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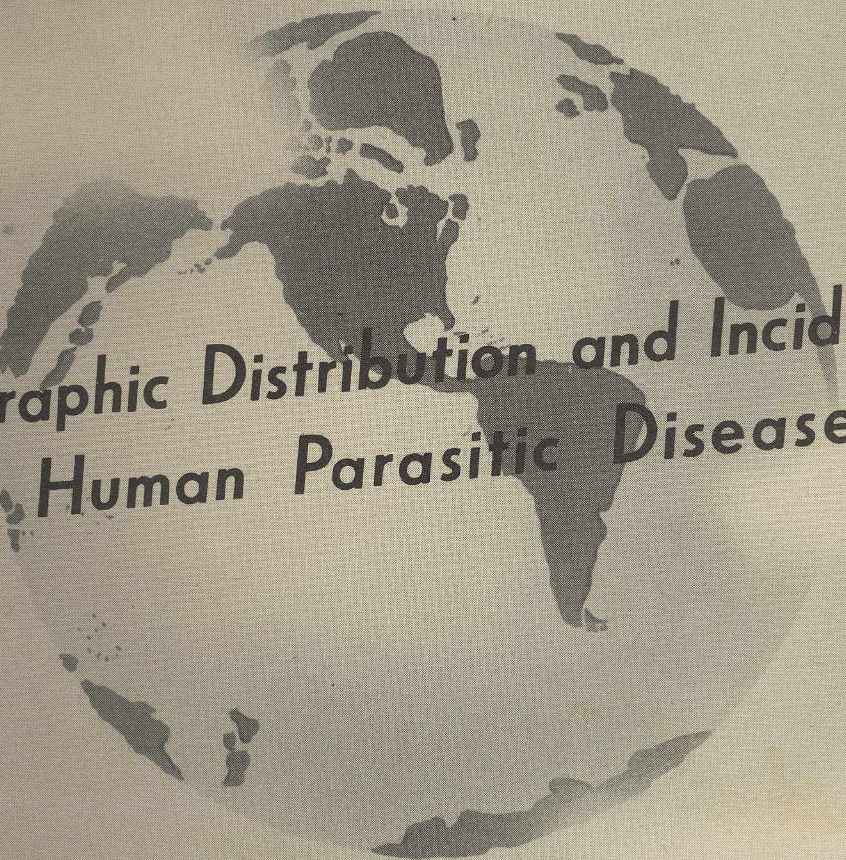
Oct., Nov., Dec., 1947



Geographic Distribution and Incidence of Human Parasitic Diseases

FEDERAL SECURITY AGENCY
U. S. PUBLIC HEALTH SERVICE
COMMUNICABLE DISEASE CENTER
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Geographic Distribution and Incidence of Human Parasitic Diseases

by Ernest Carroll Faust*

The recent world conflict intensified interest in all diseases, particularly those produced by parasitic organisms. Global operations necessitated that disease be examined on a world-wide scale. Parasitic infections are necessarily studied in relation to geography or climatology. Figure 1 shows the different climatic areas of the world. The principal warm regions are the Tropics, Subtropics, which includes a considerable part of the United States, and Temperate Zones. Some parasitic organisms are found practically throughout the world. More frequently the parasitic burden is greater in warm climates. In some instances, as in Africa and the eastern part of India, certain customs, habits, and religious practices of the people combine with climate and environmental conditions to create hyperendemic occurrence of certain animal parasite infection. A few parasite diseases are more common in temperate than in tropical areas.

This discussion of animal parasite diseases is arranged in accordance with the zoological classification of the causative organism. Table I indicates the taxonomic position of species considered here.

PHYLUM PROTOZOA

CLASS RHIZOPODA

Endamoeba histolytica, the etiological agent of amebiasis, is found throughout the world but is most prevalent in the Tropics and Subtropics. It has been found to occur significantly from the Strait of Magellan, into the northern part of Argentina, in Uraguay, the southern part of Brazil, Paraguay, and in the southern part of Peru. In these areas *Endamoeba histolytica* is not as important clinically as in the northern part of this continent where the disease is more severe, but is poorly surveyed, as indicated on the accompanying map (Figure 2, page 4). In general, amebiasis occurs from the Strait of Magellan to the Arctic Circle. A survey made in Saskatchewan a number of years ago indicated the presence of the parasite. Other workers have reported its existence in Sweden, Finland, the central and eastern parts of the USSR, South Africa, and southern Australia.

Col. Charles F. Craig estimated a number of years ago that 10% of the population of the United States was infected with *Endamoeba histolytica.* Without increasing this estimate, a safe assumption is that 300 million of the world's population have amebiasis and that at least 10% of this number are suffering from the disease at any one time. It is likely that a considerable proportion of the remaining 90% will, at some time in their lives, be attacked by amebic enteritis or possibly amebic liver abscess.

According to Colonel Craig's estimate of 10%, approximately 14.3 million people in the United States are hosts of *Endamoeba*

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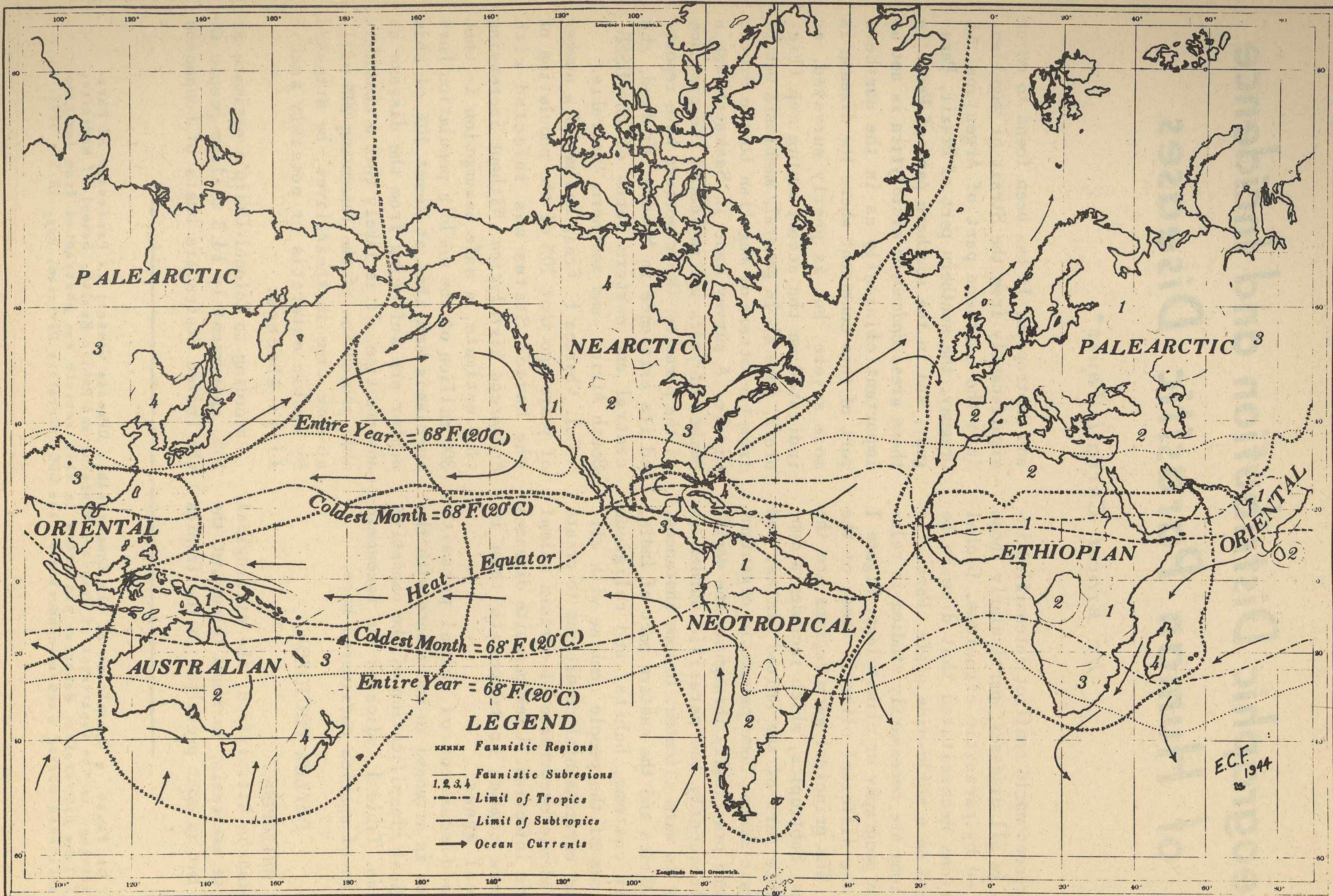


FIGURE 1. Climatic areas of the world. Equatorial isotherm, isothermic boundaries of the Tropics and Subtropics, principal ocean currents, and faunistic divisions are indicated.

Table I.

TAXONOMIC POSITION OF HUMAN PARASITIC ORGANISMS —ACTUAL OR POTENTIAL PATHOGENS

PHYLUM PROTOZOA

CLASS RHIZOPODA

Endamoeba histolytica

CLASS MASTIGOPHORA

Giardia lamblia
Chilomastix masnili
Trichomonas vaginalis
Leishmania donovani
Leishmania tropica
Leishmania brasiliensis
Trypanosoma gambiense
Trypanosoma rhodesiense
Trypanosoma cruzi

CLASS SPOROZOA

Isospora hominis
Plasmodium vivax
Plasmodium malariae
Plasmodium falciparum
Plasmodium ovale

CLASS CILIATA

Balantidium coli

PHYLUM NEMATODA

Trichinella spiralis
Trichocephalus trichiurus
Strongyloides stercoralis
Ancylostoma duodenale
Ancylostoma braziliense
Necator americanus
Trichostrangylus spp.
Enterobius vermicularis
Ascaris lumbricoides
Wuchereria bancrofti
Wuchereria malayi
Onchocerca volvulus
Loa loa
Dracunculus medinensis

PHYLUM PLATYHELMINTHES

CLASS TREMATODA

Schistosoma haematobium
Schistosoma mansoni
Schistosoma japonicum
Fasciola hepatica
Fasciolopsis buski
Clonorchis sinensis
Paragonimus westermani

CLASS CESTOIDEA

Diphyllobothrium latum
Sparganum spp.
Diphylidium caninum
Hymenolepis nana
Hymenolepis diminuta
Taenia saginata
Taenia solium
Echinococcus granulosus

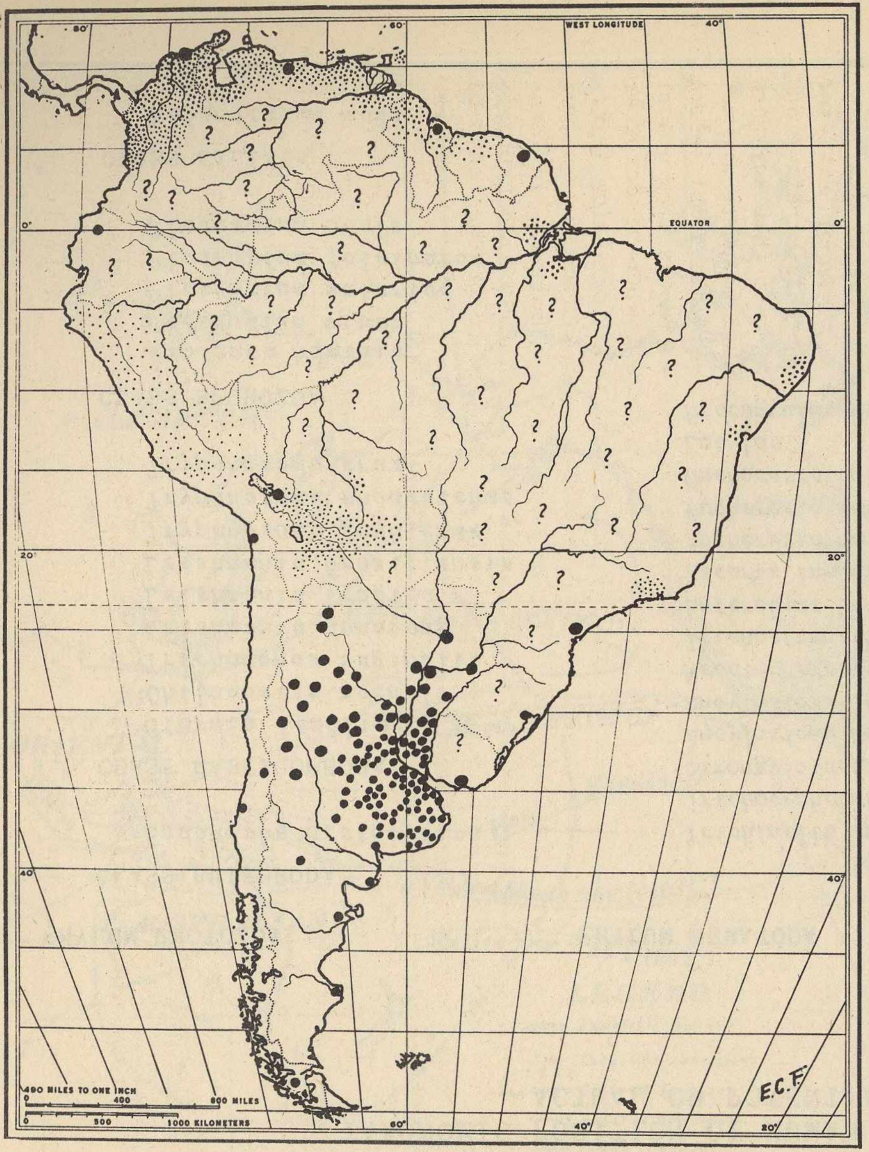


FIGURE 2.

FIGURE 3.

Location of amebiasis surveys and estimated incidence in South America (Fig. 2) and in North America (Fig. 3). Large dots indicate known presence of clinical amebiasis, with or without survey data; question marks indicate unknown status of amebiasis.

histolytica. Figure 3 (page 4) indicates by solid circles the foci or areas where surveys have been made in this country, and by fine dots the estimated prevalence in North America. Although this map is four years old, it is essentially up-to-date, since very few surveys have been made of populations during the war years in extra-military groups. The map indicates that surveys have been fairly well distributed. The lack of information through the mountain states, the western and southwestern part of Texas, the Plain States, and in the Carolinas does not mean that amebiasis does not exist there, but that sufficient surveys have not been conducted in these areas.

As with many other diseases, reports of *Endamoeba histolytica* must be evaluated critically on the following basis: 1) the competency of the individual making the examination; 2) the extent of examination made, whether on a single stool or several stools, and 3) technics used, whether a direct examination or concentration technics were applied. For example, if the zinc sulfate technic is used in combination with direct fecal films, the yield of positives is practically doubled. The more stools examined, the greater the possibility of approximating the actual number of positives. In addition, data must be evaluated in respect to the population being surveyed.

CLASS MASTIGOPHORA

The Mastigophora or flagellate protozoa constitute a large group, of which several forms occur in the human body.

Giardia lamblia is a widely distributed infection, by far the most common parasite found in the human intestine. The infection is much more prevalent in children, to the period of adolescence, than in adults. *Giardia lamblia* is transmitted in food or drink contaminated by feces containing *Giardia* cysts. The infection is pathogenic only in a small minority of cases.

Chilomastix mesnili, Enteromonas hominis, and *Trichomonas hominis* are other non-pathogenic intestinal flagellates of world-wide distribution.

Trichomonas vaginalis is morphologically rather similar to *T. hominis* but is a distinct species. The parasite is found in vaginal secretions, and in urine from both men and women. The pathogenicity of *vaginalis* is unsettled although gynecologists regard a form of vaginitis as being caused by this parasite.

Genus *Leishmania*

Figure 4 (page 6) indicates distribution of the three types of leishmaniasis: visceral leishmaniasis caused by *Leishmania donovani*; cutaneous leishmaniasis of the Old World, caused by *Leishmania tropica*; and mucocutaneous leishmaniasis of the New World, caused by *Leishmania brasiliensis*.

The visceral type (commonly referred to as kala-azar) occurs in Manchuria, a large area of north and northwest China, a newly found area in west China, Assam where the parasite was first discovered, Calcutta and vicinity, and eastern India. It also is found in the Transcaucasian region and north of the Ural Mountains. There are numerous foci of the infection in the Mediterranean area. Several foci occur in the midcontinent of Africa. Areas in the Anglo-Egyptian Sudan are very important, for there the disease is more fulminating and has a higher mortality rate than anywhere else. We in the Western Hemisphere are not exempt from this disease. The first record in this part of the world was from a ~~foci~~ focus in northeastern Brazil when viscerotome surveys were being made for yellow fever. More recently it has been found in northern Argentina, in adjacent Bolivia, in Venezuela, and in Colombia. In all, probably about 300 million people or one-tenth of the world's population suffer from visceral leishmaniasis.

The cutaneous type, caused by *Leishmania tropica,* occurs in the drier areas of India, extending from the northwestern part toward Asia Minor, likewise in North Africa and tropical Africa but never exactly in the same foci as the visceral type. More than 200 million persons are infected with this parasite.

