prem.	Man Hrs. L & LF* per Prem.	Estab. Poisonings	Pints per Estab.	Man Hrs. L & LF* per Estab.	Projects Reporting	Estab. Treated	Man Hrs. L & LF* per Estab.	USPHS Man Hrs. Worked	Other Man Hrs. Worked	Total Man Hrs. Worked
Alabama	5	4,021	4.21	0.57	10	5,303	1.07	0.67	1,870	1.77	1.05	2	16	73.63	3,235	5,768	9,003
Arkansas	1	131	1.27	0.63	—	—	—	—	—	—	—	1	52	127.25	1,120	5,580	6,700
Florida	3	3,748	2.68	0.38	3	405	1.46	0.65	301	1.49	2.14	2	46	14.85	2,727	6,425	9,152
Georgia	27	9,722	2.58	0.56	23	16,033	0.52	0.42	262	1.39	2.66	5	140	55.65	4,325	16,281	20,606
Louisiana	4	411	4.50	1.10	5	2,053	0.26	0.97	1,184	1.07	1.28	3	45	116.27	3,298	5,883	9,181
Mississippi	1	144	2.43	0.61	6	4,451	0.69	0.29	140	0.76	2.07	1	20	70.00	1,280	1,767	3,047
N. Carolina	1	35	0.60	0.74	3	4,063	0.54	0.26	235	0.29	0.69	5	173	65.36	1,864	10,677	12,541
S. Carolina	4	477	0.64	0.71	1	42	0.12	0.38	315	0.91	7.12	4	42	99.74	2,585	4,202	6,787
Tennessee	—	—	—	—	—	—	—	—	—	—	—	4	48	97.71	2,960	1,730	4,690
Texas	15	567	3.91	3.90	6	2,719	0.44	0.86	5,181	0.55	1.33	11	213	79.09	9,702	18,563	28,265
Virginia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	61	19,256	2.96	0.64	57	35,069	0.62	0.49	9,488	0.92	1.52	38	795	83.12	33,096	76,876	109,972

*Labor and Labor Foremen

SUMMARY OF DDT RESIDUAL SPRAY OPERATIONS

April 1 — June 30, 1948

State	No. Cos.	No. Houses Sprayed	Lbs. DDT	Man-Hours			Lbs. DDT Per House	Man Hr. per House	Man Hr. per Lb. DDT	Cumulative
				CDC	Local	Total				July 1, '47 — June 30, '48 Total House Spray Applic.
Alabama	33	87,855	89,833	70,717	25,410	96,127	1.02	1.09	1.07	150,493
Arkansas	43	100,820	141,957	21,506	114,633	136,139	1.41	1.35	0.96	181,562
Florida	28	47,270	58,499	8,282	52,890	61,172	1.24	1.29	1.05	90,413
Georgia	37	99,718	74,670	25,288	60,767	86,055	0.75	0.86	1.15	189,774
Kentucky	13	11,171	21,802	2,752	28,837	31,589	1.95	2.83	1.45	15,916
Louisiana	19	52,112	66,568	10,492	53,998	64,490	1.28	1.24	0.97	62,969
Mississippi	19	108,724	133,561	48,830	76,111	124,941	1.23	1.15	0.94	174,494
Missouri	13	40,885	40,968	7,888	51,243	59,131	1.00	1.45	1.44	80,107
North Carolina	32	38,483	36,593	3,666	36,014	39,680	0.95	1.03	1.08	58,482
Oklahoma	11	21,517	23,834	15,379	7,396	22,775	1.11	1.06	0.96	37,319
South Carolina	41	88,559	89,803	11,990	97,651	109,641	1.01	1.24	1.22	189,359
Tennessee	13	31,162	62,929	8,816	51,974	60,790	2.02	1.95	0.97	35,426
Texas	34	57,699	66,641	52,497	54,135	106,632	1.14	1.85	1.60	105,400
Sub-Total Cont. U. S.	336	785,975	907,658	288,103	711,059	999,162	1.15	1.27	1.10	1,371,444
Puerto Rico & Virgin Islands	—	1,082	974	1,468	—	1,468	0.90	1.36	1.51	8,901
Grand Total	336	787,057	908,632	289,571	711,059	1,000,630	1.15	1.27	1.10	1,380,345

Division. Revised budget material was prepared for both typhus and plague activities for FY 1950 and the state allocations were announced for FY 1949. Final revision of three chapters for the rodent control manual was completed, and five typhus memos and one special memorandum were issued to the field.

Fly Control

Organization of the Fly Control Branch was completed during the quarter, with the assignment of Dr. Herbert F. Schoof, Entomologist, to fly control activities in June. Space was provided for the Branch in Volunteer Building. Preliminary planning and preparation for fly-borne disease investigation projects continued throughout the quarter. Funds will be available for operation of fly control projects in five cities, with five additional cities used for check purposes.

Visits were made to states in Public Health Service Districts 1, 2, 3, 5, 7, and 8 in connection with selection of cities for participation in the program. Verbal agreements of participation in the program were obtained from the following cities: Troy, N. Y., District 1; Charleston, W. Va., District 2; Muskegon, Mich., District 3; Pheonix, Ariz., District 5; and Topeka, Kans., District 7.

Impounded Water Studied

Nine reconnaissance, one final, one preliminary, and one supplemental malaria survey reports were completed and submitted through channels to the Corps of Engineers

during the quarter. Requests for five additional survey reports were received for the reporting period.

Northwest Flood Activities

The Engineering Division was given the responsibility of securing adequate engineer personnel to assist the state and local health departments of the affected areas in relief activities. Engineer (R) John H. Bright of the Impounded Water Branch, this Division, was detailed to the disaster area as officer in charge of Public Health Service assistance. The Equipment and Construction Branch of the Division, with the assistance of some state offices, obtained necessary supplies, vehicles and equipment for work in the area.

Equipment and Construction

a. Chemicals

During June a significant number of complaints were received from the field regarding the apparent ineffectiveness of the DDT spray in killing flies. The consensus of the state CDC personnel appeared to be that the ready-mixed concentrate in general use this season is not as effective as the concentrate mixed locally. This problem was referred to the Technical Development Division and a report will be forthcoming as soon as all factors involved are tested and evaluated.

b. Construction

The Construction Unit received 105 work order requests involving major and minor construction work and routine maintenance during the quarter. Sixty-one of the orders were completed.

Approximately 90 percent of the general construction work on the buildings at Lawson for which work orders have been received has been completed. Difficulty was experienced during the quarter by both the Laboratory and Production Divisions at Lawson with inadequate electric power for operation of equipment. A separate bank of transformers was installed for the Laboratory Division. As soon as new transformer equipment can be obtained to replace that on loan from the Veterans Administration, a similar installation will be accomplished for the Production Division. At the request of the Veterans Administration, a meter is being obtained to measure the actual amount of electric current used by CDC at Lawson.

Entomology Division

Headquarters Office

Early in April a mobile laboratory and personnel were detailed to Mulberry, Florida, where experimental areas had been established as a part of the 2,4-D water-hyacinth investigations in cooperation with the Corps of Engineers. The experimental pond at Mulberry was sprayed with 2,4-D. Pre- and post-treatment water samples were secured and tested to furnish information on D.O., pH, color, turbidity, alkalinity, odor, CO_2, and BOD. Laboratory tests on the effects of 2,4-D on taste and odor in water were conducted by the Cincinnati laboratory. During May, sampling procedures were extended to include other hyacinth infested areas in Florida treated with 2,4-D. Owing to unsatisfactory kill of hyacinth at Mulberry, the mobile unit was moved to Belle Glade early in June where 2,4-D-treated irrigation ditches containing hyacinth were sampled.

MURINE TYPHUS, DDT-DUSTING EVALUATION. During the first quarter of 1948, 2,868 rats were combed for ectoparasites, and 2,495 rat bloods were tested for murine typhus antibodies. Comparison of the numbers of rats from untreated premises and those dusted with DDT reveals continued success in control of ectoparasites, especially of non-sticktight fleas.

After two years (1946, 1947) during which

Table I.

PERCENTAGES OF RATS WITH ECTOPARASITES

Species	January		February		March		1st Quarter		Percent Dif. in favor of dusted premises
	UN	D	UN	D	UN	D	UN	D	
X. cheopis	22	5	15	3.3	6.0	7.0	14	2.9	80
N. fasc.	8.0	0.6	5.0	0.5	1.6	0.9	4.9	0.7	86
L. segnis	10	3.0	12	7.0	18	8.5	12	6.2	53
non-stick-mtight	36	6.6	33	9.5	24	14	31	10	68
E. gallin.	7.0	1.5	7.0	2.5	2.0	0.3	5.3	1.4	74
L. bacot.	13	7.0	13	7.0	24	7.0	17	7.0	59
E. echid.	17	11	14	6.0	6.0	3.0	12	6.8	43
L. nutt.	5.7	5.0	7.0	4.6	1.2	5.0	5.0	4.9	2.0
P. spin.	27	23	32	37	34	26	31	29	4.5

PERCENTAGES OF RATS POSITIVE FOR TYPHUS

When weighted uniformly per state	14	14	11	11	11	13	12	13	—

fewer rats from dusted than from untreated premises had typhus antibodies, no real difference is apparent in percentages positive for the first quarter of 1948 (undusted 12, dusted 13) when data are weighed by states and then averaged. When, however, the percentage is based on mass data (total number of positives in total number of bloods examined), the results appear more favorable (undusted 18, dusted 13).

Explanation, in part, is that during the first quarter of any year, the differences in percentages of rats from dusted and undusted premises are generally smaller. Samples must be large if they are to reveal any difference. Also, the small degree of difference during the first quarter could be due to transmission from rat to rat of those parasites remaining after dusting or to movement of rats from undusted to dusted premises, and vice-versa, thereby tending to minimize any difference that might have resulted from dusting.