Mucocutaneous leishmaniasis, caused by *Leishmania brasiliensis,* is found in several foci in Brazil, Peru, Ecuador, and Colombia. *Brasiliensis* probably occurs

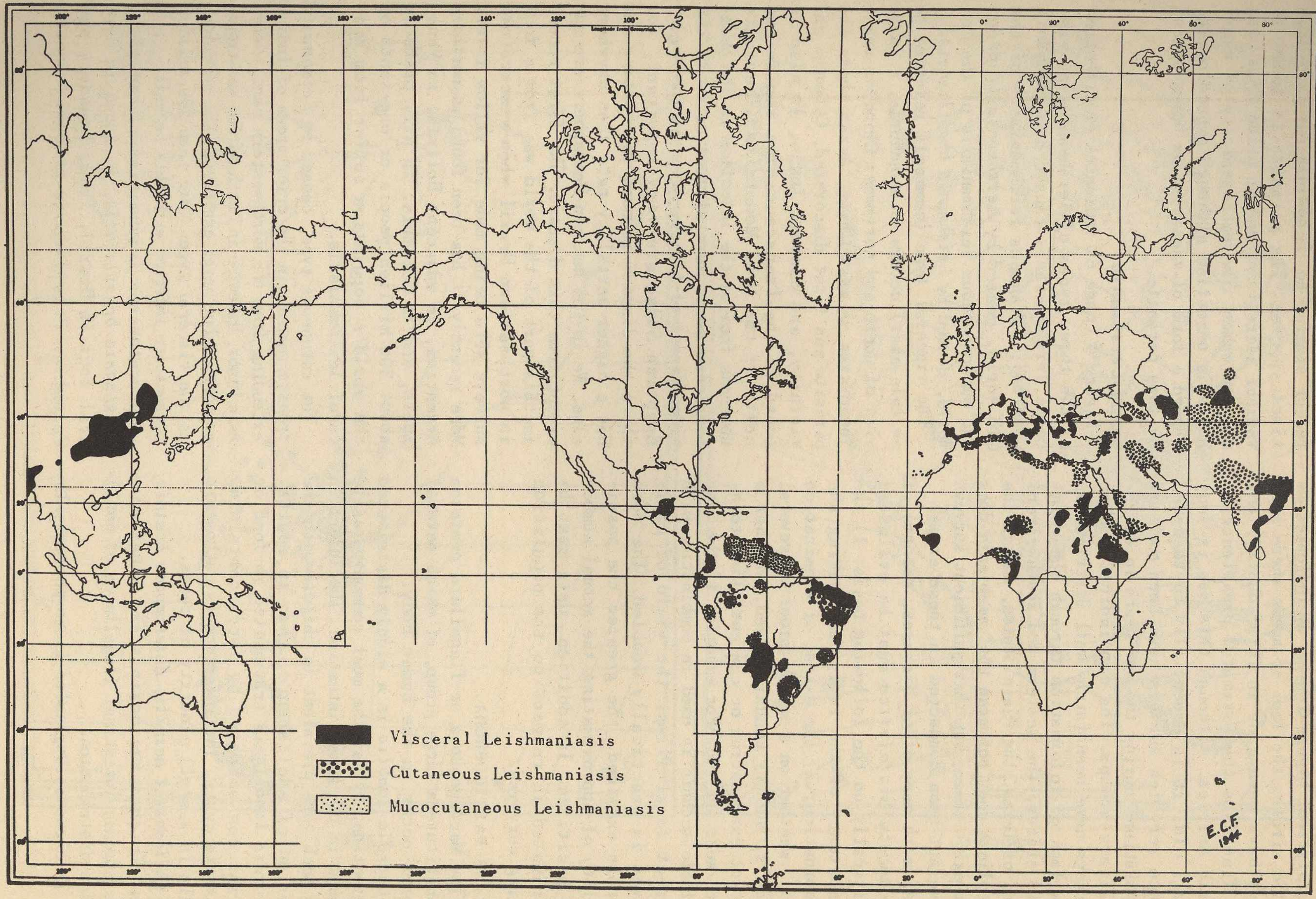


FIGURE 4. Distribution of the three different types of leishmaniasis.

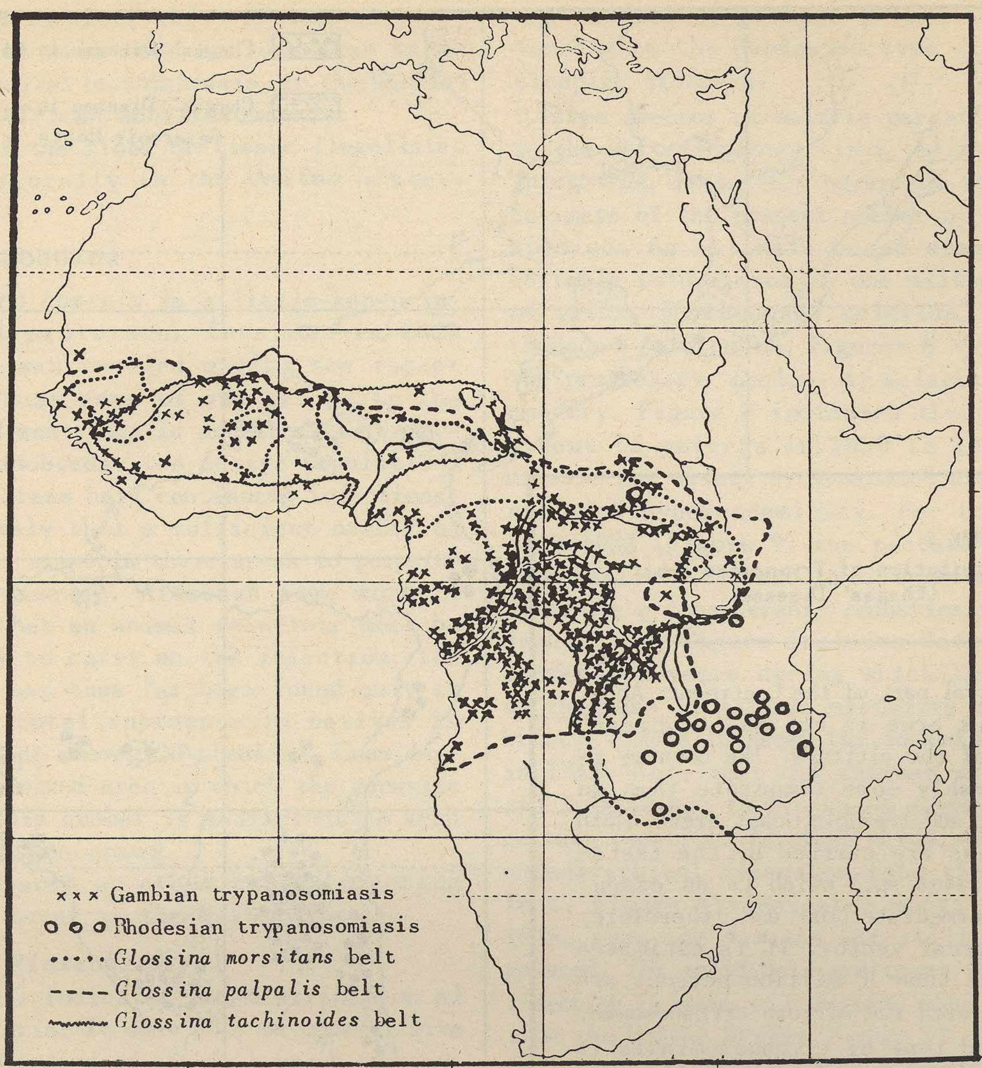


FIGURE 5. Distribution of *Trypanosoma gambiense*, *Trypanosoma rhodesiense*, and breeding area of tsetse flies in Africa.

throughout Central America although we know most about it in Yucatan and the adjacent portion of Guatamala where the disease is known as the Disease of the Chicle Gatherers, although it is just as common among individuals who work in the mahogany forests. In the southern part of Brazil and Paraguay the disease is found in the less tropical, deciduous forests. In Peru it is more commonly found in the inland mountain valleys.

All three species of *Leishmania* are transmitted by different species of the sand fly, *Phlebotomus*. There is almost no breeding of *Phlebotomus* in the United States. A few species have been described, but intensity and extent of breeding is much less than in areas where leishmaniasis is endemic. The American type of leishmaniasis is believed to infect five million or more people.

Genus *Trypanosoma*

Two trypanosomes occur in tropical Africa and are responsible for so-called "African sleeping sickness." Figure 5 shows the distribution of *Trypanosoma gambiense* and *Trypanosoma rhodesiense*. *Trypanosoma gambiense* has a very extensive distribution. *Trypanosoma rhodesiense* is found in the

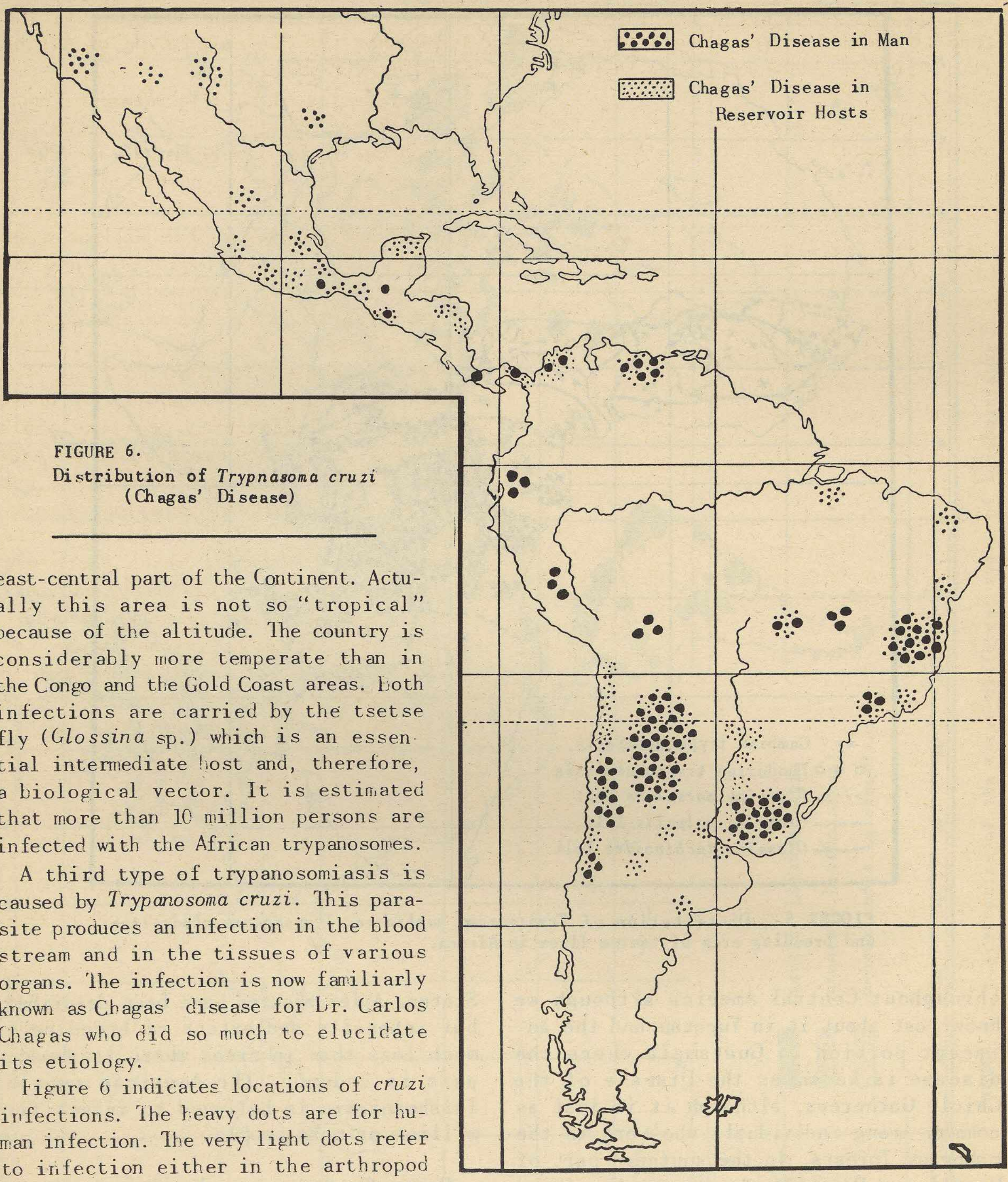


FIGURE 6.
Distribution of *Trypnasoma cruzi* (Chagas' Disease)

east-central part of the Continent. Actually this area is not so "tropical" because of the altitude. The country is considerably more temperate than in the Congo and the Gold Coast areas. Both infections are carried by the tsetse fly (*Glossina* sp.) which is an essential intermediate host and, therefore, a biological vector. It is estimated that more than 10 million persons are infected with the African trypanosomes.

A third type of trypanosomiasis is caused by *Trypanosoma cruzi*. This parasite produces an infection in the blood stream and in the tissues of various organs. The infection is now familiarly known as Chagas' disease for Dr. Carlos Chagas who did so much to elucidate its etiology.

Figure 6 indicates locations of *cruzi* infections. The heavy dots are for human infection. The very light dots refer to infection either in the arthropod host or in animal reservoirs of the infection. This parasite is most interesting in that practically any mammal is a good host. Armadillos, opossums, many kinds of rodents, bats, monkeys, and the domestic guinea pig of South America are all common reservoirs. *Cruzi* is transmitted by assassin bugs, of which there are many species.

Chagas' disease is found from central Chile and southern Brazil up to the southwestern part of the United States. The most northern record of human infection is in the state of Oaxaca in southern Mexico on the Pacific slope. Approximately 8 million people, and possibly more, are afflicted with this disease, which is considered by some to be much more serious than kala-azar, visceral leishmaniasis, or the Gambian type of African schistosomiasis.

None of the blood or tissue flagellates occur naturally in the United States.

CLASS SPOROZOA

Isospora hominis is a little-known intestinal protozoon. Interest in this parasite was renewed during the recent war, because some of our troops in the south and west Pacific acquired the infection. Undoubtedly the native populations in these areas have continuing infections. It is likely that a sufficient number of infections exist in these areas to perpetuate the disease. Although some workers believe that an animal reservoir must be necessary to carry on the infection, the organism has thus far been found only in man. The total incidence in natives is probably not above 100 thousand. Considering the limited area in which the parasite occurs, this number is sufficient to keep the infection going.

No *Isospora* or other human-infecting Coccidia occur in the United States.

Genus *Plasmodium*

Figure 7 indicates the distribution of human malaria. It does not, of course, give the distribution of the four known species, *Plasmodium vivax*, producing vivax malaria; *Plasmodium malariae*, producing the quartan type; *Plasmodium falciparum*, producing falciparum malaria, and *Plasmodium ovale*, producing the ovale type. It is practically impossible to determine the species of plasmodia in the billion persons in the world suffering from malaria. A reasonable assumption is that practically all of the malaria extending into the Temperate Zones is *vivax;* that both *vivax* and *falciparum* contribute to the hyperendemicity of malaria in the Tropics, and that quartan infections usually occur sporadically or in localized spots. An exception is a part of tropical Africa where quartan infection is widely distributed. *Ovale* malaria is found primarily in east-central Africa in about the same area, perhaps a little farther north than the Rhodesian type of African sleeping sickness.

Three species of malaria parasites occur in the United States: *vivax, malariae,* and *falciparum*. It is very hazardous to make an estimate of the present number of cases by species. An estimate based upon fairly reliable information is one million cases of *vivax*, 50 thousand *malariae*, and 500 thousand *falciparum*. Figures 8 to 10 show the progressive decline of malaria in this country. Figure 8 indicates the probable extent of malaria in 1850 to 1860. The disease was widely disseminated with dense areas of hyperendemicity. For the years 1929-1938 (Figure 9) the picture was not essentially different in distribution, but there was a considerable reduction in incidence. This figure includes data on the depression years during which there was an increase in malaria mortality and morbidity. Figure 10 shows the marked decrease in 1943. Note that the intense areas now are limited not to blocks of states but to certain counties. In other words, there was a geographical recession into the mother foci. Figure 11 indicates mortality for 1945, when the disease was still further reduced. The solid dots are cases where the infection is known to have been acquired outside the United States. Figure 12 shows the 1945 morbidity attributable to malaria. Note that quite a number of malaria cases were reported outside of known endemic areas, as in Minnesota, in the New England States, and in parts of Ohio. Actually these areas are less malarious today than they have ever been. The cases reported were almost exclusively infections acquired overseas or in the South during the war years. This map reflects the fact that in Mississippi, South Carolina, and in the eastern part of Texas case reporting was probably more accurate than in some other places.

A very great recession in malaria has taken place, particularly during this last decade. If this advantage is followed up, there is no reason why malaria in the United States cannot be almost completely under control within ten years.

FIGURE 7. World Distribution of Malaria.