RODENT-PLAGUE INVESTIGATIONS. Plague infection was recovered from pack rats taken in April in the eastern quarter of Gaines County, Texas. Presence of infection was suspected because of the disappearance of prairie dogs from one section of a four-mile long colony. The "dead" section of the colony, about one mile in diameter, was made the center of a series of investigations. Around this center two half-mile-wide bands were established, target-fashion, the outer margin of the outermost band being three and one-half miles from the center. The mile-wide areas between bands were left untrapped to insure relatively undisturbed conditions within the study area. Selected stations beyond these bands are being trapped and other stations are being kept under observation so as to detect plague epizootics by observing conditions in strategically located prairie dog towns. These latter are interspersed in uncultivated areas variously isolated and surrounded by cultivated land. These observations should yield information regarding effects of cultivation on existence and spread of plague.

In that area 224 packrats, 174 kangaroo rats, 80 hares and rabbits, 36 prairie dogs, 31 grasshopper mice, 25 ground squirrels, and several coyotes, birds, and small mice were taken by the middle of May without further evidence of plague infection.

Packrats appear to be the most widely distributed primary reservoir. Prairie dogs appear to be reservoirs, but their distribution is non-continuous. All these animals were caught in such a way as to obtain a measure of their relative abundance, based on the number caught per 100 trap-nights.

Dysentery Control Project, Pharr, Texas

PHARR BRANCH ACTIVITY. As originally planned, control operations in Hidalgo County after September 8, 1947, were designed to evaluate various control methods. These evaluations had progressed without other than seasonal interruption when a poliomyelitis epidemic developed in April. Because of the desirability of maintaining the best possible fly control in treated towns, in order better to evaluate the possibility of polio vectoring by flies, no strict segregation of treatment methods was maintained after mid-April.

Increase in Fly Production. Coincidental with the development of the polio epidemic, there occurred a steady increase in fly production. Never during the course of the project had there been such a favorable combination of weather conditions and widespread breeding media to produce flies in large numbers. Heretofore, large-scale breeding had been fairly well limited to rural areas at various distances from urban areas. All these usual places, and others, contributed to fly production during the fourth quarter. They were augmented by areas of citrus dehydration wastes located well within the urban boundaries.

New Problems. Problems not previously encountered arose with monotonous regularity. Prime among these, in addition to the urban area breeding, was the emphatic manner in which long-recognized grill-method evaluation deficiencies suddenly became intensified.

The sanitary land fill demonstration, which Sanitary Engineer (R) Paul P. Maier carried on at Weslaco, has been exceedingly successful. Originally the dump had covered approximately ten acres. Selection of dumping sites for individual trucks was governed only by the accessibility left by preceding dumpers. By the end of May, all this unsightly fly-breeding and rat-harboring material was underground, and a systematic landfill was in progress.

ALBUQUERQUE BRANCH ACTIVITY. As a result of early rains, fly breeding in this area got off to a rather unexpected early start. For the most part, control operations were begun as indicated by fly prevalence. The primary entomological objectives of this branch are three-fold: (1) To see if fly control will affect dysentery prevalence; (2) To test relative effectiveness of different fly control methods; and (3) To determine, if possible, the level of fly reduction necessary to achieve a reduction in dysentery rates. The extreme decentralization of the program activities has proved to be a far greater limiting factor than had been anticipated, but work is progressing as well as circumstances will permit.

THOMASVILLE BRANCH ACTIVITY. Main activities of this branch were the establishment of a working area, surveillance of this area, and field investigations of methods to determine block populations of flies.

Encephalitis Project (California)

AVIARY STUDIES. Four flight runs for breeding birds were established in the early spring, in an effort to raise wild birds in captivity. The availability of known non-immune young birds is very important in a study of the transmission of encephalitis. It has been necessary to develop satisfactory diets and to determine the areal needs of the various species in captivity in order to obtain nesting. House finches have made ten nesting attempts, but only one pair has raised young. The use of potato tuber moth pupae, supplied by the University of California, Division of Biological Control, has helped solve this problem. Sparrows have built six nests, from two of which young have been raised successfully. Bullock Orioles have refused to nest in captivity. Mourning and Chinese ringnecked doves have nested normally.

Technical Development Division

Environmental Sanitation Studies

To provide information on which a sound municipal fly control program might be based, studies were begun to determine the sources of fly populations in the City of Savannah, Georgia, and the relative importance of such sources.

Movement of Blow Flies from City Dump Area. To aid in investigating the role of the city dump as a source of flies within the city proper, flies were released on the dump and fly traps were operated in the city. The dump is situated just outside the northeast corner of the city limits. In recent years, war housing projects were constructed within less than one-half mile of the dump area. The center of the business district is about three miles away.

City garbage and refuse of all types are unloaded on the surface of the dump area, combustible material is burned, and the remaining material is bulldozed over the edge of the dump to fill in a low, marshy area. Observations during the past several years indicated that enormous numbers of flies of all kinds were being produced on the dump, but it was not known whether the flies left the attractant material on the dump area to move into the city proper.

Kind of Flies Used. The flies used in this study were the yellow-eyed mutant strain of *Callitroga macellaria* recently developed in this laboratory. Laboratory reared pupae were exposed in a protected receptacle on the dump area so that the emerging adults were free to leave the receptacle at will. To determine whether the yellow-eyed strain was absent in nature, the traps were operated 12 days prior to release of the first pupae, without the recovery of any of the yellow-eyed flies. Traps were situated at one-half-mile intervals along five lines radiating from south-southwest to due west of the dump area for a distance of three and one-half miles. In addition, one trap was placed on the dump area about 200 yards north of the point of release, and one trap a quarter of a mile west of the release point. The release point was at the extreme southern edge of the active portion of the dump area, so that the trap on the dump area was in direct line of flight between the release point and the most active part of the dump. All other traps were toward the city, away from the dump area.

Flies Released. During a five-week period beginning May 10, approximately 57,000 yellow-eyed flies were released on the dump. The first yellow-eyed fly was recovered on May 14 in a trap in a residential area two miles from the point of release. The traps were operated until June 21. During the entire trapping period a total of 21 yellow-eyed flies was recovered in 10 different traps. Seventeen different recoveries were made, some of which represented duplicate recoveries in the same trap. They were made in seven different traps, ranging from one-fourth to two and one-half miles in or toward the city from the release point, before any of the yellow-eyed flies were recovered on the dump area in the trap only 200 yards distant from the release point. The greatest distance of recovery was two and one-half miles in the city from the release point.

On the basis of the experiment, and studies of flight habits of house flies and blow flies made by other workers, it seems reasonable to conclude that a significant portion of the fly population of the City of Savannah is being produced on its garbage dump area and is returning to the city proper by normal movement. Since the dump area of Savannah is as far, or farther, removed from the city environs as the dump areas of many other cities, it also seems reasonable to conclude that fly control on garbage dumps, either by chemical and/or sanitation methods, is a necessary accessory to any city-wide fly control program.

Garbage Collection Survey

To learn more exactly what part the garbage can and garbage collection play in fly

TABLE II

SUMMARY OF GARBAGE COLLECTION SURVEY
in Savannah, Georgia
May 17-21, 1948

Factors Observed	Percent Frequency of Occurrence in					
	Best White Residential Area	Middle-class White Residential	Negro Tenement Residential Area	Downtown Commercial Area	Industrial Area and Industrial Housing Development	Total
Premises with inadequate containers	11.9	48.8	32.4	21.8	6.3	22.4
Premises with unserviceable containers	11.9	28.6	28.7	12.7	19.2	21.3
Premises having non-standard containers	11.5	44.0	88.0	20.0	69.4	53.8
Premises with container covers absent	9.5	30.4	57.1	78.2	56.2	42.3
Premises with container covers not in place	24.6	45.3	64.8	96.4	62.8	53.1
Garbage spillage by householder	18.6	11.8	6.2	43.7	6.3	11.9
Garbage spillage by collectors	2.4	4.9	2.5	20.0	1.5	8.4
Potential breeding material in can	75.7	68.6	53.2	56.4	62.0	63.8
Active fly breeding in can	29.4	27.6	28.0	7.3	21.2	25.2
Number of premises surveyed	252	203	275	55	333	1118

production in a city, the activities of garbage collectors and the status of garbage containers were studied in five typical locations in Savannah. These areas included the areas of newer homes, older homes, tenement residential sections, the downtown commercial district, and the industrial section, including part of an industrial housing development. Such things as the type and adequacy of the garbage can, its serviceability, presence of covers and whether used, spillage by householder or collection crew, the presence of potential fly-breeding material in the can, and the presence of actual fly breeding in the can were recorded. The speed with which the garbage collectors worked made it impossible to probe the potential breeding material in the cans, and the figures on active fly breeding in the can are based solely on the frequency with which fly larvae could be observed in the bottoms of the cans after the cans had been emptied of trash and left for reuse.

The accompanying table gives a summary of the findings of this survey.

Inadequate Garbage Cans. As indicated by a later survey, the inadequacy and unserviceability of the garbage cans are responsible for fly development in the soil under the garbage cans. The spillage listed in the table was mostly papers, cans, etc., and was rarely associated with fly breeding. The one pricipal factor correlated with active fly breeding was the presence of a sludge of potential fly-breeding material left in the cans routinely after the cans were emptied of loose garbage and trash. This occurred with the highest frequency in the best residential areas. The lower frequencies in the older areas and tenement residential areas may be due partially to a higher rate of unserviceable cans, where the soft, wet garbage fell through holes in the bottoms of the cans rather than accumulating in the cans.

This survey indicated that the garbage can plays an important part in producing

flies in a city, and close attention must be given to fly breeding in and around garbage cans.