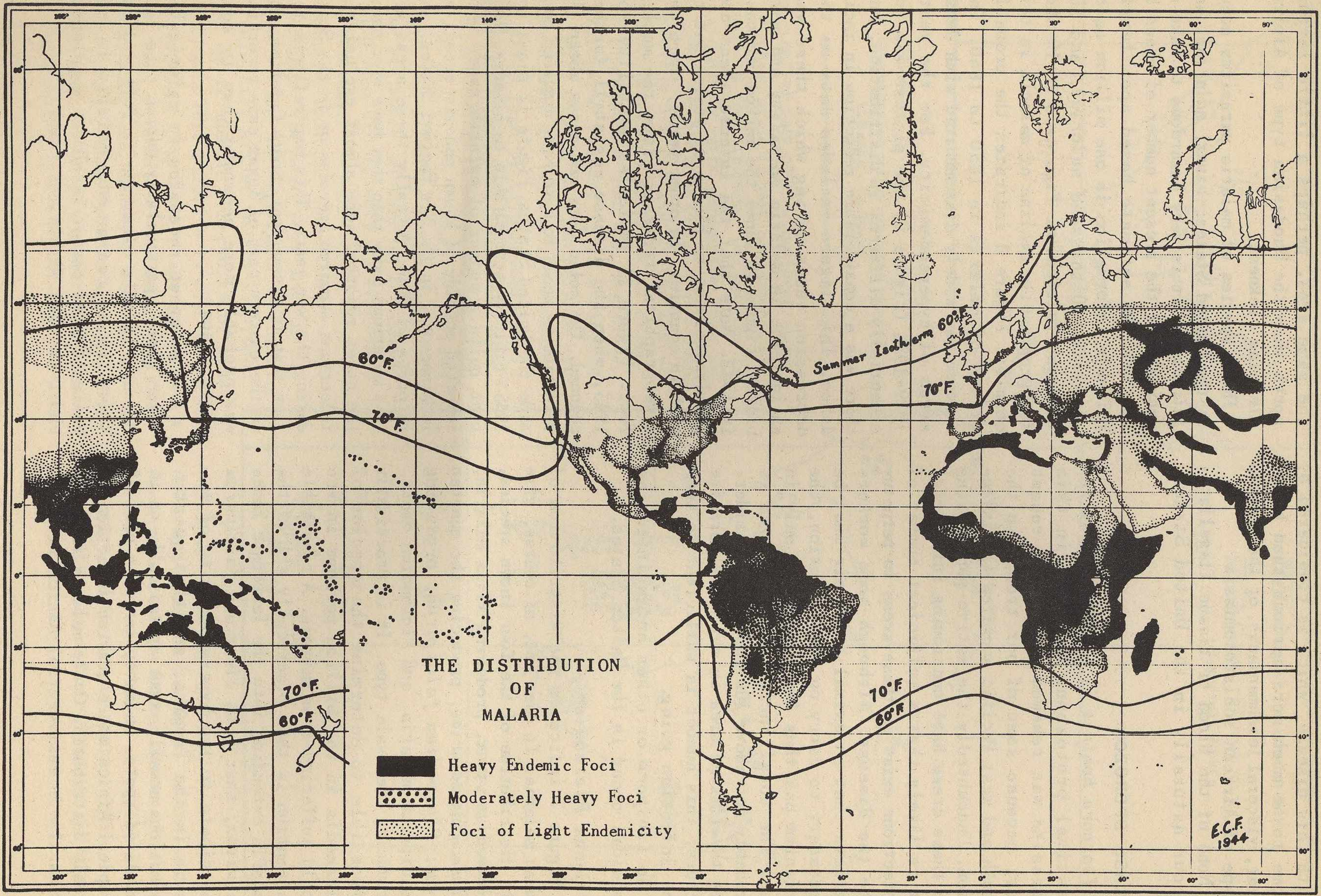


FIGURE 8. Distribution of Malaria in the United States 1850 —1860.

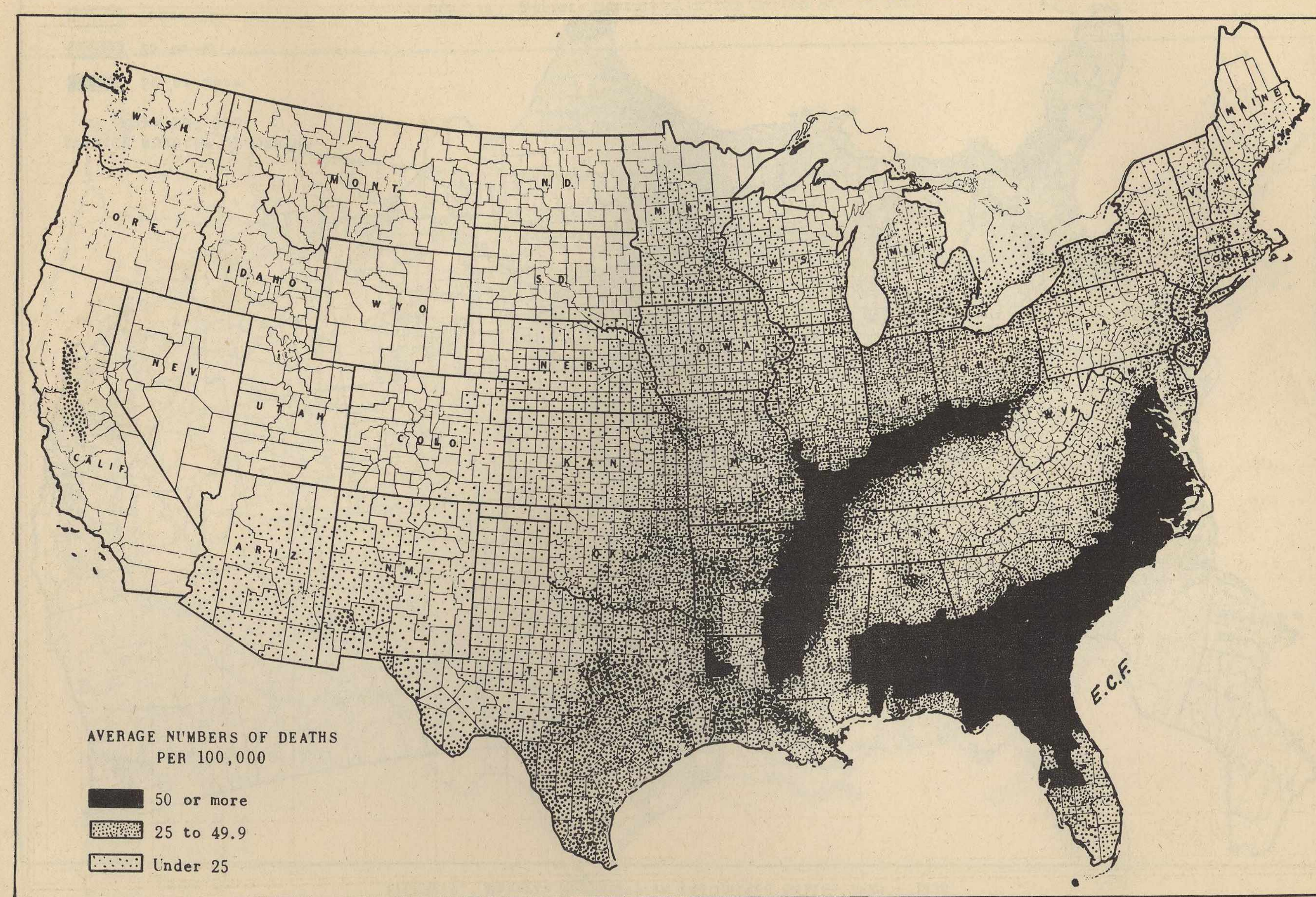


FIGURE 9. Malaria Mortality in the United States 1929 — 1938.

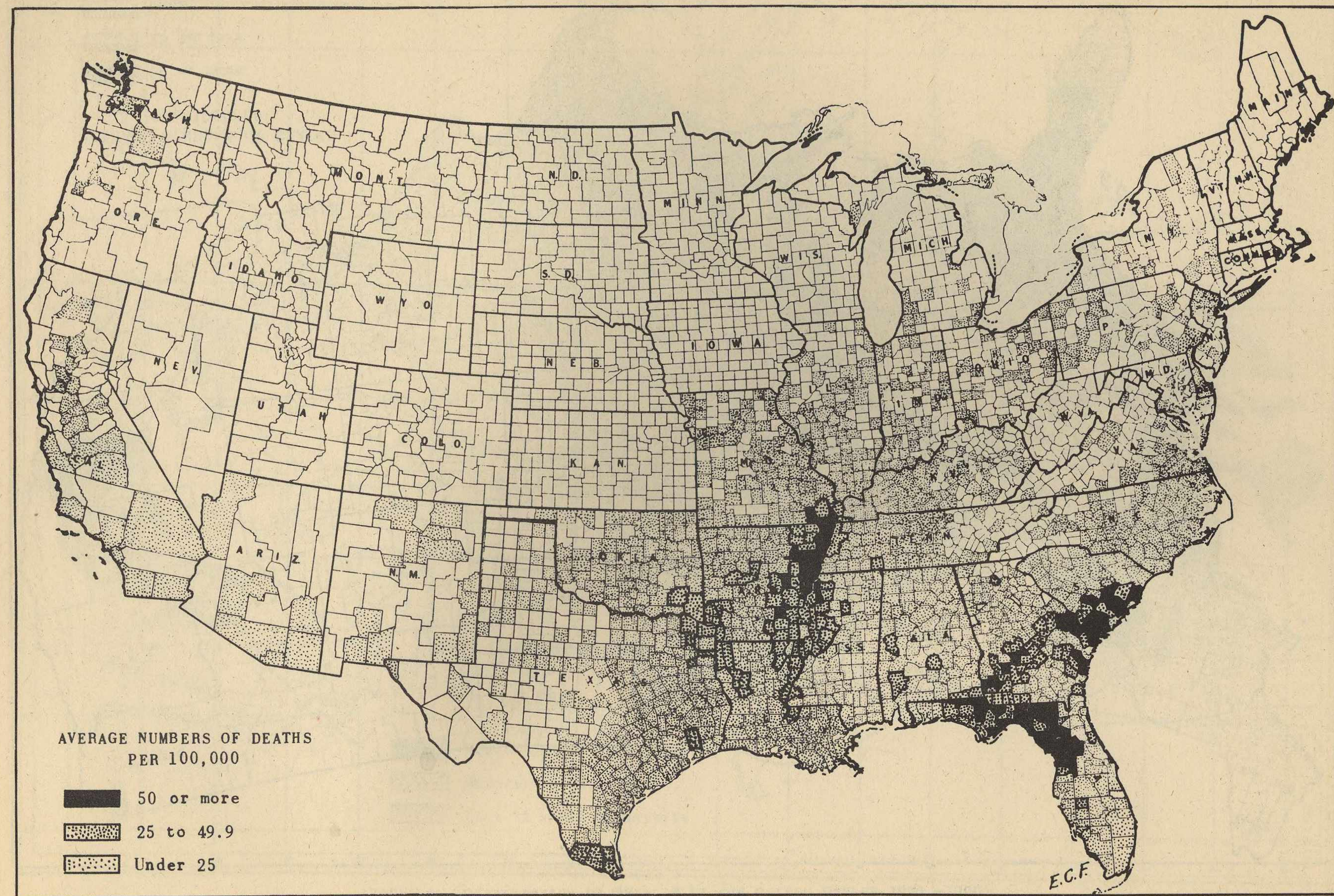


FIGURE 10. Malaria Mortality in the United States 1943.

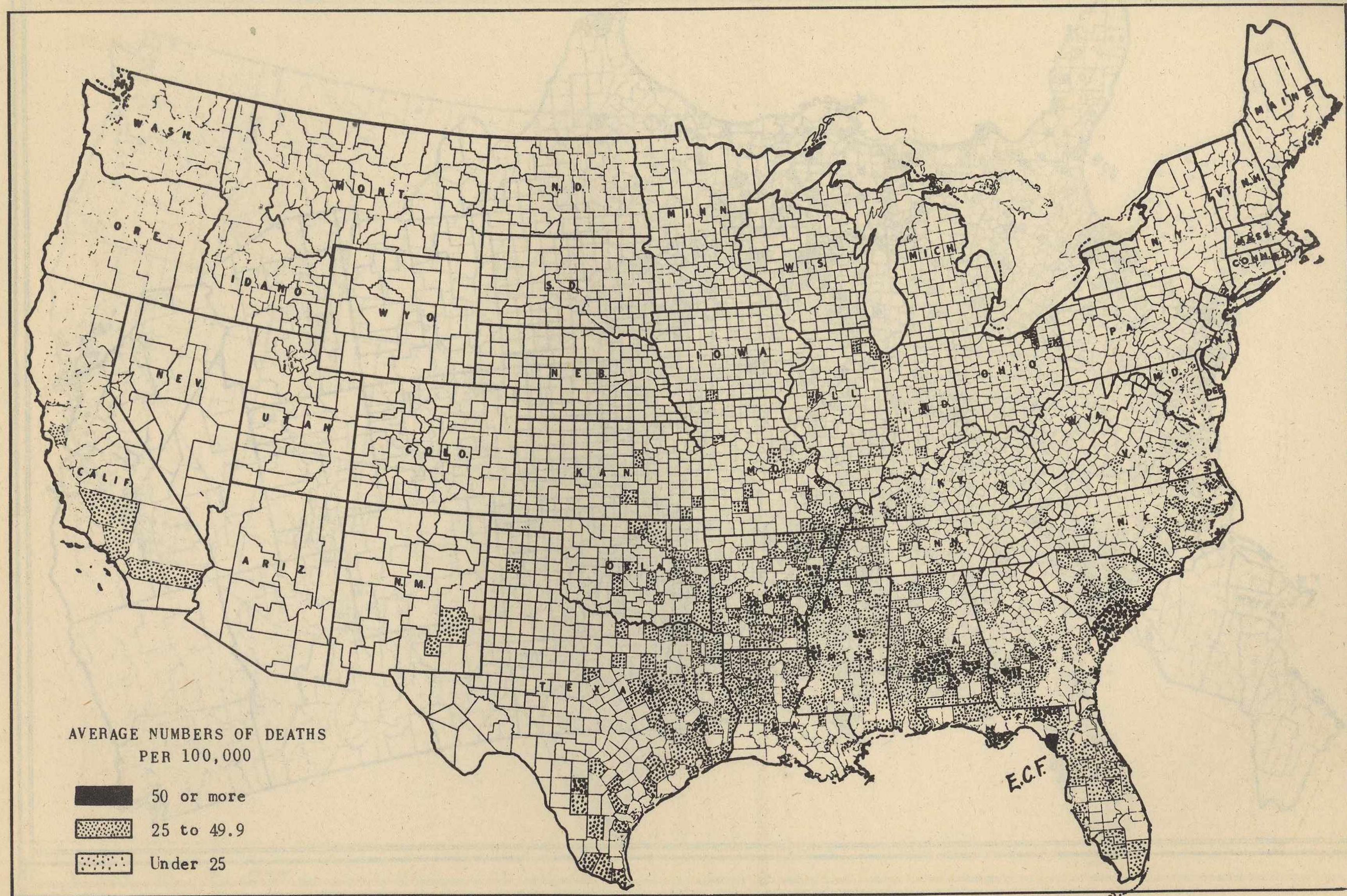


FIGURE 11. Malaria mortality in the United States 1945. The solid dots indicate cases known to have been acquired outside the United States.

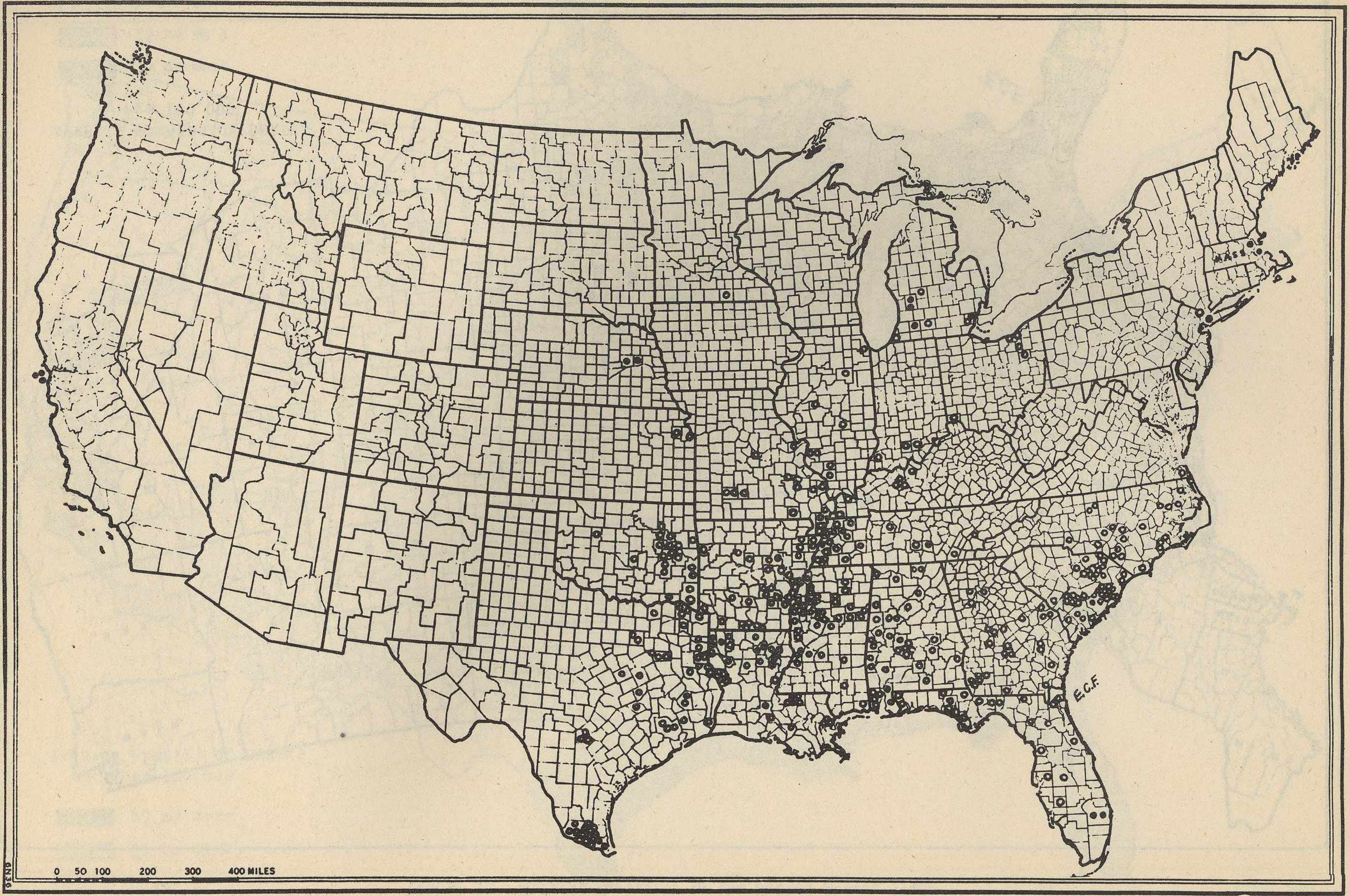
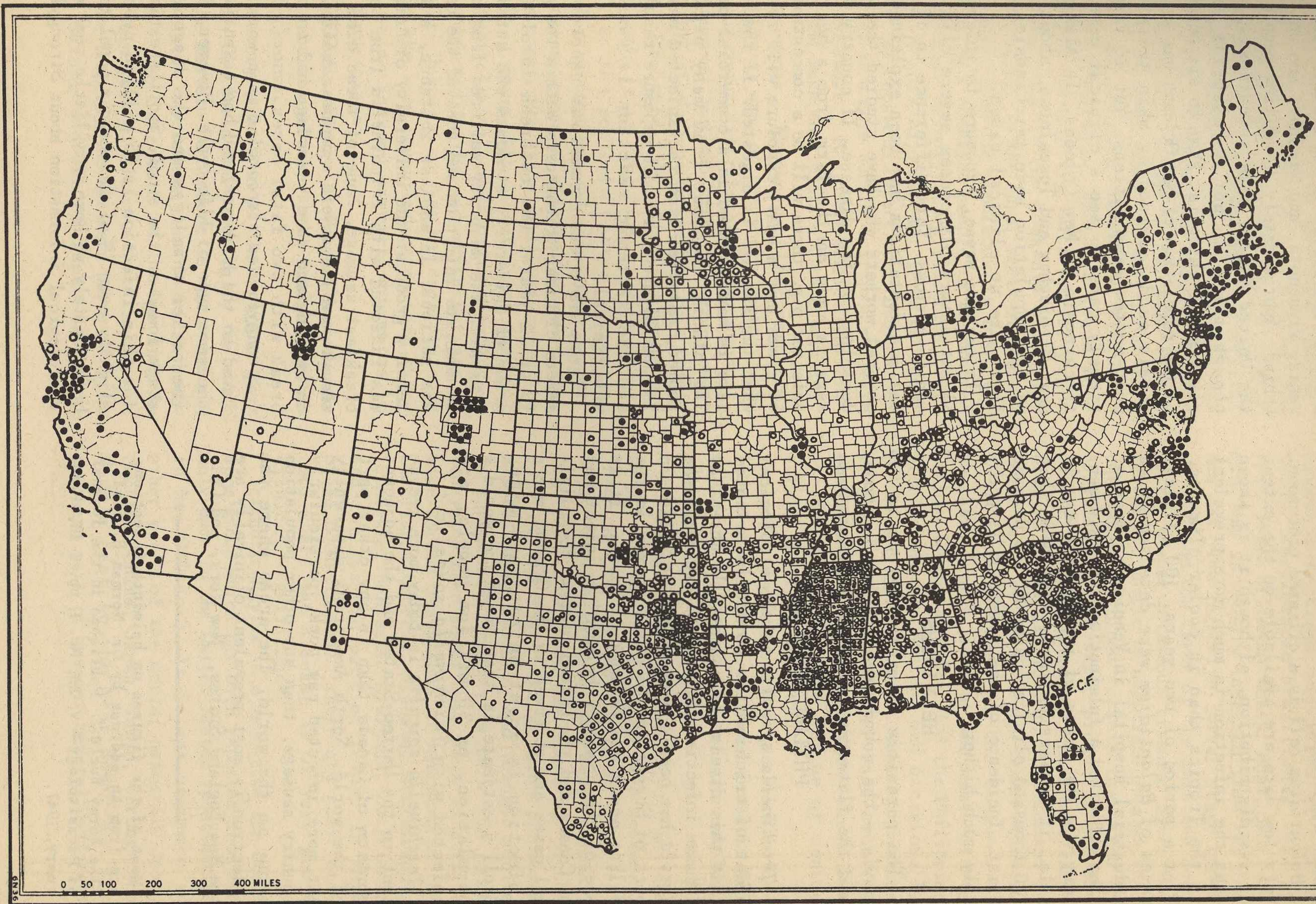