Fly Breeding Sources in Urban Areas

To determine the various sources of fly breeding in urban areas and their relative importance, surveys of individual premises were begun in typical sections of Savannah. Only the surveys in the residential areas have been completed, but this information seems sufficiently conclusive to be presented separately. Additional work remains to be done in the downtown commercial district, industrial areas, and in spot surveys of feed stores, poultry establishments, abattoirs, privies and so on, to complete the overall survey.

Surveys for fly-breeding sources have been completed in typical residential and tenement residential sections of Savannah, with approximately 100 to 150 premises being surveyed in each area. Each housing unit or vacant lot was considered to be individual premises. Observations were made for such possible breeding sources as privies, dog feces, poultry or livestock feed and feces, small animal carcasses, garbage cans, soil around garbage cans, decaying vegetable material and sewage pollution.

Survey Results. Survey data indicate that the garbage can and dog stools are the principal neighborhood sources of fly breeding in the residential sections of the city proper. No other significant source of fly breeding has been found in typical urban residential areas. The flies being produced in the garbage cans and dog stools in the residential areas are undoubtedly augmented by migration from the city dump and possibly other outlying breeding sources such as privies, industrial areas, abattoirs, etc., the relative importance of which should be revealed in later survey work. In any event, however, dog stools and dirty garbage cans are factors to be considered in any municipal fly control program, as they are factors likely to be common to all cities.

Fly breeding was found occurring in more than one source on many premises, both dog stools and garbage cans frequently producing flies on the same premises. Fly breeding in dog stools is not by any means confined to the premises of dog owners. For example, of the 41 percent of the premises in the best residential area on which fly breeding in dog stools was observed, only 15 percent were premises of dog owners. The higher rate of fly breeding in garbage cans in the best residential area may be attributed to two possible factors — more soft garbage is placed in the cans, and the care of the can is often left to domestic servants who have little interest in the condition of the can. In average residential areas of Savannah, chickens and livestock, other than dogs, appear to be relatively unimportant as a source of fly production.

Veterinary Division

Rabies

The fourth quarter showed the greatest strides in rabies control activities ever carried out in the nation. Programs operating cooperatively with this Division were expanded in Arizona, Colorado, Indiana, and Michigan, in addition to the states already functioning. The latter include Florida, Georgia, New Jersey, New York, Ohio, Kansas, and Illinois. As soon as personnel is available, additional rabies activities will be inaugurated in Texas, South Carolina, West Virginia, and Iowa. Considerable assistance also was given by the Rabies Control Branch to local communities that were developing rabies eradication programs. The greatest number of rabies cases was reported in the midwestern states and Texas. The Division now receives regular reports from 36 states on animals infected by rabies.

Intensive rabies control programs in Memphis and Shelby County, Tennessee, which ended the first week of April, have shown very favorable results; 23,000 dogs were immunized during the program with the assistance of 17 local practicing veterinarians. The Memphis program was inaugurated and developed as the result of an emergency aid call to the Rabies Control Branch, in the face of one of the largest rabies epidemics in the country. The smoothness with which Dr. M. L. Graves, City-County Health Officer, and his staff developed the program was very impressive.

Brucellosis

The studies in Indiana have progressed to include different types of rural populations. Local physicians in Indiana were very cooperative in assisting the Indiana Department of Health and other agencies interested in this study. From preliminary information at hand, the epidemiology of brucellosis can be broken down into three patterns: (1) ingestion of infected foods of animal origin; (2) occupational disease on the farm and (3) occupational disease in animal handling industries. The 6,000 reported human cases of brucellosis in the United States were generally equally divided among these three patterns of infection.

Q Fever

Q fever investigations were assisted by the assignment of personnel to the Public Health Service Rocky Mountain Laboratory and the Q fever project in Southern California. The study team at Hamilton, Montana, was able to infect cattle for the first time and demonstrate clinical symptoms in the affected animals. These clinical symptoms included increased temperatures, swelling and inflammation of the udder, and systemic reactions. The symptoms were of short duration and disappeared within a period of 10 days. Continued observation of these animals indicated that an animal may become a carrier of the organism with no apparent symptoms. Other experiments demonstrated that calves could be infected by milk from infected cows. They were successful in infecting the two calves that were used, and recovered the organisms from the blood and feces.

Epidemic Aid

Dr. Martin Baum was detailed to the Columbia River Valley to assist state health departments in preventing the spread of disease during the emergency flood period. He was able to give assistance in regard to local meat processing problems, rabies and encephalitis control, and in disposal problems involving animals.

Training Division

Cooperation in North Carolina

As a result of negotiations by representatives of CDC, District Office 2, the North Carolina State Health Department and the School of Public Health at the University of North Carolina, the Training Division agreed to assign a sanitary engineer to North Carolina as soon as possible after July 1, 1948. He would join the field training unit at the School of Public Health. The unit operates in cooperation with the State Health Department to assist field training in North Carolina. In addition, in accordance with the Kellogg Foundation grant, it also will assist other southeastern states in inaugurating and conducting field work.

Proposed Denver Center

In conferences of CDC officials with City of Denver and University of Colorado officials, certain temporary buildings were offered by Dr. Darley, Dean of the Colorado Medical School, to house the proposed field training center at Denver, Colorado. The center would be situated on the medical school campus and would serve all states in

District 8 — Colorado, Montana, Utah, Idaho, and Wyoming.

Special Services Branch

On account of the rapidly increasing number of visitors from foreign countries coming to the Communicable Disease Center from the Rockefeller Foundation, the Institute of Inter-American Affairs, and the International Health Division, U. S. Public Health Service, it appeared desirable to establish a Special Services Branch. Preparations were made for this during May and June.

There was a large influx of foreign visitors to the Center during the quarter. At the close of the International Congress on Tropical Medicine in Washington in May, many of the distinguished visitors wished to see the facilities of the Center. Foundations and agencies in this country which plan fellowships and graduate training of selected personnel from other countries of the world have found CDC field training facilities to be helpful. All sent their fellows and representatives in large numbers.

Headquarters Activities

E. S. Tisdale, Division Chief, represented the U. S. Public Health Service and the American Public Health Association at the first Inter-American Congress of Sanitary Engineering in Santiago, Chile. He gave a paper dealing with field training programs in sanitary engineering which was illustrated with 30 lantern slides. Much interest was expressed in the methods used at our field training stations and in the audio-visual training aids which might be made available to the countries of Latin America.

Production Division

Films Distributed

Distribution of CDC films exceeded the 500-per-month mark in June.

A breakdown of actual distribution for the three months of the quarter shows distribution of 399 prints in April, 448 in May, and 503 in June — a total of 1,350 prints distributed during the quarter. Eighty percent of the motion pictures distributed to date have been on short loan periods, while distribution of film strips was for longer periods.

All CDC motion pictures relating to medical studies have been submitted to the American College of Surgeons for preview, evaluation and listing in their catalogue. Of 15 films previewed, 13 were approved for the American College of Surgeons' seal.

VD Films Under Way

Motion pictures and film strips in the Venereal Disease program are intended for showing to two general groups: the first group consisting of physicians, students of medicine, nurses and students of nursing; the second group consisting of Public Health personnel, including physicians, nurses, contact investigators, and technical personnel on the county, state, and Federal level.

In Group I, two color film strips are on the production agenda: "The Diagnosis of Primary Syphilis" (5-087.0) and "The Horizon of Syphilis" (5-086.0). The first picture deals with the important maxims of diagnosis in primary syphilis, and points out some of the errors made by practicing physicians. In addition, the techniques of darkfield examination are shown and great emphasis is placed on the importance of this type of examination as a diagnostic procedure in primary syphilis. The latter picture, "The Horizon of Syphilis," deals with the course syphilis takes when untreated, giving a broad perspective of the disease from its inception to later complications which involve the heart and nervous system.

In Group II, one black and white film strip on the agenda, "Venereal Disease and Tuberculosis Survey in Georgia" (5-121.0) has already been released. A documentary presentation of Georgia's case-finding program, this strip explains how these surveys are planned and organized and shows how results may be obtained.

International Congresses

Five exhibits were prepared by the Production Division for the Fourth International Congresses on Tropical Medicine and Malaria, for display in Washington May 10 to 19.

Exhibits dealing with CDC and TVA were on display in the lobby of the Departmental Auditorium for the entire conference, while scientific exhibits dealing with Engineering, Malariology, and Veterinary Medicine were displayed in the Hall of Nations, Washington Hotel. Gale C. Griswold, Chief of Production Division, supervised the motion picture showings.

PRODUCTIONS RELEASED

4-001.0 Reservoir Maintenance — Chapter V
4-034.0 Manson's Blood Fluke
4-057.0 Climbing Activities of Rats
4-070.0 Excystation and Motility of *Endamoeba histolytica*
4-073.0 The Production and Processing of Oysters
4-078.0 Sewage Treatment
5-015.0 Identification of U. S. Genera of Adult Female Mosquitoes
5-024.0 Pathology of Pulmonary Tuberculosis
5-097.0 The Identification of Some Common Rat Lice
5-098.0 The Production and Processing of Oysters
6-002.0 I.C.T.M.M. Exhibit for CDC in Departmental Auditorium (Requested by State Dept.)
6-002.1 I.C.T.M.M. Exhibit for TVA in Departmental Auditorium (Requested by State Dept.)
6-003.0 I.C.T.M.M. Exhibit for Engineers in Hall of Nations (Scientific)
6-003.1 I.C.T.M.M. Exhibit for Malariologists in Hall of Nations (Scientific)
6-003.2 I.C.T.M.M. Exhibit for Veterinarians in Hall of Nations (Scientific)
6-005.0 Laboratory Diagnosis of Pulmonary Diseases (for T. B. Lab.)
10-005.1 Cancer Series — The Visiting Nurse and Cancer (Series B — May 5, 1948)
10-005.2 Cancer Series — The Visiting Nurse and Cancer (Series B — June 5, 1948)
10-009.1 Cancer Series — Techniques of Cancer Nursing (Series C — May 5, 1948)
10-009.2 Cancer Series — Techniques of Cancer Nursing (Series C — June 5, 1948)

PROJECTS RELEASED:

1-002.0 Two 8x10 Lice Enlargements Ordered 3-9-48 by Entomology Divn. for Ectoparasite Atlas
1-003.0 Photographs 8x10 for National Institute of Vital Statistics, Nursing Divn.
1-004.0 Identification Photographs of Students, T. B. Laboratory
1-005.0 Systemic Fungus Diseases from Histologic Sections
1-006.0 Photographs 5x7 of "Scotch Tape" Use in Obtaining Pinworm Specimens
1-007.0 Photographs 8x10 of Culture Tubes
1-008.0 Photographs 8x10 of Negatives for Ross Institute of Tropical Hygiene, London
1-010.0 Shellfish Sanitation Flat Pictures Series
3-001.0 Two Pin-Maps Ordered by Engineering Divn. 6-11-48
8-007.0 Photographs for Publication in Fourth I.C.T.M.M.
9-005.0 Maps of Malaria Incidence and CDC Spray Operations for 1948
10-006.0 Teaching Slides for Clinical Microscopy
10-007.0 Maps of Malaria Incidence and CDC Spray Operations for 1948
10-010.0 Systemic Fungus Diseases from Histologic Sections
10-011.0 Six Organizational Charts for T. B. Evaluation Laboratory
10-012.0 Mycology Training Course Slides of Textbook & Journal Photographs, Graphs & Figures.
11-002.0 Photography for Technical Development Divn. in Savannah
11-003.0 Photography for National Institute of Vital Statistics, Nursing Divn.
11-004.0 Negative from Safe Water Storyboards for USPHS Reports Section, Washington
11-005.0 Malaria Posters for Operational Field Program, for Engineering Divn.

PRODUCTIONS IN PROGRESS:

4-043.0 Life Cycle of the Fish Tapeworm
4-046.0 McGehee Bayou
4-047.0 Hand Ditching in South Carolina
4-049.0 Epidemiology of Murine Typhus

4-050.0 Typhus Complement Fixation
4-069.1 Malaria Control in the Kentucky Reservoir
4-072.0 Life Cycle of the Hookworm
4-076.0 Epidemiology of Brucellosis
4-077.0 Use of Airplanes for Mosquito Control—General Principles
5-014.0 Health Agencies of the United States
5-023.0 The Liver in Schistosomiasis Mansoni
5-048.0 The Biological Basis of Human Malaria
5-052.0 Identification of Malaria Parasites in the Thick Blood Film
5-061.0 Identification of Anopheline Larvae
5-070.0 Normal Arteries and Veins
5-077.0 The Identification of Some Common Rat Mites
5-079.0 Fundamentals of Detergents
5-086.0 Syphilis Horizon Chart
5-087.0 The Lesions of Primary Syphilis
5-092.0 Aquatic Plants Associated with Anopheles Mosquito Breeding Areas
5-102.0 Foot & Mouth Disease — USPHS Significance
5-103.0 Brucellosis as an Occupational Disease in Industry
5-104.0 Brucellosis as an Occupational Disease on the Farm
5-106.1 The Liver: Second Edition
5-109.0 Federal Public Health Organization 1948
5-112.0 The Communicable Disease Center, USPHS
5-121.0 VD — TB Survey
8-001.0 Year Book of CDC for Library & Reports Division
8-008.0 CDC Film Catalogue
9-003.0 Sanitary Well Construction
9-004.0 Description of Standard Chlorinators
9-007.0 Essential Elements in a Water Purification Plant
9-008.0 Auxiliary Treatment of Water
9-009.0 Sanitary Analysis of Water
9-014.0 Microscopy of Drinking Water
10-013.0 Cancer Series D — 116 Nursing Slides

PROJECTS IN PROGRESS:

1-009.0 Photographs 8x10 for Laboratory Division
8-009.0 Rat-Borne Disease Prevention and Control Manual Photographs for Training Division
8-011.0 Line Drawings of 16 Photographs Ordered by Laboratory Divn.
9-015.0 Slides of Mites, Fleas, Lice & Ticks for Training Divn.
11-001.0 Assembling of "Pinworm" film for N.I.H.
11-006.0 Glossy Prints of V.D. Activities

Library and Reports Division

EDITORIAL BRANCH

Orientation Manual. Duplication and distribution of this manual was made during the quarter. Manual is entitled "...for the Nation's Health."

Annual Report. Copy for this report was sent to the printer. Distribution will be made at an early date.

LIBRARY BRANCH

During the quarter work continued on the catalogue for the Library of the Technical Development Division, Savannah, Georgia.

Periodicals have been checked against holding cards, and a simpler system for routing periodicals has been devised in order to expedite distribution. A Kardex file is being compiled to facilitate cataloguing of periodicals. The first allotment of the Medical Library Association duplicate exchange material has been distributed.

The following is a list of current books recently added to the library:

Advances in Enzymology and Related Subjects, Volumes 1-3, 5-8, 1941-1948.
American Council on Education — American Universities and Colleges, 5th ed., ed. by A. J. Brumbaugh, 1948.
Beckman, Harry — Treatment in General Practice, 1948.
Bodansky, Meyer — Biochemistry of Disease, 1947.
Castiglioni, Arturo — A History of Medicine, 1947.
Cecil, R. L. — Textbook of Medicine, 1948.
The Chemotherapy of Filariasis, New York Academy of Sciences. Annals, v. 50, art. 2, p. 19-170, 1948.
Churchman, Charles West — The Theory of Experimental Inference, 1948.
Clark, William Mansfield — Tropics in Physical Chemistry, 1948.
Cold Spring Harbor, N. Y. Biological Laboratory. Symposia on Quantitative Biology. v. 12 Nucleic Acids and Nucleo-Proteins. 1948.
Darrow, Karl Kelchner — Atomic Energy, 1948.
Dubois Albert — Diseases of the Warm Climates, 1948.

Fisher, Ronald Aylmer — Statistical Methods for Research Workers, 1948.
Francis, John — Bovine Tuberculosis, 1947.
Gould, Adrian Gordon — Careers in Public Health, 1947.
Harvey, William Clunie — Insect Pests, 1948.
Jaques, Harry Edwin — How to Know the Insects, 1947.
Judy, William Lewis — Handy Dog Booklets, 1946-48.
Kracauer, Siegfried — From Caligari to Hitler, 1947.
Lesnik, Milton Jack — Legal Aspects of Nursing, 1947.
Low, Robert Cranston — Atlas of Bacteriology, 1947.
Modern Plastics Encyclopedia, 1948 ed.
National Tuberculosis Association. Transactions, 1947.
Phelps, Earle Bernard — Public Health Engineering, v. 1, 1948.
Public Administration Service — Public Administration Organization, A Directory, 6th ed., 1948.
Rippel-Baldes, August — Grundriss der Mikrobiologie, 1947.
Rivers, Thomas Milton — Viral and Rickettsial Infections in Man, 1948.
Savory, Theodore Horace — Latin and Greek for Biologists, 1946.
Shepard, William Peacey — Essentials of Public Health, 1948.
Snell, Foster Dee — Colorimetric Methods of Analysis, v. 1 Theory,... 1948.
Symposium on the Use of Isotopes in Biology and Medicine, 1948.
Tennessee Valley Authority. Health and Safety Department. Malaria Control Division — Significant developments in TVA's malaria control Program, 1948.
Theilheimer, William — Synthetic Methods of Organic Chemistry, v. 1, 1948.
Trelease, Sam Farlow — The Scientific Paper, 1947.
U. S. President's Scientific Research Board— Science and Public Policy, v. 1-5, 1947.
U. S. War and Navy Departments. Armed Forces Special Weapons Project. Joint Crossroads Committee, v. 1 — Radiological Defense...1948.
Vaughan, Warren Taylor — Practice of Allergy, 1948.
White, Benjamin Vroom — Diagnosis in Daily Practice, 1947.
Williams, Richard Tecwyn — Detoxication Mechanisms,-1947.
Wolf, Frederick Adolph — Fungi, a Manual of General and Systemic Mycology, 2 v. 1947.
Zinsser, Hans — Textbook of Bacteriology, 9th ed., 1948.

Administrative Division

Personnel Branch

CSC Approval. Approval was secured from the Civil Service Commission in Washington for an amendment to Schedule A of the Civil Service regulations. This provision makes it possible for CDC to employ Sub-professional and Crafts-Protective-Custodial personnel for a period not to exceed 150 days in a calendar year. This provision is part of the overall objective of the Branch to provide permanent status on the basis of high standards for permanent CDC personnel, and make it possible to employ persons not meeting these standards when operational exigencies require.

During the quarter, 548 interviews were conducted with applicants seeking employment with the Communicable Disease Center. Recruitment was conducted which resulted in 49 temporary and 11 competitive appointments processed for Headquarters. Seventy-two applicants acceptable to operating officials were recruited, with positions being committed to them. The following shows length of time required to find these applicants: 44 percent committed same day request received, 76 percent committed same week request received; only eight requests required over two weeks to fill.