FIGURE 12. Malaria morbidity in the United States 1945. The solid dots indicate cases known to have been acquired outside the United States.



CLASS CILIATA

Balantidium coli is a ciliated protozoon. Very few data are available on the extent of its distribution, although it is known that the infection is much more prevalent in the Tropics than in cooler climates. Over a period of two years, 100 clinical cases of *Balantidium* were detected in an industrial hospital in Venezuela. Most of them exhibited a fulminating type of dysentery. On the basis of information available, it appears unlikely that more than 100 thousand clinical cases of the disease exist. Incidence of the infection is probably much higher.

HELMINTHS

The parasitic helminths belong to two phyla — the roundworms, phylum Nematoda, and the flatworms, phylum Platyhelminthes.

PHYLUM NEMATODA

Trichinella spiralis is the etiological agent of trichinosis. It should be noted that this disease is essentially absent as a human infection in tropical areas. *Trichinella* has been a very common infection in part of Europe and is still common in the Balkan areas and regions of Russia. It is one of the commoner helminthic infections of Canada and the United States. Few clinical cases are observed in the Orient, where infection is scant in rats and pigs. Stoll's estimate is that 1% of the world's population, or 30 million people, are infected with *Trichinella spiralis.**

Trichinella spiralis is today more prevalent in the United States and the adjacent portion of Canada than in any other part of the world. North Americans apparently eat more infected raw pork, particularly country sausage, than any other population group in the world. The areas where the infection is most prevalent clinically are the New England States, New York, and California. The states of New Jersey, Pennsylvania, Minnesota, and Missouri are not far behind. Approximately 23 million people in the United States have trichinosis, although these do not necessarily have clinical trichinosis. Five to six percent of the population of New Orleans has trichinosis as determined by skin tests and post-mortem examinations. Yet it is extremely rare to see a clinical case of trichinosis in New Orleans. In Alabama, near Birmingham and Tuscaloosa, about 30% of the population have trichinosis, but there are no clinical cases.

In certain areas, exposure to infection almost invariably causes severe clinical manifestations. This difference in clinical manifestations has been explained by several workers who have studied the epidemiology of the disease. If country sausage is made on the farm from a heavily infected pig, there will be a concentration of cysts and a heavy exposure will result when the sausage is digested. If the sausage is manufactured in a commercial packing plant, the meat from many pigs is pooled, material from the infected animal is thus diluted, a light exposure results, and the systemic reaction is usually subclinical.

There have been numerous records of severe clinical trichinosis within the past 10 or 12 years. One outbreak involved a group of university students who attended a picnic. The majority suffered from mild to moderate infection and none of the cases was serious. In another instance, a fraternity group at the University of Arizona was infected with *Trichinella* from their breakfast sausage. None of these died although some had severe symptoms. A CCC Camp in New England some years ago had an outbreak with two fatal cases.

Strongyloides stercoralis is a worm related to the hookworm, and has essentially the same type of life cycle. However, larvae rather than eggs are the diagnostic stage found in the stool. Stoll's estimate for this infection is 35 million people, slightly over 1% of the world's population. Unfortunately we have very little real epidemiological information about *Strongyloi-*

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*Most of the figures on helminth infections are from an address by Dr. Norman R. Stoll, "The Wormy World." Published in the Journal of Parasitology— V. 33, No. 1, pp. 1-18, February, 1947.

des. Many areas of the Tropics are not involved. In Panama and Venezuela, however, *Strongyloides* is found in 20-25% of all the stools examined. Specific microclimatic conditions are necessary for the survival of *Strongyloides*. In general, its occurrence in the United States is similar to the distribution of hookworm. Although infections have been found in central New York state, Kansas City, Tennessee, Kentucky, and the Carolinas, they are found more commonly around the Gulf Coast. Cases appear north of the hookworm belt only sporadically. In the rural areas of Louisiana about 4% of the population is infected. Perhaps 400 thousand people in the United States have *Strongyloides* infection. This is much more significant than an equal number of hookworm infections since *Strongyloides* is a more subtle, insidious parasite than hookworm. It is more difficult to diagnose and much more difficult to eradicate.

Whipworms. Whipworms (*Trichocephalus trichiurus*) are, on the whole, more tropical in their distribution than *Ascaris*. In tropical and sub-tropical areas, more than 10% of the population has this infection. Probably 355 million persons are involved. It is true that in many areas, such as the southern United States and similar subtropical and moderately temperate areas, cases of clinical whipworm diseases constitute but a small percent of the infected group. Yet almost every month of the year clinical cases of this infection are admitted to the pediatric service of Charity Hospital in New Orleans. In such cases the worm count indicates that there may be a thousand or more whipworms in the intestines.

Hookworms. Figure 13 (Page 18) shows the distribution of the three common species of hookworms.

Hookworm infection of the tropical part of the Old World and practically the whole of the Western Hemisphere is due primarily to *Necator americanus*, the "American hookworm." The infection of Europe and the northern part of Africa, which is outside of the Tropics, the northern parts of India and China, and all of Japan is due to *Ancylostoma duodenale*. These are the two common intestinal hookworms of man. A third, *Ancylostoma braziliense*, has at least three different hosts: dogs, cats, and man. Man is usually infected from the dog and cat. The infective larval stage bores through the top layer of the skin and down to the deeper cutaneous tissues. Since the larvae are unable to negotiate passage into the cutaneous blood vessels they keep on migrating in the skin, producing the so-called "creeping eruption." This manifestation is common in Florida, less common in other parts of the Gulf and South Atlantic Area, and is found on the beaches of southern Brazil, in west and east Africa, Ceylon, Calcutta, Malay, and the Philippine Archipelago. In Africa, and occasionally in the Philippines, *Ancylostoma braziliense* is found as an intestinal infection. In these cases, it is probably the human strain rather than the feline or canine strain which is involved.

Stoll's estimate of intestinal infection for all three of these worms is 457 million, or about 15% of the world's population.

According to Stoll's figures, 1.8 million people in the United States have hookworm. These are for the most part in the rural South. In the more isolated rural communities the infections are found up to the edge of the town, and genuine hookworm disease among children and younger adults is encountered. Surveys within the past ten years have shown that there is still a wide-spread prevalence of hookworm in the Carolinas, Georgia, Alabama, Mississippi, Tennessee, Kentucky, Arkansas, Louisiana, and the eastern part of Texas. In this broad hookworm belt, there are restricted foci where the disease is of very great clinical significance.

Trichostrongylus is a member of the hookworm group which has been reported from man only once in the United States (post-mortem in New Orleans). It is not uncommon in other parts of the world, primarily Java, Sumatra, China, Japan, India, through the Middle East to the Near East, and the southern part of Russia. Several different species are involved. Stoll estimates that 5.5 million people are infected with *Trichostrongylus*. This estimate is quite conservative. Species of this genus are common parasites of cattle, sheep, goats, and other ruminants throughout the world, including the United States. The infection is transmitted to man and other animals by ingesting grass or other green stuff on which the partly-encysted infective larvae are found. It differs from hookworm infection in that the larva is swallowed instead of entering through the skin.

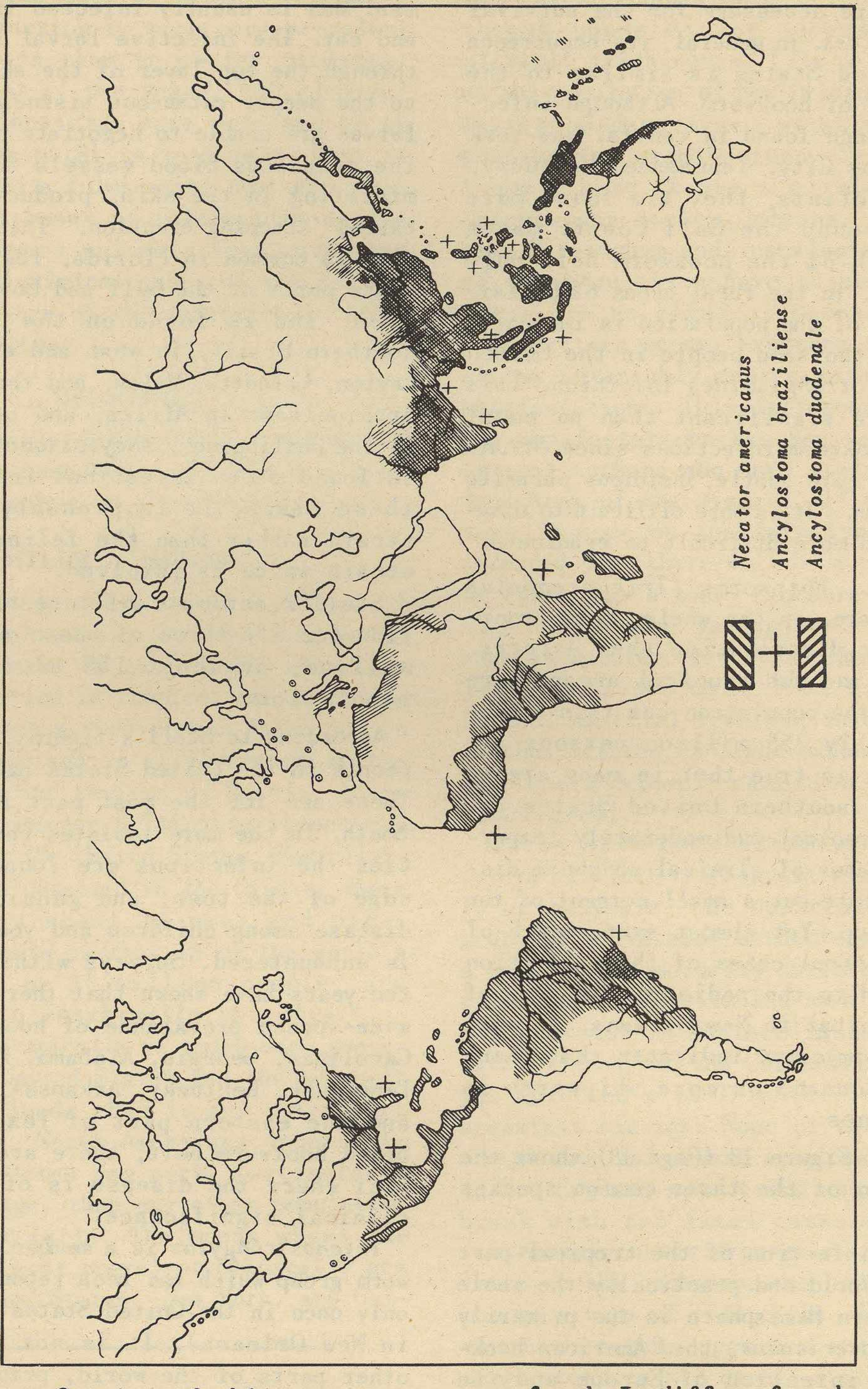


FIGURE 13. Distribution of hookworm infections. The symbol ⊙ indicates locations where hookworm infections have been acquired in mines.

Enterobius vermicularis is the seat worm or pinworm. Stoll's world estimate is 209 million infections. This is based on surveys probably not made primarily by swab examination but by ordinary stool examination. This latter method at best would disclose only 10% of the positive cases. The estimate can, therefore, be raised considerably. Possibly one-third of the world's population have pinworm infection.

By Stoll's estimate, 18 million persons in the United States are infected with *Enterobius vermicularis*. This figure is unquestionably very low. The infection is uniformly distributed over the country. It is about as prevalent in institutional groups and large families in one area as in another.

Ascaris lumbricoides infects from 750 million to one billion people throughout the world. This roundworm is very rarely found in strictly temperate areas. The *Ascaris* belt of the new world extends south from the Mason and Dixon line to southern Brazil. In the Old World it extends from central Europe to the southern part of Africa, while the tropical region farther to the east in the Eastern Hemisphere is hyperendemic for *Ascaris*. Ascariasis infection is much more common in childhood than it is in adults. Children are responsible not only for reinfecting themselves and their playmates but to a very considerable extent for the infection of adults.

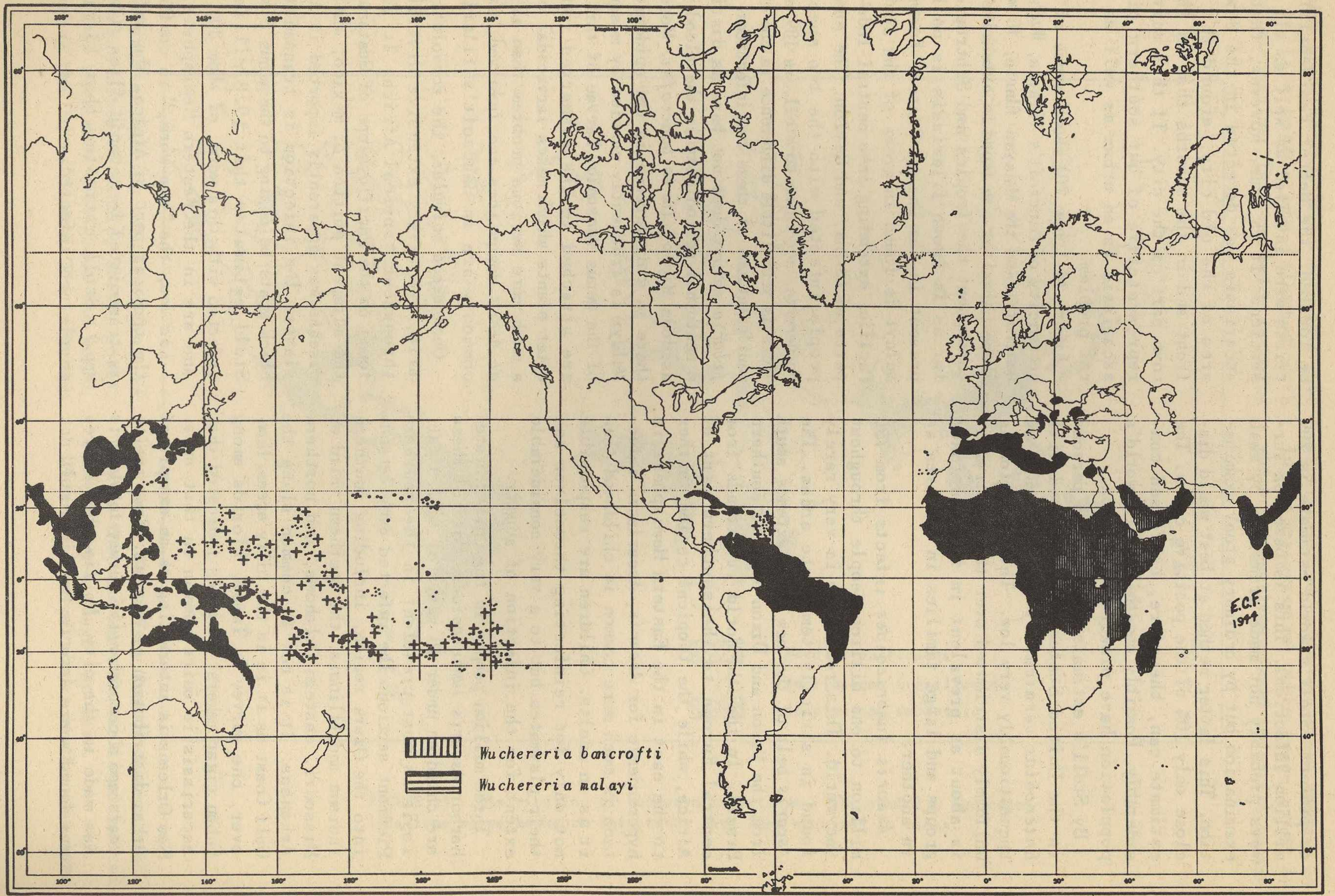
Three million people in the United States harbor *Ascaris lumbricoides*. Most of these are children under 10 years of age. Ascariasis is most prevalent in the southern Piedmont section. The infected area extends into the Ozark region, including southern Indiana and Illinois, the southern third of Missouri, eastern Oklahoma, and northern Arkansas. It is not as common along the Gulf Coast as it is in the hilly areas. However, one survey in Tampa, Florida among Cuban cigar makers' families indicated that ascariasis is quite common in that area. New Orleans is interesting as an example of urban distribution of *Ascaris*. Some twelve years ago a comprehensive survey for *Ascaris* was made in the city. No five-block area was found where *Ascaris* families could not be located. The better residential districts were involved as well as all other sections. It is true, however, that more ascariasis was detected in the downtown area of the old city, around the river front and in the suburbs than in the uptown part of the city. If this survey is representative of our southern cities, ascariasis is an urban as well as a rural problem.

Figure 14 (page 20) shows areas of hyperendemicity of Bancroft's filaria, *Wuchereria bancrofti* and the Malayan filaria, *W. malayi*. These parasites are found in extensive areas throughout the Tropics and Subtropics. As far as is known filariasis is no longer present in the United States. *Wuchereria malayi* is found in areas of the southwest Pacific, extending into central Indo-China, parts of China, and Ceylon. The number of people infected with the two species of *Wuchereria*, according to Stoll, is 189 million. There is very little difference in the clinical manifestations of these two infections. *Microfilaria malayi* does not have as distinctive a nocturnal periodicity in the blood stream as does *Microfilaria bancrofti*. Moreover, there is a difference in the epidemiology. *Malayi* is frequently carried by mosquitoes of the genus *Mansonia*. Larvae of this genus are attached to the submerged roots of water plants which makes larvicidal control a much more serious problem than if *Culex* or *Aedes* mosquitoes are involved, as they commonly are in Bancroft's filariasis.

Onchocerca volvulus, the convoluted filaria, has a very extensive distribution throughout tropical Africa. It is also found on the Pacific slope of Guatamala and the adjacent portion of Mexico, where the disease was apparently imported in African slaves. The infection is transmitted by black gnats belonging to the genus *Simulium*. Stoll estimates that 19.8 million are infected with this worm, of whom 800 thousand are in the Western Hemisphere. e/

Loa loa, the "eye-worm," is confined to the tropical part of Africa. The infection is transmitted by tabanid flies (*Chrysops* spp.). Stoll estimates that 13 million people are infected.

FIGURE 14. Distribution of Filariasis.



Dracunculus medinensis, the dragon worm or guinea-worm, has various species of Cyclops as intermediate hosts. This infection in man is found extensively in India, the Middle East, parts of Africa, and in southern part of the USSR. It probably has now completely died out from the Brazilian and Guinean portions of the Western Hemisphere where it existed as late as a quarter of a century ago. Forty eight and three-tenths million persons are believed to be infected with this parasite.

PHYLUM PLATYHELMINTHES

CLASS TREMATODA (Flukes)

Schistosomes

Figure 15 (page 22) shows the distribution of the three schistosomes of man. *Schistosoma japonicum* is confined to areas in the Far East. Five small foci are in Japan. The whole Yangtze River basin is involved, four islands of the Philippines are infected, and one focus has been found in Celebes.

Schistosoma mansoni is found in the lower half of the Nile Delta, in many other foci of Africa, in Puerto Rico, Santo Domingo and some of the Lesser Antilles, Venezuela, Dutch Guiana, and in extensive areas in Brazil.

Schistosoma haematobium probably originated in the Nile Valley. Today extensive areas of infection exist in Africa, the southern tips of Europe, and in western Asia. Stoll estimates the human infections for these species as follows: *japonicum* 46 million, *mansoni* 29 million, and *haematobiam* 36 million.

Numerous cases of *Schistosoma mansoni* are being imported into the United States from Puerto Rico, and Puerto Rican students in this country occasionally have mild Manson's schistosomiasis. Based upon the rate of infection in Puerto Rico, at least 100 thousand Puerto Rico residents in New York have *Schistosoma mansoni* infection. Nevertheless, it is unlikely that this disease will become established in this country since suitable snail hosts are not present in the New York area. Recently some native snails from southern Louisiana have been experimentally infected so the possibility of the disease becoming established exists, even though it is remote.

Other Flukes

Fasciola hepatica is a common liver fluke of sheep. Not many persons are reported to be infected but human infection is known in the Orient, Africa, southern Europe, particularly the southern part of France, and various parts of the Latin America. Man usually contracts the infection by eating water cress to which the little encysted larvae are attached.

In the United States *Fasciola hepatica*, or the related *Fascioloides magna*, is found in Louisiana, eastern Texas, in irrigation areas in the Southwestern States, Oregon, Washington, and more recently in Wisconsin and Ohio. Sheep and cattle are the reservoir of the infection and they are responsible for the spread of the disease to uninfected areas.

Fasciolopsis buski is indigenous to central and south China, Formosa, French Indo-China, Siam, Assam, Bengal, and in the islands of the Southwest Pacific. This infection is contracted by eating certain water plants containing the encysted stage. Probably about 10 million persons have this infection.

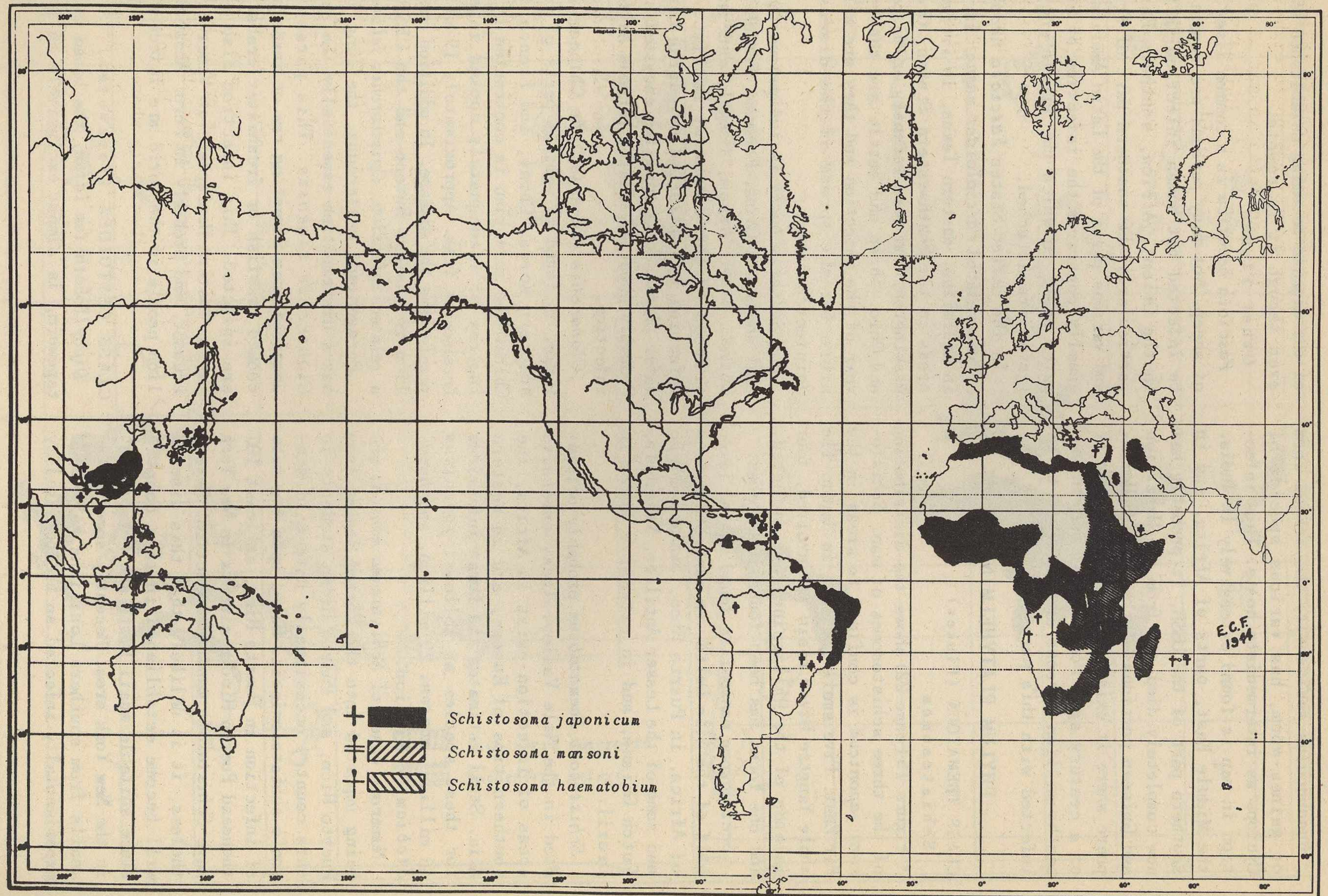
Clonorchis sinensis, the Chinese liver fluke, is found in various parts of Japan, southern Korea, China, and French Indo-China. The infection is contracted by eating raw or inadequately cooked infected freshwater fish. Approximately 19 million people have the disease. In addition one million in eastern Europe and the USSR have a related infection, *Opisthorchis felineus*.

Paragonimus westermani, the lung fluke, has a distribution essentially the same as *Clonorchis sinensis*. This parasite is acquired from ingesting raw or inadequately cooked crawfish or freshwater crabs which are infected. This infection also occurs in the Western Hemisphere in Venezuela, in Ecuador, and probably in Peru. About 3 million people in the world are infected.

CLASS CESTOIDEA (Tapeworms)

Diphyllobothrium latum, the broad or fish tapeworm, is almost exclusively an infec-

FIGURE 15. Distribution of Schistosomiasis.



tion of the North Temperate Zone. It has, however, been found in the Arctic. Very few other localities are involved. The infective larval stage (sparganum) is found only in fish living in cold water. Stoll estimates that about 10 million people are infected. A related species of *Diphyllobothrium* is found in the Orient in which the sparganum stage is at times found in man. Human infection is reported from Java, Sumatra, southern China, Formosa, and Japan. The sparganum stage of this *Diphyllobothrium* typically develops in the tissues of amphibia, reptiles, birds and mammals. Man becomes the second intermediate host when infected tadpoles are swallowed. Moreover, in China and French Indo-China the flesh of a bird, frog, or snake is sometimes applied to a festering lesion on the skin or to an inflamed eye. The warmth of the human tissues causes the worm to enter the human tissues. Probably 100 thousand people in the Orient have this infection.

In the United States, *Diphyllobothrium latum* occurs in northern Minnesota and the northern peninsula of Michigan. It is found much more extensively in adjacent portions of Canada from the Atlantic to the Pacific coasts. Cases of *Diphyllobothrium latum* occur beyond the boundary of the endemic areas. Fish from endemic areas are shipped as far south as St. Louis and Louisville and as far east as New York City. If infected fish is eaten uncooked or inadequately cooked after shipment, it is likely to produce infection. There are reports of cases from New York City in people who have not been outside the city area. These infections can be traced to shipped fish. It is relatively simple to control such exposure by prohibiting shipment of fish during the highly endemic season, the latter part of the summer and early fall months.

Dipylidium caninum, the dog tapeworm, is common in dogs and cats. Whenever these domestic animals have fleas, as they usually do, the infection may be occasionally transferred to man. Human infections are found only in children who have been fondling these pets, and accidentally swallow the infected fleas. Records from New Orleans indicate infections occur in children from under one year of age up to eight and ten years. The incidence in man is probably about the same in the United States as elsewhere in the world.

Hymenolepis nana, the dwarf tapeworm, is primarily a childhood parasite. It is found more in the Subtropics than in the Tropics, and is very uncommon in cooler climates. About 20 million children throughout the world are infected. In the United States *Hymenolepis nana* occurs principally in the South but may extend as far north as the Ohio River. The incidence is usually moderate. Probably not more than 100 thousand to 200 thousand children in this country are infected. In certain areas, however, infection rates may be as high as 5-10%. These areas are in north Georgia, east Tennessee, and east Kentucky. Ordinarily the number of worms present in the individual is few, but occasionally heavy infections are observed where the number of worms amount to several thousand.

Hymenolepis diminuta, the rat tapeworm, seldom produces human infection. It has been found sporadically in Texas, Louisiana, Mississippi, Arkansas, Tennessee, Kentucky, Alabama, Georgia, and the Carolinas. There are a very few records from farther north.

Taenia saginata, the beef tapeworm, is common particularly through the Mohammedan population of the world. In the United States about 1% of the beef in federally inspected slaughter houses which gets to the consumer has the viable larval stage. There are altogether close to 39 million people in the world who have this infection. At any one time at least 100 thousand people in the United States are infected with *Taenia saginata*.

Taenia solium, the pork tapeworm, has a very much lower incidence and a more limited distribution. It is primarily found in eastern and southeastern Europe, India, and in Mexico. Mexico is the only place in the Western Hemisphere where its incidence is high. Altogether about 2.5 million persons are infected.

Taenia solium is very rare today in the population in the United States. Formerly it was not uncommon to see so-called "measly" pork which contained the larvae stage. It is only in the last decade that practically all *Taenia solium* infections have died out. Nevertheless, the rare cases which now occur should be given very careful laboratory and clinical attention because of the grave possibility of human larval infection, that is human cysticercosis, occurring as a result of previously acquired intestinal infection.

Hydatid worm. *Echinococcus granulosus*, which causes hydatid disease, is greatly over-rated statistically, at least as of the present time. The disease is commonly found in hogs, sheep, cattle, and, from time to time, in man. Today human infection is of importance particularly in the very fertile Plata River Valley of Argentina. About one-third of all the cases which come to surgery in the hospitals in Buenos Aires, Argentina are hydatid cysts. Altogether, the infection throughout the world today in the human population is not much over 100 thousand, whereas 25 or 30 years ago it may have been as much as one million. This reduction has occurred as a result of certain preventive measures, and from care with reference to handling dogs around sheep, cattle and hog ranches. The latter entails the periodic deworming of dogs to get rid of the adult stage of the worm so that the eggs will not be passed in the dog's excreta and reach man, to be swallowed and produce hydatid cyst.

In the United States, *Echinococcus granulosus* was quite a problem before 1924. Then new immigration laws went into effect and a high percentage of the previous immigrants from eastern and southeastern Europe were excluded on a quota basis. However, this infection does exist naturally in the United States. It has been found in several western states among persons who have been associated with sheep. Moreover, there is a record of approximately 15 indigenous cases in Louisiana, individuals who had not been out of the deep south and the majority of whom had never been out of the state of Louisiana. The infection exists also in eastern Tennessee. Although this disease is not widely prevalent, whenever there is a suggestion in the clinic or the laboratory of abdominal cysts of any kind, the laboratory worker, as well as the internists and surgeons, should always think of the possibility of hydatid cysts.

ACKNOWLEDGEMENT: Figures 1, 4, 5, 6, 13, 14, and 15 are from *Clinical Parasitology*, Fourth Edition, 1947, by Charles F. Craig and Ernest Carroll Faust. The courtesy of the authors and publishers, Lea and Febiger, Philadelphia, in permitting their use here is acknowledged with sincere appreciation.

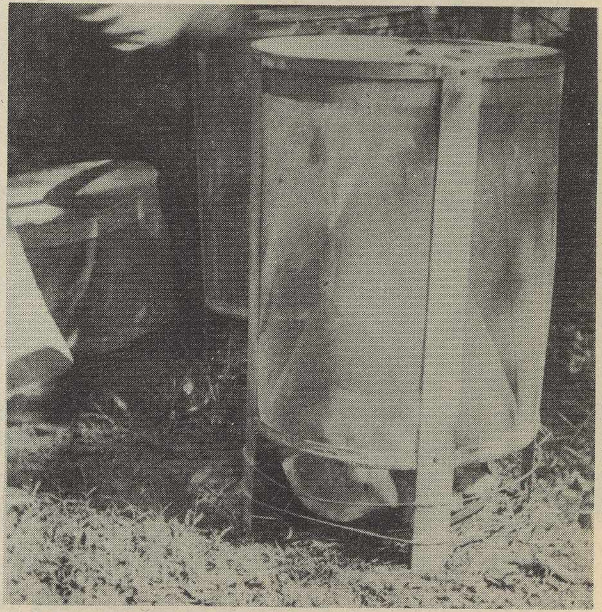
SPECIAL PROJECTS

In this section of the bulletin will be included items describing unusual or especially outstanding projects. Readers are urged to contribute to **SPECIAL PROJECTS** such articles on their activities as will be of general interest. **HEADQUARTERS NOTES** and **FIELD NOTES** sections have been discontinued. A section in future issues will be devoted to **DIVISION REPORTS.** These will appear in the next bulletin following receipt of regular quarterly reports from Headquarters Divisions.