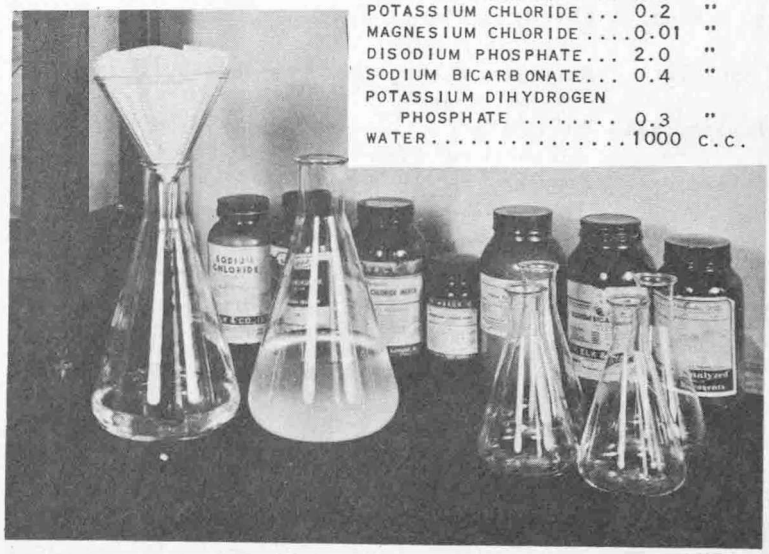
The July-August-September CDC Bulletin inadvertently listed Dr. Karl Friederich Meyer's name as Kenneth F. Meyer, on the article "Streptomycin in Experimental Plague." Dr. Meyer, who presented the paper December 2, 1947, before the 43rd Annual Meeting of the American Society of Tropical Medicine at the Biltmore Hotel, Atlanta, is coauthor with Stuart F. Quan, Lucile E. Foster, and Adelien Larson. All are of the George Williams Hooper Foundation, University of California, San Francisco. The Bulletin regrets the mistake, is glad to make a correction.

● THE PREPARATION OF MODIFIED BOECK AND DRBOHLAV'S MEDIUM

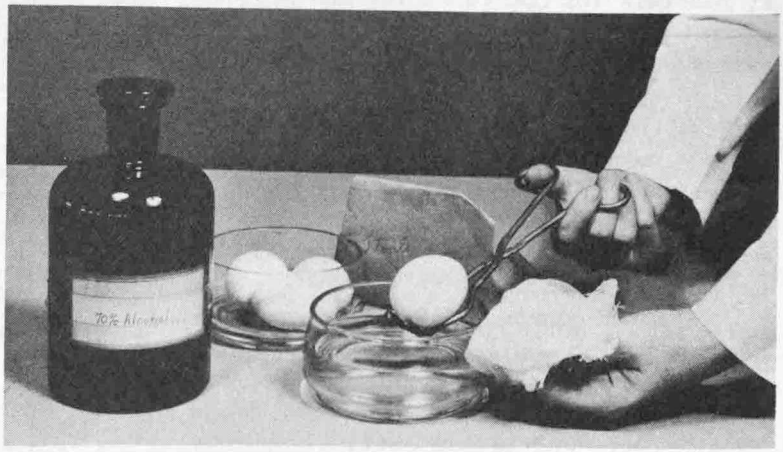
1

LOCKE'S SOLUTION

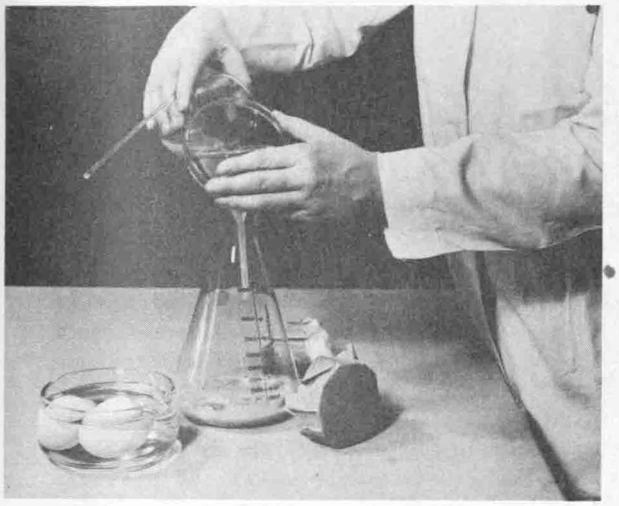
SODIUM CHLORIDE	8.0	GRAMS
CALCIUM CHLORIDE	0.2	"
POTASSIUM CHLORIDE	0.2	"
MAGNESIUM CHLORIDE	0.01	"
DISODIUM PHOSPHATE	2.0	"
SODIUM BICARBONATE	0.4	"
POTASSIUM DIHYDROGEN PHOSPHATE	0.3	"
WATER	1000	c.c.



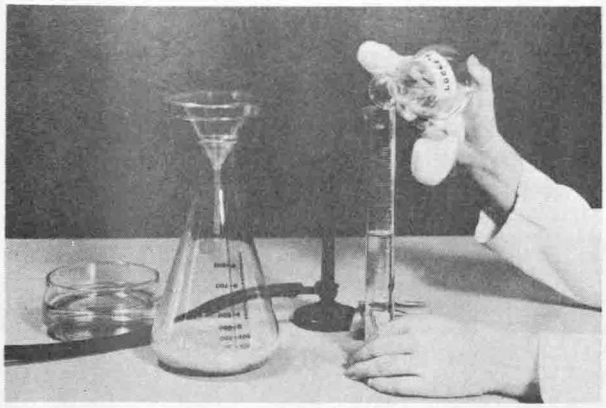
Modified Locke's solution is prepared according to the formula shown in photograph. The chemicals are added to the water in the order given, then heated to 100° C (Arnold.) for 20 minutes to precipitate. After cooling to room temperature and filtering through paper, it is dispersed in about 100cc. amounts in small Erlenmeyer flasks, plugged, and sterilized in the autoclave at 121.6°C. for 15 minutes.



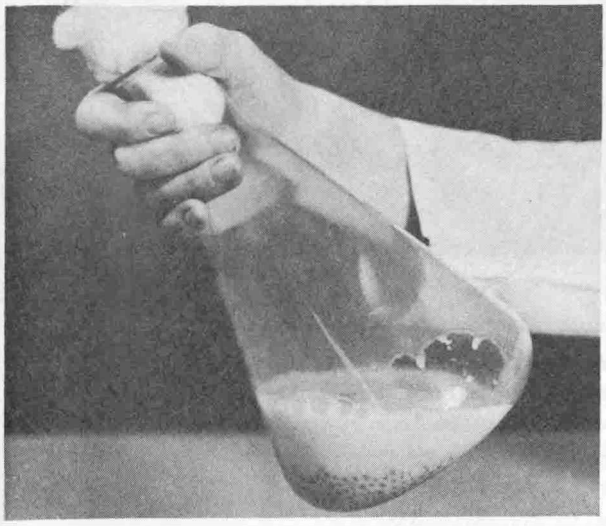
2 Fresh eggs are washed with soap and water and rinsed in 70 percent alcohol.



3 They are broken carefully into a beaker and transferred to a flask containing beads. Four eggs measure about 180 cc.



4 Locke's solution is added to the eggs in the proportion of 50 cc. of Locke's to 180 cc. of whole egg.



5 The flask is shaken to emulsify.

6 The mixture is filtered through gauze into a dispenser. This removes all unmixed egg white.

7 It is then dispersed into tubes in the amount necessary to make a slant of about 1½ inches (4-5 cc.).

8

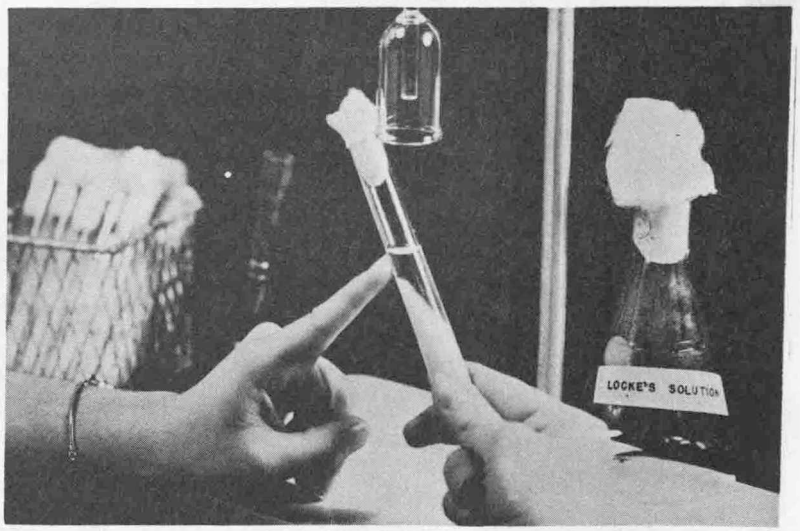
INSPISSATION OF MEDIUM

The tubes are placed in the chamber of the autoclave in the desired slanting position. Wooden boxes of swamp cypress (or any wood which does not warp easily in live steam) help to maintain an even temperature during inspissation. To inspissate in an autoclave without a jacket, close all exhaust valves and allow the steam to enter as fast as possible until the pressure of the trapped air and steam in the chamber registers 15 pounds. Hold at this pressure for 15 minutes. Cut off steam supply and allow pressure to drop gradually, keeping all outlets tightly closed to prevent bubbling.

9

ADDITION OF THE OVERLAY AND STERILIZATION OF THE MEDIUM

When the inspissated slants are cold, cover to a depth of 1 cm. with sterile Locke's solution. The medium is then sterilized in the autoclave at 121.6°C. (15 lbs.) for 15 minutes. The pressure is allowed to drop gradually. The medium is tested for sterility by incubating at 37°C. for 24 hours. Each tube is then examined grossly for bacterial growth. The sterile medium is stored in the refrigerator until needed.



A continuation of this discussion "Inoculation of Boeck and Drbohlav's Medium" will appear in the January-February-March issue of the CDC Bulletin.

Special Projects . . .