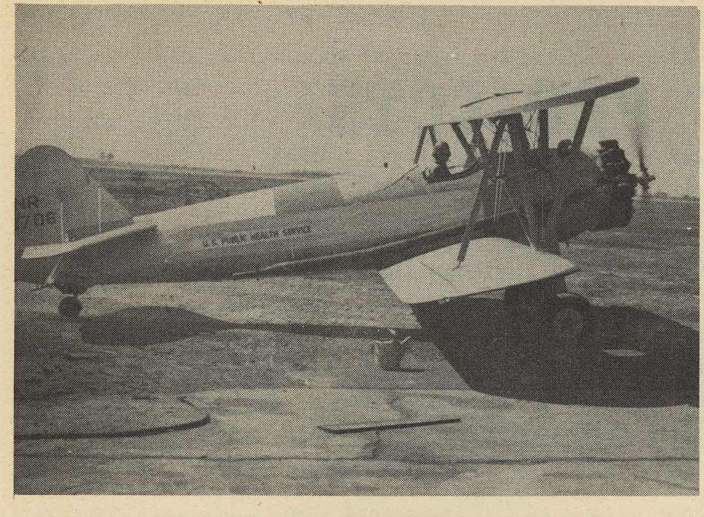
POLIOMYELITIS CONTROL INVESTIGATIONS

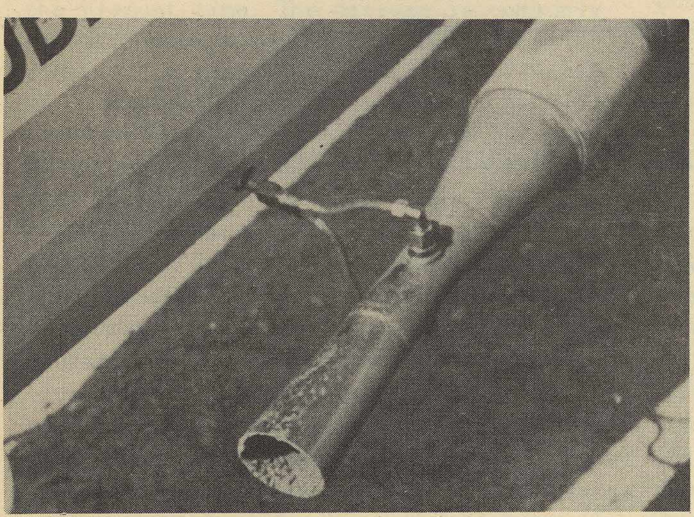
As part of a study to determine if control of flies will appreciably reduce incidence of poliomyelitis, CDC obtained permission of the State Health Department of Delaware to conduct fly control operations and make observations during the recent outbreak at Wilmington.

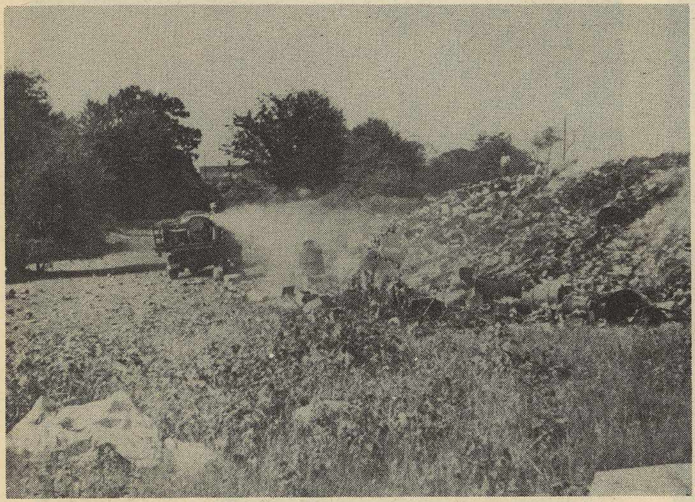
For the past several years, flies have been considered as possible vectors of the disease. Some time ago, CDC personnel devised a program to obtain pertinent data during a polio outbreak. Control crews were trained for operations, and procedures were outlined for evaluating results. Mobile units were set up and kept standing by for quick action in event that polio was reported in a



Fly counts were obtained before and after spraying with grill (left) and traps (right).







(upper) Airplane insecticidal unit used to disperse thermal aerosol. (center) Aerosol generator used on plane for disbursing DDT (lower) Spraying garbage dump with air blast sprayer.

satisfactory study area. For practical reasons the experimental control work could be done only in cities with a population of 50,000 to 200,000. The Epidemiology Division has meticulously assembled morbidity data to detect the first indications that an unusual number of polio cases was occurring.

The Wilmington outbreak was the first since equipment and plans were ready for action. There was some premonition of an epidemic in the area in July. After the first reported cases, the number grew to 15 per week. On August 19 CDC headquarters was informed that there seemed to be an incipient epidemic in Wilmington. CDC representatives were in the city the next day. Actual fly control operations were started on August 28.

DDT was applied by airplane and by ground crews. Three-tenths pound of DDT per acre per application was applied by airplane over the entire city four times during the first week. Weekly applications were continued for the next three weeks. Airplane spraying was supplemented by ground crews using hand or power equipment.

Entomological evaluation based on grill counts of flies and fly trapping indicated that satisfactory control of flies was obtained. Specimens of flies were obtained for virus isolation work at Montgomery.

It was hoped that control could be instigated while the epidemic was increasing. Analysis of epidemiologic data gathered during the investigation indicates, however, that the peak of the epidemic was probably reached on August 13. So it may not be possible to draw conclusion as to the effect of fly reduction on the occurrence of human cases of poliomyelitis from data collected at Wilmington. When laboratory work is completed, additional data may provide more substantial information.

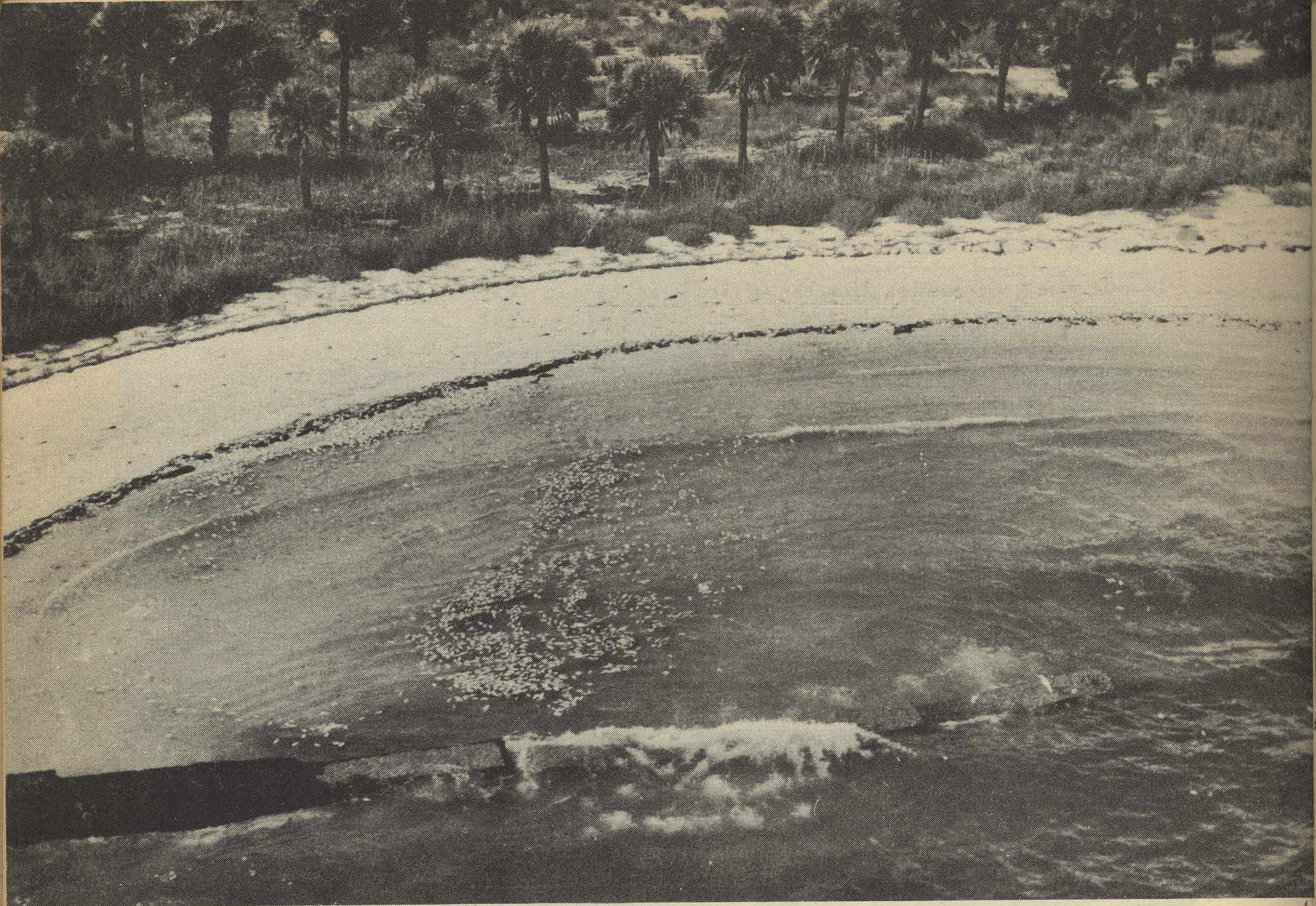
INVESTIGATIONS OF "RED TIDE" FISH KILL IN FLORIDA

In response to a request from the Office of the Surgeon General, Dr. F. Earle Lyman, Assistant Chief of the Entomology Division, CDC, accompanied by Mr. D. C. Thurman, Jr., CDC Entomologist of the Florida State Board of Health, visited the West Coast of Florida on July 28, 1947, to investigate the dying fish problem in that area and to arrange for CDC assistance in alleviating fly breeding conditions.

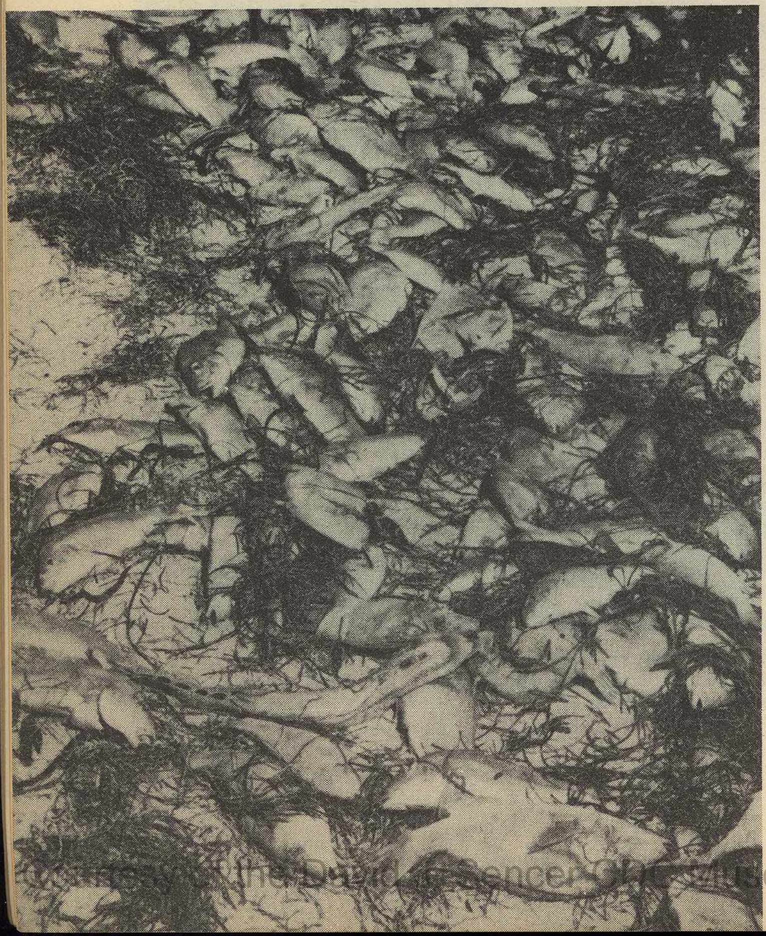
The present plague of dying fish began during late November 1946 and has continued in a series of more or less interrupted outbreaks up to the time of the present investigation in July 1947. Large numbers of fish had begun dying on the Gulf Coast of Florida early in July and west winds had littered the beaches from Boca Grande northward to Sarasota with tons of decaying fish including many deep-sea fish, such as tarpon and jewfish, as well as smaller fish, crabs, etc.

Many residents had moved away from the beaches because of the foul odors. Not only was the area affected by foul odors but a throat irritation accompanied by coughing was experienced by persons visiting the beaches. The dead fish accumulated just above the high tide mark soon became virtually alive with scavenger fly maggots belonging to the families Calliphoridae and Sarcophagidae. The first peak of fly

Raft of dead fish floating in the open waters of the Gulf, note the bloated appearance of these fish. (Photograph courtesy the Times, St. Petersburg, Florida.)



(above) Protected bays and coves collect large numbers of dead fish. (left) Masses of decaying fish collected on the beaches at the high-tide mark where they breed enormous numbers of flesh and blow flies. (Photographs courtesy the Times, St. Petersburg, Florida.)



emergence occurred near Sarasota on July 28. However, at Boca Grande to the south many adults already had emerged and flies were extremely abundant on the vegetation adjacent to the high tide mark. In those places where the fish had been raked or collected into piles or had been buried in shallow pits (covered 6 inches or less with sand,) fly breeding was more intense than in those areas where the fish had been allowed to remain on the surface to dry in the sun.

The exact causes of the fish kill are still unknown. According to a report by Dr. F. G. Walton Smith of the University of Miami, such kills in the past have occurred in many parts of the world, and records show that they have occurred in

Florida in 1844, 1854, 1878, 1880, 1882, 1883, 1908, and 1916. The recent kills are associated with what is known as the "red", "yellow", or "rotten" tide, which gives the water a color from amber yellow to red or green. This red tide is evidently caused by the presence of enormous numbers of a dinoflagellate protozoan (Class Mastigophora, *Gymnodinium* sp.), as yet unidentified. According to Dr. Smith, the fish are probably killed by some toxic substance, presumably a gas which results from the decay of these dead microscopic organisms. Moreover, the kill has not resulted from wartime poisonous gases buried in the Gulf, from adverse meteorological conditions, or from a gill infection of the fish by *Gymnodinium* itself. All of these causes, however, have had popular support.

It was observed during the investigation that samples of sea water containing *Gymnodinium* had a much higher viscosity than normal sea water. When heated, small bubbles of gas formed which upon inhalation by humans produced a very distinct irritation to the mucous membranes of the throat and caused severe coughing. This irritation subsided quickly when breathing of the fumes from the heated water stopped. No distinctive odor from the gas was apparent nor was any irritation produced after the water had been boiled for a short time, cooled, and then reheated, which seems to indicate that the irritant is a gas readily released by boiling. Water samples were collected by Dr. W. W. Anderson, Chief, Gulf Investigations, Fish and Wild Life Service, New Orleans, for complete analysis in Washington. A report of the findings will be sent to CDC when completed.

RECOMMENDATIONS MADE

After discussions of the problem by CDC investigators in conference with Dr. W. L. Wright, Health Officer of Sarasota County, Mr. Ross E. Windom, City Manager of Sarasota, and Mr. Melton Williams, Director of Anti-Mosquito District of Sarasota County, it was recommended that DDT be used for controlling the adult flies. This step was advisable in order to prevent the flies from migrating into the towns and creating a nuisance. Arrangements were made for CDC, through the Florida State Board of Health,

Accumulated dead fish form almost solid mats at the water's edge.

(Photograph courtesy the Times St. Petersburg, Florida.)

to furnish the DDT and supervision and for the county and city to supply the necessary labor and equipment for applying the spray. A Dobbins 100-gallon orchard sprayer was available although it was considered too small for the purpose. Mr. John A. Mulrennan, in charge of CDC activities for the Florida State Board of Health, furnished eight 55-gallon drums of DDT isomer, 35 percent concentrate, which arrived in Sarasota by truck on July 31. Spraying of the DDT was initiated immediately and was continued under the supervision of Mr. Thurman. While greater success could have been obtained by using an airplane or a ground fog machine for dispensing the DDT, the group felt that, because of the limited health hazard, this greater expense was not justified.

RESULTS

Spraying was begun on Sarasota county beaches on August 1 by a crew of four men. Fly control of the worst areas was soon effected and spraying work was discontinued about August 8. Prior to application of the spray the beaches were inspected and spray applications were scheduled as near as possible to the peak of emergence so that adult flies were killed before they began to migrate. A small amount of spraying was done at Boca Grande on Gasparilla Island on August 2 - 3. Here the flies already had migrated from the beaches and were becoming a nuisance around homes. The 5% DDT emulsion applied with a Bean orchard sprayer was used throughout the town and excellent results were obtained.

SPECIAL ENTOMOLOGICAL ACTIVITIES IN FLORIDA

***ANOPHELES ALBIMANUS* SURVEY**

During the winter of 1946-47, evidence was accumulated which indicated that *Anopheles albimanus* is established in the Florida Keys on Stock Island near Key West, with intermittent breeding on Key West itself. Collections of adults have since been taken in light trap collection on Boca Chica, Cudjoe Key, Marathon (Vaca Key) and Islamorado. The Entomologists of the U.S. Quarantine Service determined a specimen of this important *Anopheles* from Fisher's Island in Dade County, in the spring of 1947.