SOME POSSIBLE CAUSES OF COMPLAINTS ON THE DECLINE IN EFFECTIVENESS OF D D T RESIDUAL SPRAYING IN 1947

From the Technical Development Division
Communicable Disease Center, Savannah, Georgia

Beginning late in 1946, and with increasing frequency during 1947, reports have been received from both foreign and domestic sources indicating that the more recent applications of DDT residual sprays have not been as effective against flies as those applied in 1945 or 1946. Some of the possible causes of these complaints are discussed below. Most of the complaints are undoubtedly attributable to a combination of several of these possible causes, the various individual causes alternating as the principal one under the variety of circumstances involved in each case. Since practically every complaint was based on the alleged failure to control house flies, the following discussions deal principally with that insect.

Attempted Substitution of DDT for Sanitation

1 The extravagent claims which characterized much of the wartime publicity which DDT received before its availability for general use, and its remarkable effectiveness, have led some to depend upon residual spraying to control fly breeding without maintaining proper premise sanitation. This tendency has been encouraged by the failure of many publications on the use of DDT to stress the need for continuing good sanitation. At dairies, food processing plants, and on farms, where an abundance of fly breeding material occurs, DDT cannot be used as a substitute for good sanitation. Field tests conducted in the Technical Development Division have repeatedly shown that DDT treatments which are effective in the presence of adequate sanitation, fail to give effective control in the presence of poor sanitation which permits the buildup of fly populations so great that the available DDT-treated surfaces cannot satisfactorily control them. Such a change may occur quickly in hot weather when fly breeding is very rapid. Many people whose former fly problem was eliminated by the initial applications of DDT combined with the sanitation which they then practiced, have made possible the return of their fly problems by becoming lax in their sanitation practices. In the absence

of proper education and guidance from trained personnel, such people tend to blame the return of their fly problem on the failure of DDT. A vigorous educational program should practically eliminate this cause of complaint.

Difference in Fly Population Trends from Year to Year

(2) The surfaces on which house flies tend to rest indoors differ greatly from those on which mosquitoes typically rest. The present house spraying program is designed to treat mosquito resting surfaces. House flies tend to rest on tables, floors, and furniture, especially if food is present, and these places are seldom treated. Consequently a considerable length of time may elapse before house flies in a home receive a toxic dose of DDT. Furthermore, flies which have been irritated by contact with DDT attempt to leave the house, and will do so if possible, so that the lack of dead flies and the presence of live ones are not always conclusive evidence that the DDT is not effective. Checks made in the house early in the morning, however, should give some indication of the effectiveness of the treatment in killing flies which entered the house during the latter part of the previous day.

The present house spraying program also limits treatments to the houses only, leaving untreated the outbuildings where treatment would give the best results for fly control.

Popular Misconception as to what Spray Treatments should be Expected to Accomplish

(3) Most of the complaints are based on the numbers of house flies observed. Some complain because roaches are seen walking across treated walls without dropping off. Others complain of the failure of the DDT to kill mice, dog flies that bite them on porches or outdoors, and other insects around porch lights.

Complaints of this type are a clear indication of the need for a strong educational program to acquaint the public with the objectives of the control program.

Present Malaria Control Spraying Procedures are not Designed for Fly Control

(4) Some complaints were made on the basis that there was no difference noted in the fly population before and after the first spraying in 1947. Due to the late cold winter in the southeast, the fly population was later in developing in 1947 than in previous years. In many cases there were no appreciable numbers of flies present immediately before or after the first spraying, so that it is not surprising that there was no detectable difference in the population. In 1946, house flies reached the peak of their population in southeastern Georgia in June, while in 1947 flies were relatively scarce in June and did not reach their population peak until late August and early September. These differences in population development might well account for

some of the variations in population comparisons at any given period of the two years.

Psychological Factor

5 The psychological reaction of the public toward the control program is probably the most important single factor involved in the complaints. Visits to homes from which complaints had originated have repeatedly indicated that householders who were formerly annoyed by the continual presence of hundreds of insects now consider a very few insects intolerable. The drastic reduction in the insect population brought about by the first treatment of DDT created such a favorable comparison that the few remaining insects were essentially ignored. The householder has become progressively more conscious and more critical of a lesser and lesser number of insects as the control program has continued in operation. A contributing factor has been the inclusion of the public in the financing of the control program. Where the residents are paying for the spraying service, they are inclined to demand perfection.

On several occasions, members of the Technical Development Division who visited some of the homes from which complaints had been received were greeted with a statement such as "Flies are worse now than ever, even before DDT spraying began." On making a survey of the premises, however, only two or three flies could be found on the porches, even in the presence of food for pets, and none could be found indoors. The presence of numerous fly specks showed, however, that a large fly population had been present prior to initiation of DDT spraying. In one instance, the complaining householder operated a community store and had apparently influenced others in the neighborhood, as the complaints were relatively uniform from several nearby homes, none of which were justified on the basis of the few flies observed at the time they were visited. In every instance where wall cage tests were made on the premises of complaining householders, the results indicated that effective DDT residues were still present at the time of the tests.

The fallacy of attempting to depend upon memory to accurately compare one season's insect population with that of another season has been repeatedly demonstrated. During field tests at dairies this year, some operators commented frequently that more flies were present on their premises this year than were observed last year, while recorded fly counts taken in the same manner by the same worker actually indicated that approximately the same fly population was present both years.

Although they were inclined to grumble about the fly population present, the greater majority of the people visited readily agreed that their present problem was quite small as compared to the period before the use of DDT, and

expressed the hope that the control program would be continued.

Use of Old or Non-Standard Spray Material

6 Many of the complaints, from both foreign and domestic sources, are traceable to the use of old DDT concentrates purchased from the War Assets Administration or other non-standard materials, such as DDT by-product. Analysis of some of these products indicated that the amount of DDT which they contained varied greatly and some of the War Assets concentrate contained 20 percent emulsifier.

Chemical analysis of two drums of standard 35 percent DDT concentrate purchased in the summer of 1946 and stored over winter, indicated that the DDT content after a little over one year of storage was only 28-30 percent. Another drum of 35 percent DDT concentrate, which originally contained 10 percent Tween 80 emulsifier, 3.5 percent Thanite, 46.5 xylene, 5 percent Iso-propane and 35 percent DDT, and which was stored under similar conditions, was found to contain only 23 percent DDT; the odor of the concentrate was very disagreeable; it was a dark-orange color and formed an emulsion which was stable for only about five minutes.

Biological tests with technical DDT and 90 percent DDT water wettable powder stored for over a year under dry, protected conditions gave slightly less effective results than new material.

These facts, meager though they are, indicate the undesirability of using old and non-standard materials. Care should be taken to avoid the procurement of excessive quantities of DDT, particularly in the liquid state, and the consequent long-term storage which that involves.

Treatment of New Surfaces May be More Effective than Treatment of Previously Treated Surfaces

7 When the first complaints began to be received, indicating that retreatments may not be as effective as an original treatment, laboratory and field tests were begun at Savannah to evaluate the effectiveness of the two types of treatments. Both types of tests indicate that the first retreatment gives slightly less effective results against *Anopheles quadrimaculatus* mosquitoes than does the original treatment of new surfaces. Field tests failed to show any difference against house flies, however, the insect with which most of the complaints were concerned. The field tests also indicated that a retreatment three months following the original treatment gave better results against *Anopheles quadrimaculatus* during the fourth, fifth, and sixth months of the test period than did a single treatment applied at the beginning of the test period. It is believed that the difference between an original treatment and a single retreatment is so slight that it could not be detected by gross observations. Research work to test the

effects of additional retreatments is under way in the Technical Development Division.

Possible Inherited Resistance of Flies

8 In those areas where the control program has been in operation for two or three years, it is possible that there may have been a buildup in population of a strain of flies which are resistant to DDT. Such a resistance phenomenon has been observed with other insects and insecticides in the past. The Orlando, Florida, laboratory of the Bureau of Entomology and Plant Quarantine has had some success in developing in the laboratory a strain of house flies that show some resistance to DDT.* The conditions under which this resistant strain has been developed was by repeated exposure to a space spray, whereas on the extended program operations a residual deposit is used. Thus the applicability of the results to field conditions is not known. At the present time, with the limited data on this phenomenon, apparent failures in DDT residual treatment should not be attributed to resistant strains of insects. Work on this problem is being continued and it will probably require several years to evaluate fully the importance of this factor in the future use of DDT. The Technical Development Division is investigating the possible inherited resistance of *Anopheles quadrimaculatus* to this insecticide.

Variations in Dosage Applied

9 Since the inauguration of the extended program there has been a gradual tendency for some States to modify the recommended application dosages of 200 mg. of DDT per sq. ft. of treated area. This has resulted in some States using a single application of 300 mg. per sq. ft., some are using two treatments of 100 mg. per sq. ft., and some are continuing the recommended program of two treatments per season at the rate of 200 mg. per sq. ft. These variations undoubtedly produce variable results. Investigations are under way at Savannah to develop information as to the optimum dosage for repeated applications, and data on this problem will be released as rapidly as possible.

Attitude of Spray Crews

10 Some evidence was noted that the approach and attitude of some spray crews were conducive to the development of a feeling among residents that the spray program was not what it should be. Instances were encountered in which the crew belittled the first treatment, in which the War Assets material had been used, in an effort to "sell" the second

* Wilson, H. G. and Gahan, J. B.; DDT-Resistant Houseflies and Their Comparative Resistance to Other Insecticidal Sprays. Paper presented before the American Society of Tropical Medicine in Atlanta, Georgia, December 4, 1947.

treatment. Several residents reported that they didn't believe the spray crews themselves thought much of the treatment from the indifferent way in which they went about applying it. In a few cases, evidence of poor spraying was noted by the presence of "hour-glass" marks on the walls with untreated spots present. Householders occasionally based their complaints on the short time spent by the crew in treating their homes.

Administrative Attitude Toward Spray Program

11 In some instances, those responsible for the administration of the spray program have possibly contributed to the development of some of the points mentioned in the previous paragraph, by stressing too strongly the quantity production of the spray crew rather than quality. Good administration must, of necessity, continually strive to reduce costs by improving operating speed and techniques. However, placing too much emplasis on the amount of work produced without due regard to the quality as well, will soon result in hasty, and consequently poorer, work by the crews. This point should be given very careful consideration in future planning in those areas where only one treatment is to be applied each year.

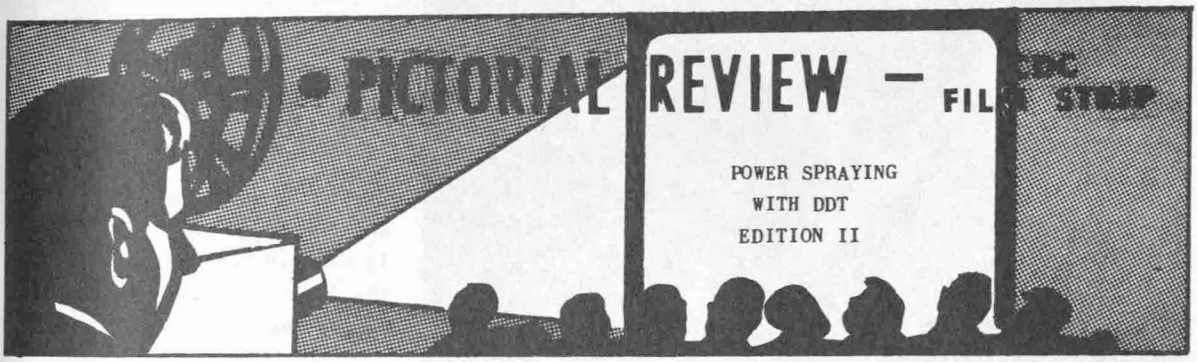
CONCLUSIONS

Several general conclusions may be drawn from study of the above comments. The first and perhaps most important conclusion is that a vigorous educational program is needed to acquaint the public with the objectives and limitations of the control program, how DDT kills insects, and the part each resident must play in maintaining good sanitation in order to derive maximum benefits from the control work. Such an educational program would help correct much of the popular misconception regarding DDT and the extended program, and should tend to counteract the presently important psychological factor resulting from the reduction in the residents' tolerance to flies.

Some of the possible causes of complaint can be eliminated by careful planning and procurement of supplies to avoid long-term storage of materials and the use of questionable materials.

Spray crew personnel should be "sold" on the program in order that they can properly present it to the public. Equal importance should be given to the quality of their work as well as quantity.

The proper evaluation on the importance of some of the possible causes of complaints must await further investigational work which is being conducted as rapidly as possible, data on which will be released as soon as it becomes available.



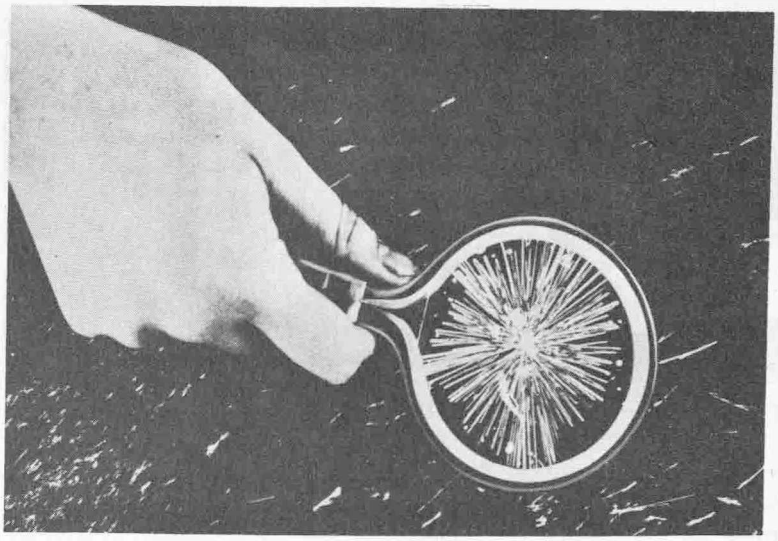
PRODUCTION NO. 5-002.1
35mm SOUND FILM STRIP
PHOTOGRAPHY: COLOR

RUNNING TIME: 14 MINUTES
LENGTH: 95 FRAMES
RELEASED: 1945

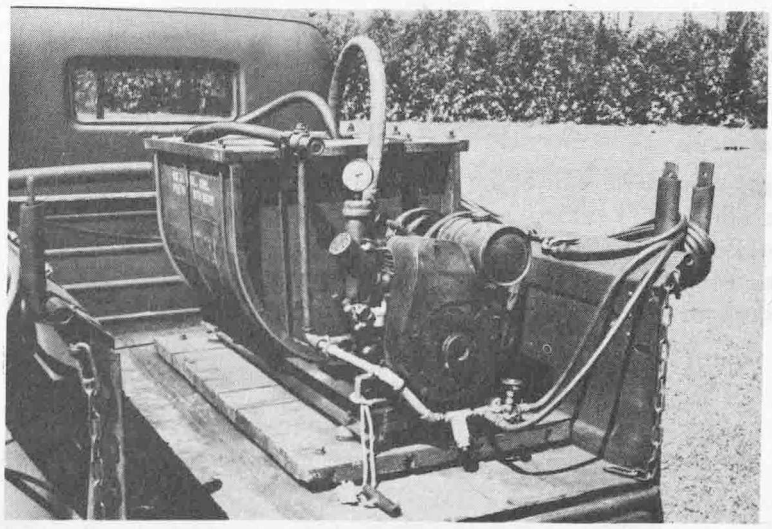
This 95 frame sound film strip in full color portrays the use of power sprayers for residual spraying with DDT. It affords an efficient means for instructing public health malaria control field personnel in methods of power spraying.

The film depicts equipment parts and how they function, lubricating the sprayer, testing equipment with water, filling with emulsion, loading truck, spraying operation, reloading truck, cleaning of equipment and preparation for the next operation.

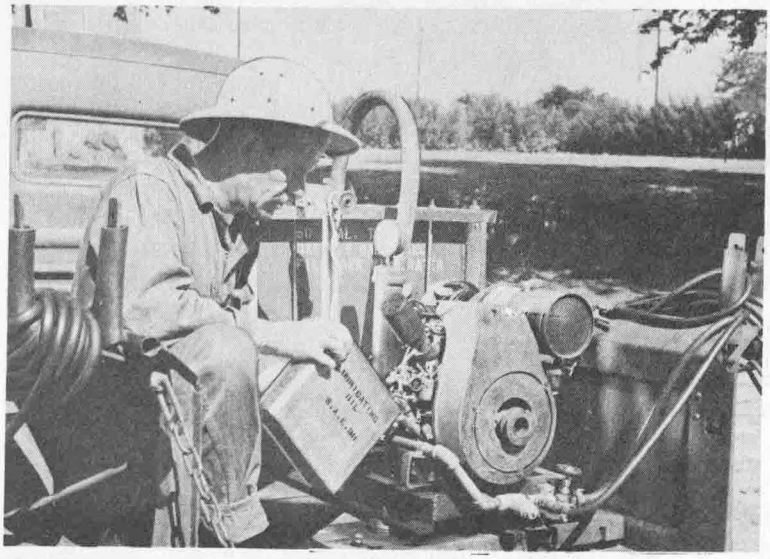
1. An effective means of destroying the adult mosquitoes which may rest within buildings is by the use of DDT as a residual spray.



2. Correct spraying leaves thousands of tiny DDT crystals evenly distributed on surfaces when the liquid portion of the spray evaporates.

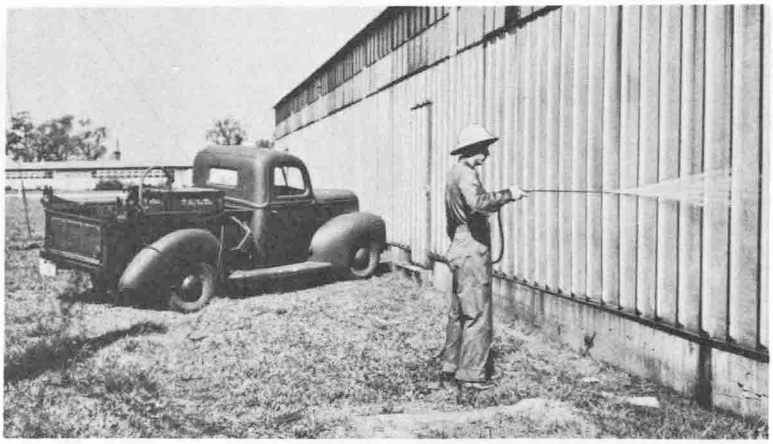


3. A power spraying unit may consist of a small engine, a pump, a 50 or 100 gallon tank, two connecting hoses and spray guns with valves, wands and nozzles.