For the purpose of gaining additional information about the distribution, populations and biology of *Anopheles albimanus*, an intensive anopheline survey of South Florida has been inaugurated under the direction of CDC Activities, Division of Entomology, Florida State Board of Health. Mr. J. S. Haeger, entomologist, assigned to the project, has established headquarters at Homestead, Florida, from which point he will cover the area south to Key West and and Cape Sable, operating light traps at strategic locations and searching for anopheline larvae in likely looking breeding places. From data obtained during this survey conclusions will be made as to whether or not control work is warranted.

SPOTTED FEVER INVESTIGATIONS

Entomological investigations are being carried on in connection with the occurrence of sporadic cases of Spotted Fever in Florida. Clinical cases have been reported from a number of widely separated areas and cases which have been more definitely identified by the use of blood tests have been found at Quincy in Gadsden County, near Bradenton, Manatee County, and at Orlando in Orange County. Arrangements have been made with the Virus and Neurotropic Disease Laboratory of the U. S. Public Health Service in Montgomery, Alabama to test ticks collected from places where human diseases were acquired. Several collections have been submitted to the laboratory. An investigation has been made of the Gadsden and Manatee County cases and plans are being made to collect ticks in Orange County in the near future.

Species of ticks collected in suspected areas are as follows: *Dermacentor variabilis* Say, *Amblyomma americanum* (L), *Amblyomma maculatum* Koch, and *Ixodes scapularis* Say.

VETERINARY PUBLIC HEALTH DIVISION ESTABLISHED

The Veterinary Public Health Division was established in the Communicable Disease Center on September 5, with Dr. James H. Steele, DVM, MPH, as Chief. The new division, with headquarters in Atlanta, will work closely with the Laboratory and Epidemiology Divisions. The veterinary pathologist at the Montgomery laboratory will conduct investigations in conjunction with the VPH Division.

The functions of the Veterinary Division are to investigate and study animal diseases which can be transmitted to man; to develop control measures; to disseminate to State health agencies the information gathered; and to assist States in developing programs within their own veterinary divisions. The principal objective is the control of such animal diseases. Rabies, one of the important diseases of animals that can be transmitted to man, is being given intensive study and emphasis. The eradication of this disease from the United States is the goal.

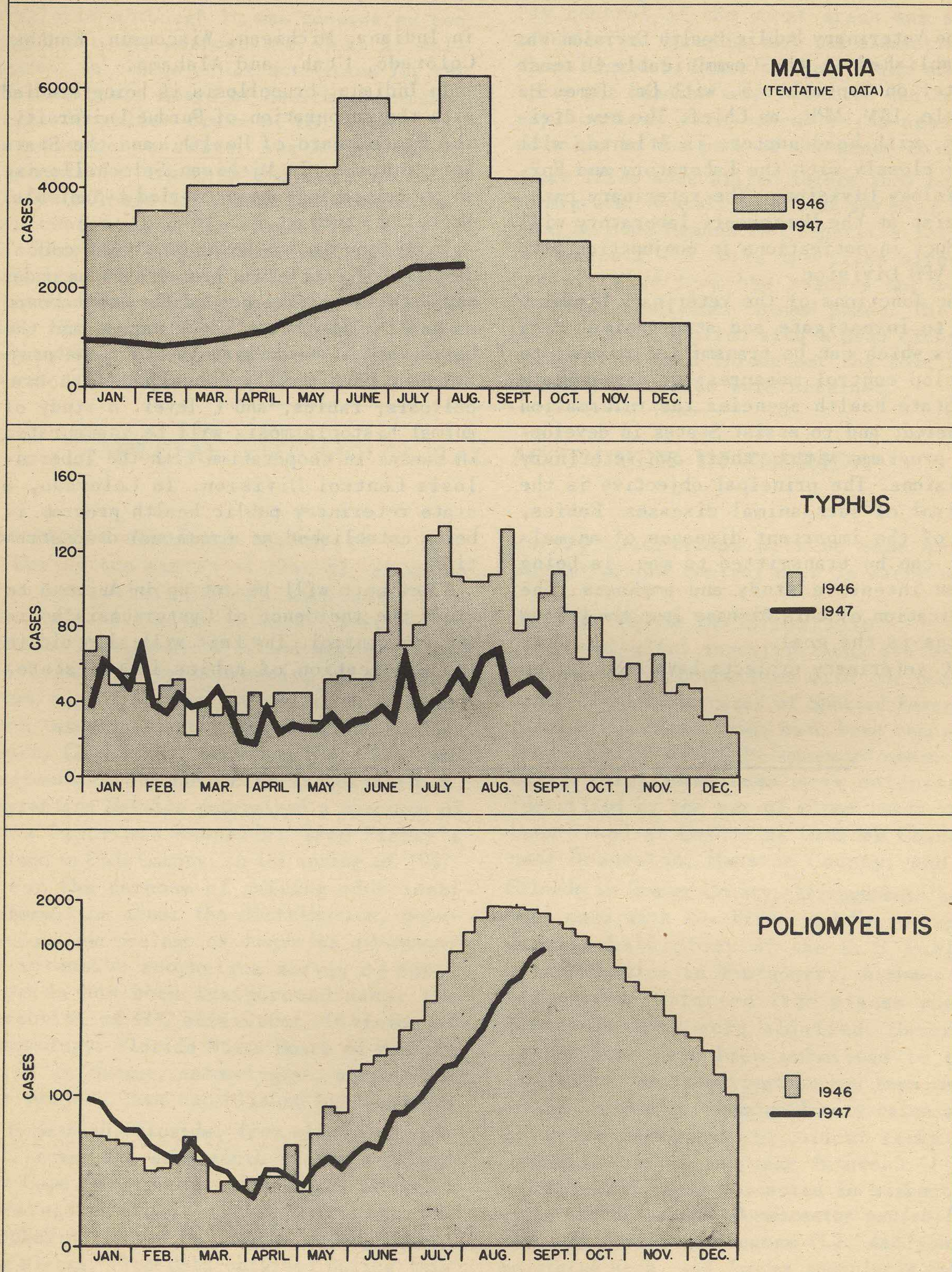
CDC veterinary projects have been set up in Indiana, Michigan, Wisconsin, Kansas, Colorado, Utah, and Alabama.

In Indiana, brucellosis is being studied with the cooperation of Purdue University, the State Board of Health, and the State Veterinarian. In Michigan Salmonellosis, an enteritic infection carried by animals, is being studied.

In Wisconsin, a joint study of coccal diseases of cattle and brucellosis is under way with the assistance of the State Board of Health, the State Veterinarian and the University of Wisconsin. In Utah, the project has been mainly concerned with brucellosis, rabies, and Q fever. A study of animal histoplasmosis will be inaugurated in Kansas in cooperation with the Tuberculosis Control Division. In Colorado, a state veterinary public health program is being established as a national demonstration.

A new unit will be set up in Arizona to study the incidence of Cystericosis bovis and its control. The Unit will also aid in the eradication of rabies in the state.

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



USPHS - CDC ATLANTA, GEORGIA * FROM PUBLIC HEALTH REPORTS

IDEA EXCHANGE

This section of the BULLETIN is being devoted to new ideas which have proved of value in CDC activities. The purpose of this section is to exchange ideas among operating units of CDC. Contributions from the field are solicited. Any idea developed locally that can have wider application, even if not new, is welcome. Send it in!

USE OF POLYVINYL ALCOHOL TO PRESERVE FECAL SMEARS FOR SUBSEQUENT STAINING

Developed by

MORRIS GOLDMAN

In Charge, Intestinal Parasite Laboratory, Laboratory Division, CDC, Atlanta, Georgia.

Fecal samples are often mailed to distant laboratories for diagnosis, either preserved with formalin or phenol or in an unpreserved condition. These procedures are adequate for the subsequent identification of any protozoan cysts and helminth forms present, but protozoan trophozoites are almost always destroyed or rendered unrecognizable.

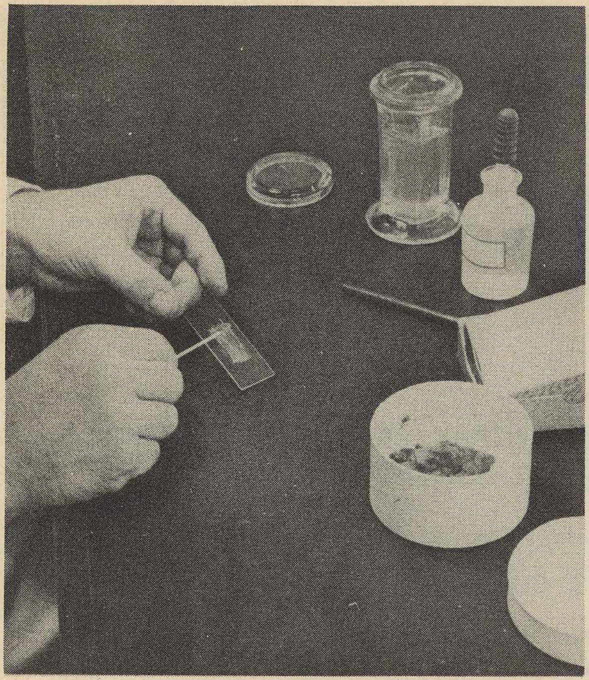
This idea* involves a method which makes it possible to submit trophozoite material in fixed smears on slides, to be stained and examined when received in the diagnostic laboratory. A fixative is added to water-soluble polyvinyl alcohol,** which then serves the dual purpose of fixing the fecal and forming a temporary mount during shipment.

The mounting medium is prepared by dissolving, in a water bath, 5 grams of Elvanol in the following solution: glacial acetic acid, 5 cc.; glycerol, 1.5 cc.; Schandinn's fixative (2 parts of saturated aqueous mercuric chloride to one part of 95% alcohol), to 100 cc.

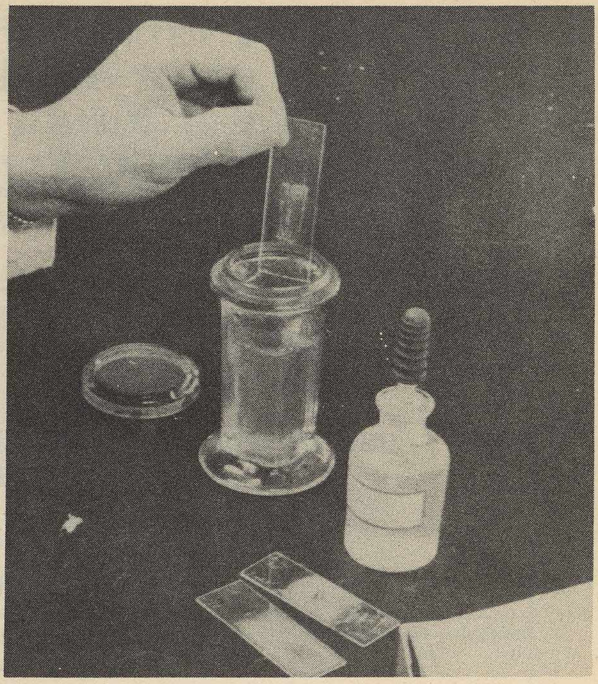
Preliminary experiments show that protozoan cysts and trophozoites as well as helminth eggs are well preserved by this method. Fecal smears prepared in this manner may be submitted to the laboratory with a reasonable assurance that the intestinal parasites present will be recognizable following staining with iron-alum hematoxylin.

* Published in Science, Vol. 106, No. 2741, July 11, 1947. The formula for the mounting medium has been modified since publication.

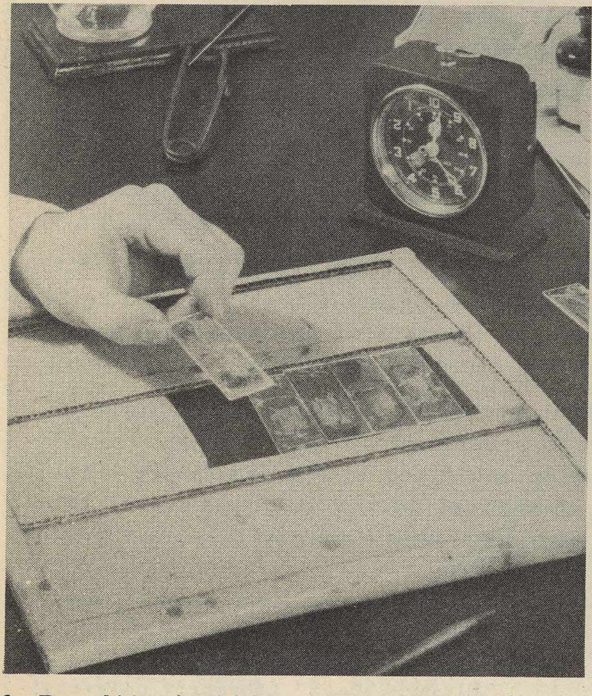
** The product used is specified as "Elvanol 90-25" (formerly polyvinyl alcohol, Grade RH-349-A, Type B, medium viscosity), obtainable from the E. I. duPont de Nemours & Co., Electrochemicals Dept., Niagra Falls, N.Y.



1. A thin fecal smear is prepared on a clean slide in the usual manner. The smear should not be permitted to dry.



2. The smear is covered with Elvanol solution by dipping the slide into a Coplin jar containing the solution. The Elvanol may also be applied over the smear with a medicine dropper.

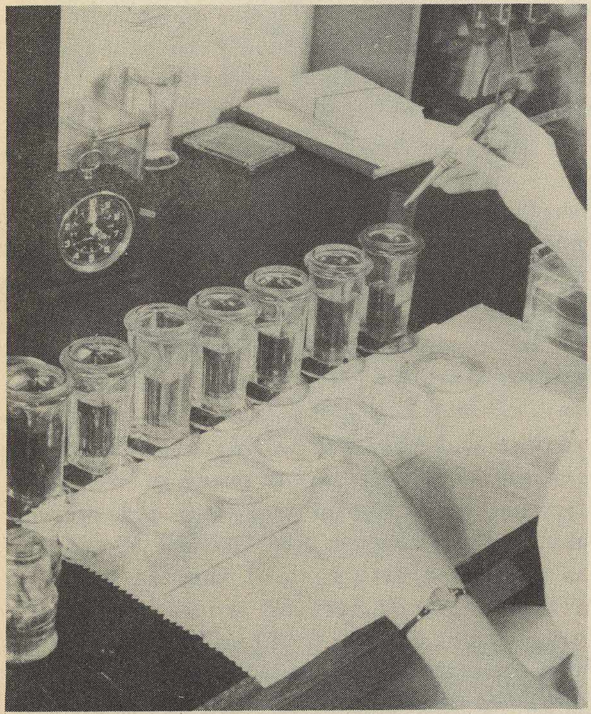


3. The slide should be set aside to dry for two to four hours, depending upon the room temperature. When completely dry, the slide is ready for mailing in any container in which the smears will not be subjected to pressure.

4. Upon receipt in the laboratory, the slide is soaked in a five percent aqueous solution of glacial acetic acid at 50° - 60° C. until all of the Elvanol film has been dissolved from the smear. This usually takes about five minutes.

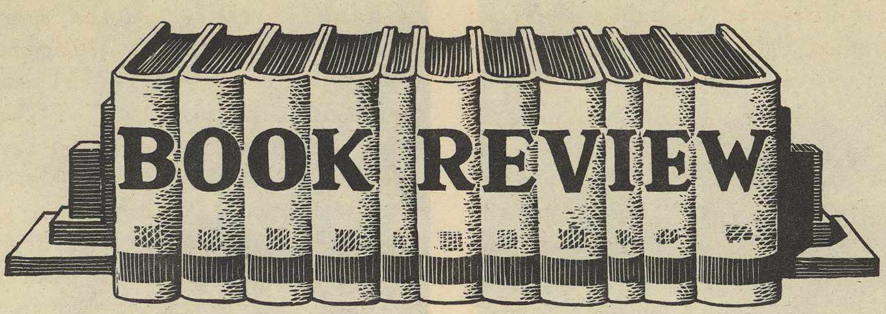
5. The slide is then rinsed in tap water for three minutes.

6. From tap water, the slide is immersed in 70 percent iodized alcohol for five to ten minutes to remove crystals of mercuric chloride.



7. Staining with iron-alum hematoxylin follows in the usual manner, and a cover slip is put over the smear.

8. The smear is now ready for diagnostic examination. Any trophozoites present in the original material can be found in the stained preparation.



DISEASES TRANSMITTED FROM ANIMALS TO MAN by Thomas G. Hull. Third Edition, Charles G. Thomas Publishing Co., Springfield, Illinois, 1947. Price $10.50.

The voluntary association of man with friendly and beneficial animals as well as the unwanted contacts with other animals sometime jeopardizes the health of man. Many diseases are shared by animals and man and others are passively transferred from man to man by animals. This book is concerned with these diseases.

All types of pathogens are considered, viruses, bacteria, fungi, protozoa and helminths. They are presented under four major sections; diseases of domestic animals and birds, diseases of rodents and wild animals, human diseases spread by animals, and animals as passive carriers of disease organisms. A final chapter summarizes the role played by each animal in the spread of disease.

Although Dr. Hull and fourteen contributors have written various parts of the book, each chapter has essentially the same organization. Brief historical accounts of the disease are followed by thorough discussions of the epidemiology and prevention. At the end of each chapter is a helpful pseudo-summary entitled "Items of Note."

The list of contributors includes many important men in the fields of public health and veterinary medicine. The author has been careful to give them full credit for their contribution. Acknowledgement is made at the beginning of the chapter that each prepared.

This is the third edition of the book that was first published in 1930. It has undergone many changes with the advent of new information pertaining to the subject. In comparing the third edition with the second it is obvious that it has been substantially enlarged and improved. There are approximately two hundred more pages and many new illustrations and tables. New chapters have been added on listerellosis, Haverhill fever, tsutsugamushi disease, Q fever, jungle yellow fever and lymphocytic choriomeningitis. Former chapters on louping ill and equine encephalitis have been combined with other diseases into one chapter on arthropod-borne encephalitides.