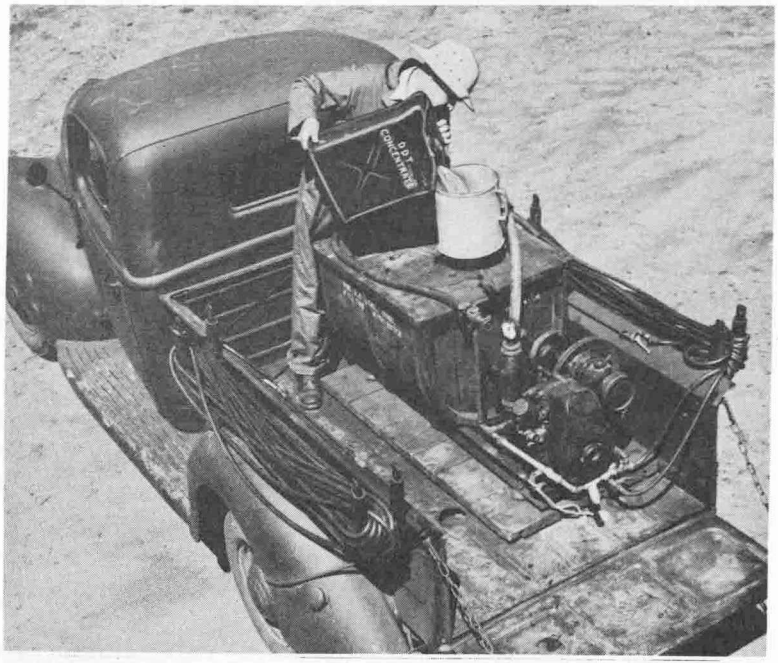


4. Proper lubrication of the engine is essential to efficient operation.

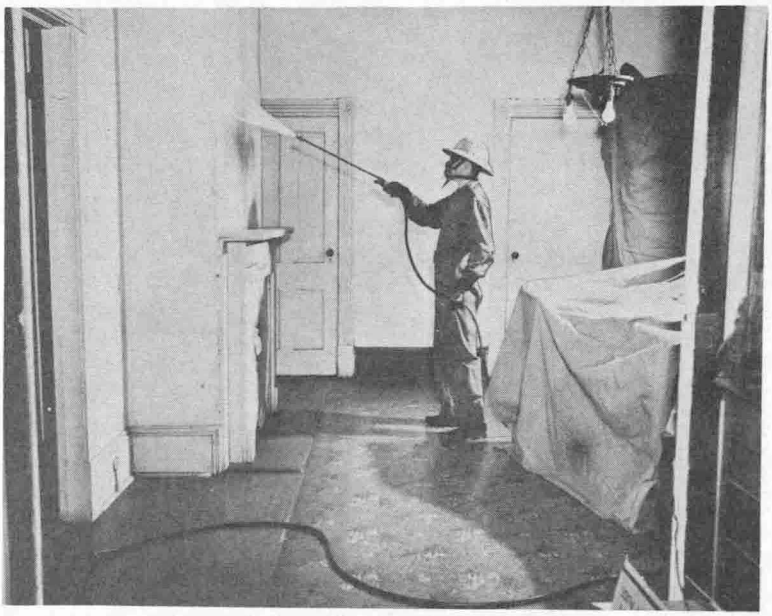
5. The sprayer is first tested with only water in the tank. Crew members practice until they learn to cover 230 sq. ft. of surface per minute.



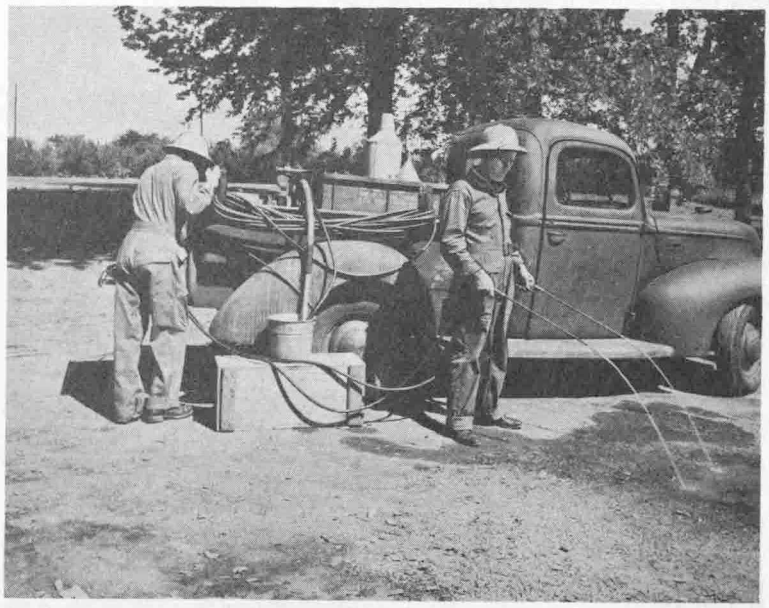
6. After testing with water the tank is filled with spray emulsion made by mixing 3½ gallons of DDT concentrate with 45½ gallons of water.



7. Where two small houses are close together, the truck may be parked between them and both houses sprayed simultaneously.



8. Spraying is started in the room farthest from the truck to avoid pulling the hose after spraying begins. When entering a room to be sprayed the operator goes completely around the furniture in the center of the room and begins spraying next to the door.



9. When spraying is finished for the day, the pump, hoses, and spray guns are flushed out with clean water.

To obtain this film address request to:

Production Division
Utilization Branch
605 Volunteer Building
Atlanta, Georgia

CHEMICAL INSECT ATTRACTANTS AND REPELLENTS by Vincent G. Dethier;* The Blakiston Company; Philadelphia; 1947-289 pages; $5.00.

A better understanding of chemical, physical, physiological, and botanical features involved in the study of attractants and repellents is offered by this book. It seeks to improve the assembly, interpretation, and evaluation of scattered works in terms of this background. It is not a compilation of recipes. It is not a manual on insect control or a comprehensive treatment of chemoreception. It is an insight into specific chemoreception as a unit of behavior. Chemistry is stressed. Practical procedures and ideas for future investigation may be found in this book.

The author states:

> "It is my conviction that more lively interest in attractants and repellents will lead to a more thorough understanding of insect behavior and ecology and in certain cases to a fuller understanding of the evolution of certain habits and behavior patterns. Answers to some of the puzzles of host-parasite relationships, food plant preferences, and physiological races are also bound up in this study. New vistas may be opened also in the field of sensory physiology, especially as it relates to quantitative evaluation of sense organs."

The book contains 10 chapters. Such topics as the nature of chemical attractants, essential oils, resins, and related substances, fermentation products, and protein and fat decomposition products are treated. Chapters on baits and traps, repellents, evolution of feeding preferences

VINCENT G. DETHIER

and on the chemical basis of taste and olfaction are also included.

In the chapter "Olfactometers and Threshold concentrations," Dethier suggests that the term, "olfactometer" be retained in speaking of apparatus designed to measure an organism's response to odors. His suggestion is made because of the convenience arising from its early origin and widespread common usage. He points out that this term, along with "chemotropometer" and "odorometer," is incorrect; it does not measure odors in the sense that a ther-

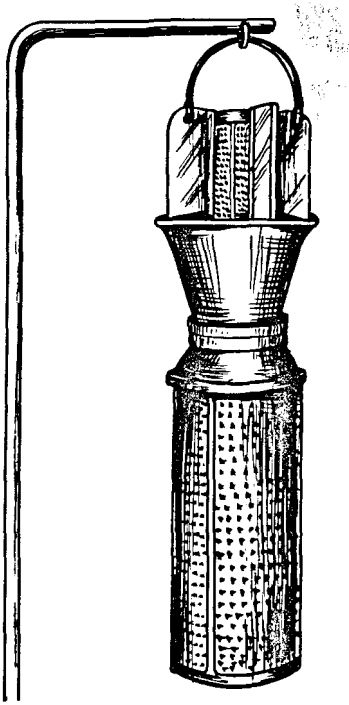
*Now Associate Professor of Biology, Johns Hopkins University.

mometer measures temperature. Dethier states that a means of observing the character of an organism's response to odors of known concentration is badly needed. He traces the history of research in olfactometers from Zwaardemaker's early apparatus to the olfactometers of recent design. Thirteen drawings of olfactometers are included. The literature on threshold concentrations is reviewed. Methods of determining true threshold values by conditioned reflexes and by detection of nerve action currents are discussed.

The author states that although plant odor is the result of a mixture of minute quantities of chemicals, there is usually one chemical fundamentally responsible for the odor. Plants are recognized by the feeding stages of insects through the agency of odors. The author also states that when dealing with attracting chemicals in pure form, preferences of larvae become quite obvious. Some may be conditioned to more than one odor. The olfactory sense in these larvae seems to be capable of discriminating among closely related odors. In this respect, the human sense of smell is simulated. Failure of plant distillates to act as anticipated in attracting larvae arises from lack of proper adjustment of concentration. Failure of an insect to respond to a distillate is no indication that the distillate does not contain attractive compounds.

In the chapter on fermentation products, it is shown that insects attracted by such products are not rigidly specific in their feeding habits. There is some degree of specificity, however, because some species are attracted in greated numbers than others. Also, among compounds available in a fermenting mixture, certain ones in pure form are more attractive to some insects than to others. Factors other than chemical ones greatly influence feeding habits of an insect (sunlight, humidity, wooded areas, etc.). Hence, the relative abundance of species at baits does not represent true ratios.

The voluminous work directed toward solving the problem of host selection by *Culex* has produced meager results. *Culex* ignore perspiration and fresh blood but will attempt to pierce an artificial object heated to 98.0° F. *Diptera* are attracted by perspiration and other host odors. No complete explanation of the factors guiding mosquitoes to blood meals is presented. Visual factors, temperature, or odors acting independently (or in combination) play a part, however. A temperature-humidity factor is probably the principal attractant. Carbon dioxide as an attractant, still the subject of controversy, is discussed. The trend in the evolution of attractants is from natural to synthetic substances. Since a bait must compete with nature it should provide a more powerful stimulus.



One type of Japanese beetle trap showing the perforated cylinder, which contains the attractant, at the center of the baffles.

Dethier emphasizes in his final chapter that the reason some larvae are restricted to plants of a certain family or genus is due almost entirely to the chemical nature of the plants concerned. Chemicals are restricted to a particular plant family or genus. This, coupled with the fact that insects are attracted to chemicals (actually not to plants) does much to explain the so-called "botanical instinct."

A discussion and numerous valuable references are given after each chapter.