"Diseases Transmitted from Animals to Man" is an interesting and valuable book, which in its new edition should do much toward accomplishing the aim set forth in the opening paragraph of the author's preface:

"The diseases which animals may transmit to man remain of interest to the veterinarian and the physician, the research worker and the health official. Each is engaged with a different phase of the problem and views the subject from a different angle. The third edition, as was the first, is presented with each of them in mind, to afford a common meeting ground where each may understand the problems of the others and thus through concerted effort reduce the number of infections which man contracts from animals."

M. M. Brooke

AN ILLUSTRATED LABORATORY MANUAL OF PARASITOLOGY by Raymond M. Cable. Revised Edition, Burgess Publishing Co., Minneapolis, Minnesota, 1943. Price $1.65.

This manual should prove to be a very valuable laboratory guide to the parasitology student. Although it was originally designed for the author's courses in this subject, it no doubt can be adapted to similar courses given in other institutions. The manual is organized in such a logical fashion that other instructors could easily arrange their laboratory sessions to coincide with the sequence presented in the manual.

The author has emphasized the parasites of medical importance. Other organisms have been included, however, to make it a well rounded manual of general parasitology. The text material is well written including many pertinent questions that should stimulate the student. The most attractive and valuable feature of the manual is the illustrative material. Practically every organism discussed is illustrated by a clear cut drawing. Most of the illustrations are fully labeled thus enabling the student to easily grasp the meaning of text material. Although in general the hundred-odd illustrations are excellent, the one of the malarial parasites should be corrected. It is labeled in such a manner that it implies that only the immature schizonts of *P. falciparum* are not usually seen in the peripheral blood.

The manual concludes with a rather complete section on laboratory techniques applied to parasitology.

The offset printing is much clearer than the mimeographed paper of the earlier edition.

The manual possesses an index and a list of selected references.

M. M. Brooke

Recent Scientific Publications are Available in the CDC Library.

FILM REVIEW

CDC FILMS RELATED TO PARASITOLOGY

These units are projected at the college level for professional and advanced technical audiences.

"PREPARATION AND STAINING OF BLOOD FILMS" (With Special Reference to the Diagnosis of Malaria).

This sound color motion picture describes the proper technics for preparing and staining thick and thin blood films used in the laboratory diagnosis of malaria. Methods of packing, shipping, and storing prepared films and directions for stain preparation are presented. Characteristics of well-prepared and stained film are indicated. Projection time: 20 minutes.

"PREPARING BLOOD FILM FOR MICROSCOPICAL EXAMINATION."

This color film strip contains some of the same information presented in the motion picture "PREPARATION AND STAINING OF BLOOD FILMS." Material is presented in greater detail and additional technics for cleaning and preparing thick and thin films by several methods are described. Recorded narration is available. Projection time: 18 minutes.

"STAINING BLOOD FILMS FOR MALARIA PARASITE EXAMINATION."

As a companion to the above film strip and motion picture, this unit gives technics in detail on staining blood films using Wright's Giemsa, and Wright-Giemsa stains. Methods of preparing buffer and stain solution and proper methods of storing solutions used in staining processes are described. Technics for staining small numbers of films and for staining in bulk are given in detail. Film strip is in color and has recorded narrative. Projection time: 20 minutes.

"IDENTIFICATION OF MALARIA PARASITES IN THIN BLOOD FILMS."

This color film strip consists of a series of photomicrographs depicting forms of malaria parasites found in thin blood films from the peripheral circulation. The malaria cycle is presented in a series of drawings. Stages of the parasites ordinarily observed are indicated. The differential diagnosis of the three common species of malaria parasites, *vivax, falciparum,* and *malariae* are presented. Characteristic forms of the three species and stages found in circulating blood are described in some detail. A recording accompanies the film strip. Projection time: 17 minutes. (A similar unit, "THE IDENTIFICATION OF MALARIA PARASITES IN THICK BLOOD FILMS" is in an advanced stage of preparation and will be available soon.)

"SCHISTOSOMIASIS," Edition I.

A color film strip with recording, projected at the professional level for physicians, parasitologists, epidemiologists, and other advanced students of biological science. Geographic distribution of various species of blood flukes, life cycle, and methods of identifying the various species are presented. Clinical information includes an account of symptoms with emphasis on the more important clinical manifestations. Importance of ova as the agent of major pathology is stressed. Information on treatment is supplied. Brief attention is given to prevention of this disease in the United States. Projection time: 18 minutes.

"SCHISTOSOMIASIS," Edition II.

This unit is similar to Edition I but is designed primarily for biologists. Observation on geographic distribution is much the same as in "SCHISTOSOMIASIS," Edition I. Methods of infection and identification of species, together with the life cycle showing characteristics of the various stages is given. Descriptions of forms commonly observed in the laboratory are presented. Accounts of treatment and prevention are also included. The film strip is in color and has recorded narrative. Projection time: 15 minutes.

"LABORATORY DIAGNOSIS OF SCHISTOSOMIASIS."

This color film strip presents methods of diagnosing schistosomiasis by demonstration of ova. Causative organisms, life cycles, and pathology related to diagnosis are described. Technics are presented for examining feces and urine. Methods of making fecal smears and of performing floatation and sedimentation tests for recovering ova are given. The rectal punch biopsy is described as a means of diagnosis. Distinguishing characteristics of ova of flukes, ascaris, and hookworms are described. The importance of diagnosis as a basis of treatment is explained. The necessity for repeated examination is stressed. Brief consideration is given to the possibility of transmission of schistosomiasis in the United States. Narrative is recorded. Projection time: 15 minutes.

"FILARIASIS."

This sound film strip, in color, is projected at the professional level for medical and related biological sciences. The geographic endemic areas where filarial worms are found are described. Samoa is considered particularly. The clinical problem of filariasis, means of infection, skin penetration, and migration of the larvae is indicated. Symptomology is described in some detail, giving an account of the lack of early symptoms and the presence of late ones. The organs attacked and the clinical manifestations are described. The life cycle within man and the mosquito are presented. Particular attention is given to the number of exposures in relation to prognosis. Exposure history, lymphatic pathology and presumptive diagnosis are considered along with supportive treatment and psychotherapy. Prevention of filariasis is discussed in some detail. Projection time: 18 minutes.

FEDERAL SECURITY AGENCY — COMMUNICABLE DISEASE CENTER, FISCAL BRANCH — U. S. PUBLIC HEALTH SERVICE

CUMULATIVE OBLIGATIONS INCURRED — BY OBJECT, FISCAL YEAR 1948
AS OF AUGUST 31, 1947

	01	02	03	04	05	07			08	09	13	
						OTHER CONTRACTUAL SERVICES						
	PERSONAL SERVICES	TRAVEL & PER DIEM	TRANS. OF THINGS	COMMUNI-CATION SERVICES	RENT & UTILITY SERVICES	REPAIRS	STOR. & CARE OF VEHICLES	MISC.	SUPPLIES & MATERIAL	EQUIPMENT	REFUNDS, AWARDS, ETC.	TOTAL
7580343.001 - C.C.D.												
Control of Malaria & D.T.O.												
A-4403(002)-Pur. of Automobiles												
A-4404-Salaries-District No. 1												
A-4405-Salaries-District No. 2												
A-4406-Salaries-District No. 3	1,471.47											1,471.47
A-4407-Salaries-District No. 4	1,528.12											1,528.12
A-4409-All Exp.Exc.Tvl.-Dist.No. 6	27,363.53	24.00	512.26	31.90		2.45		200.00	1,515.15			29,649.29
A-4410-Salaries-District No. 7	3,290.34											3.290.34
A-4411-Salaries-District No. 8	703.30											703.30
A-4412-Salaries-District No. 9												
A-4413-All Exp.Exc.Tvl.-Atlanta	411,668.35		16,549.18	335.15	2,532.37	10,527.44	659.50	792.14	236,127.87	5,413.77	1,097.50	685,701.27
Total	446,025.11	24.00	17,061.44	367.05	2,532.37	10,527.89	659.50	992.14	237,643.02	5,413.77	1,097.50	722,343.79
Operation of CDC												
A-4416-All Exp.Exc.Tvl.	197,136.00	455.05	3,461.85	1,568.30	12,720.12	273.76	156.00	6,200.44	26,264.06	13,072.63		261,308.21
A-4417(002)-Pur. of Automobiles												
Total	197,136.00	455.05	3,461.85	1,568.30	12,720.12	273.76	156.00	6,200.44	26,264.06	13.072.63		261,308.21
Murine Typhus Fever Control												
A-4418-All Exp.Exc.Tvl.	113,968.85		2,000.00	53.16	85.77	3,743.45	20.00	110.26	37,228.81	2,194.61		159,404.91
A-4419(002)-Pur. of Automobiles												
A-4420-All Exp.Exc.Tvl.-Hawaii	955.62											955.62
Total	114,924.47		2,000.00	53.16	85.77	3,743.45	20.00	110.26	37,228.81	2,194.61		160,360.53
Virus Disease Invest. & Control												
A-4421-All Exp.Exc.Tvl.	23,048.53		2,107.57	100.16	142.85	373.81		150.24	3,748.24	1,052.02		30,723.42
A-4422(002)-Pur. of Automobiles												
Total	23,048.53		2,107.57	100.16	142.85	373.81		150.24	3,748.24	1,052.02		30,723.42
Diarreheal Disease Invest. & Control												
A-4423-All Exp.Exc.Tvl.	14,677.94		200.00	128.33	34.70	336.14		26.90	5,014.90	2,153.55		22,572.46
A-4424(002)-Pur. of Automobiles												
Total	14,677.94		200.00	128.33	34.70	336.14		26.90	5,014.90	2,153.55		22,572.46

CUMULATIVE OBLIGATIONS INCURRED (Continued)

Laboratory Technological Services												
A-4425-All Exp.Exc.Tvl.	3,421.96		203.00	57.67		69.16			2,310.66	4,812.62		10,875.07
A-4426(002)-Pur. of Automobiles												
Total	3,421.96		203.00	57.67		69.16			2,310.66	4,812.62		10,875.07
Plague Control												
A-4427-All Exp.Exc.Tvl.-Atl.	3,992.13		200.00	2.91		8.96		4.55	201.36			4,409.91
A-4428(002)-Pur. of Automobiles												
Total	3,992.13		200.00	2.91		8.96		4.55	201.36			4,409.91
Total Appropriation 7580343.001	803,226.14	479.05	25,233.86	2,277.58	15,515.81	15,333.17	835.50	7,484.53	312,411.05	28,699.20	1,097.50	1,212,593.39
7580342.002-Assistance to States, Gen.												
A-3955-Salaries	10,610.32											10,610.32
A-3956-Misc. Exp.Exc.Tvl.		195.00	905.00	51.70		7.65	20.00		217.10	13.21		1,409.66
Total Appropriation 7580342.002	10,610.32	195.00	905.00	51.70		7.65	20.00		217.10	13.21		12,019.98
7580340-Control of Tuberculosis												
A-3649-Salaries	2,637.04											2,637.04
A-3650-Misc. Exp.Exc.Tvl.				56.55		12.24		8.50	2,033.79	849.97		2,961.05
Total Appropriation 7580340	2,637.04			56.55		12.24		8.50	2,033.79	849.97		5,598.09
7580110(03)-Traveling Expenses, F.S.A.												
Direct CDC Travel Allotments												
A-3148-Training		884.58										884.58
A-3161-Operation of CDC		3,425.86										3,425.86
A-3162-Control of Malaria & D.T.O.		10,490.17										10,490.17
A-3164-Murine Typhus Fever Control		4,550.16										4,550.16
A-3165-Virus Disease Invest. & Cont.		3,228.21										3,228.21
A-3166-Diarrheal Dis. Invest.& Cont.		308.51										308.51
A-3167-Lab. Technological Services		480.60										480.60
A-3169-Plague Control-Atlanta		155.00										155.00
A-3184-Control of Tuberculosis		80.00										80.00
Total		23,603.09										23,603.09
Increases to Dist. or other Div. Allotments from CDC Tvl Apportionment												
A-3152-Travel Expenses-Dist. No. 2												
A-3153-Travel Expenses-Dist. No. 3												
A-3154-Travel Expenses-Dist No. 4		200.00cr.										200.00cr.
A-3157-Travel Expenses-Dist. No. 7												
A-3163-Travel Expenses-Dist. No. 6		266.80										266.80
Total		66.80										66.80
Total Appropriation 7580110(03)		23,669.89										23,669.89
Grand Total - All Appropriations	816,473.50	24,343.94	26,138.86	2,385.83	15,515.81	15,353.06	855.50	7.493.03	314,661.94	29,562.38	1,097.50	1,253,881.35

CUMULATIVE OBLIGATIONS INCURRED -- BY OBJECT, FISCAL YEAR 1948
AS OF AUGUST 31, 1947

	01	02	03	04	05	07			08	09	13	
						OTHER CONTRACTUAL SERVICE						
	PERSONAL SERVICES	TRAVEL & PER DIEM	TRANS. OF THINGS	COMMUNICATION SERVICES	RENT & UTILITY SERVICES	REPAIRS	STOR. & CARE OF VEHICLES	MISC.	SUPPLIES AND MATERIAL	EQUIPMENT	REFUNDS, AWARDS, ETC.	TOTAL
7580343.001-Control of Communicable Diseases												
Control of Malaria and D.T.O.												
A-4403(002)-Purchase of Automobiles										20,900.00		20,900.00
A-4404-Salaries-District No. 1												
A-4405-Salaries-District No. 2	1,199.60											1,199.60
A-4406-Salaries-District No. 3	1,471.47											1,471.47
A-4407-Salaries-District No. 4	3,056.24											3,056.24
A-4409-All Exp.Exc.Tvl.-Dist. No. 6	38,902.39	24.00	512.26	39.60		2.45		300.00	6,054.35			45,835.05
A-4410-Salaries-District No. 7	4,859.87											4,859.87
A-4411-Salaries-District No. 8	1,406.60											1,406.60
A-4413-All Exp.Exc.Tvl.-Atlanta	585,701.45	338.28	16,944.35	1,232.06	3,911.32	15,747.81	938.00	5,051.59	309,616.03	195,094.56	1,097.50	1,135,672.95
Total	636,597.62	362.28	17,456.61	1,271.66	3,911.32	15,750.26	938.00	5,351.59	315,670.38	215,994.56	1,097.50	1,214,401.78
Operation of Communicable Disease Center												
A-4416-All Exp.Exc.Travel	295,774.39	1,043.48	6,163.86	3,520.05	18,948.23	1,110.92	234.00	9,982.35	33,508.00	25,955.42		396,240.70
A-4417(002)-Purchase of Automobiles										15,300.00		15,300.00
Total	295,774.39	1,043.48	6,163.86	3,520.05	18,948.23	1,110.92	234.00	9,982.35	33,508.00	41,255.42		411,540.70
Murine Typhus Fever Control												
A-4418-All Exp.Exc.Travel	167,912.57	50.00	2,400.00	104.81	127.04	4,880.75	40.00	121.46	43,059.89	43,755.28		262,451.80
A-4419(002)-Purchase of Automobiles										1,000.00		1,000.00
A-4420-All Exp.Exc.Tvl.-Hawaii	955.62											955.62
Total	168,868.19	50.00	2,400.00	104.81	127.04	4,880.75	40.00	121.46	43,059.89	44,755.28		264,407.42
Virus Disease Investigations & Control												
A-4421-All Exp.Exc.Travel	37,872.73		2,108.32	102.16	179.29	572.40		153.58	6,256.84	1,911.18		49,156.50
A-4422(002)-Purchase of Automobiles												
Total	37,872.73		2,108.32	102.16	179.29	572.40		153.58	6,256.84	1,911.18		49,156.50
Diarrheal Disease Invest. & Control												
A-4423-All Exp.Exc.Travel	21,877.94		295.65	206.80	44.24	516.91		63.55	6,450.95	16,085.05		45,541.09
A-4424(002)-Purchase of Automobiles										1,300.00		1,300.00
Total	21,877.94		295.65	206.80	44.24	516.91		63.55	6,450.95	17,385.05		46,841.09
Laboratory Technological Services												
A-4425-All Exp.Exc.Travel	4,496.96		203.00	90.62		69.16			6,984.11	5,635.99		17,479.84
A-4426(002)-Purchase of Automobiles												
Total	4,496.96		203.00	90.62		69.16			6,984.11	5,635.99		17,479.84

CUMULATIVE OBLIGATIONS INCURRED (Continued)

Plague Control												
A-4427-All Exp.Exc.Tvl.-Atlanta	5,197.13		200.00	5.63		27.54		4.55	343.51			5,778.36
A-4428(002)-Purchase of Automobiles												
A-4429-All Exp.Exc.Tvl.-Hawaii												
A-4430-All Exp.Exc.Tvl.-San.Fran.												
Total	5,197.13		200.00	5.63		27.54		4.55	343.51			5,778.36
Total Appropriation 7580343.001	1,170,684.96	1,455.76	28,827.44	5,301,73	23,210.12	22,927.94	1,212.00	15,677.08	412,273.68	326,937.48	1,097.50	2,009,605.69
7580342.002-Assistance to States, Gen.												
A-3955-Salaries	13,210.32											13,210.32
A-3956-Misc. Exp.Exc.Travel		195.00	1,197.28	73.53		74.01	30.00		710.09	243.46		2,523.37
Total Appropriation 7580342.002	13,210.32	195.00	1,197.28	73.53		74.01	30.00		710.09	243.46		15,733.69
7580340-Control of Tuberculosis												
A-3649-Salaries	4,277.04											4,277.04
A-3650-Misc. Exp.Exc.Travel				109.90		12.24		14.93	2,392.65	1,796.10		4,325.82
Total Appropriation 7580340	4,277.04			109.90		12.24		14.93	2,392.65	1,796.10		8,602.86
7580348.001-Operating Expenses, National Institute of Health, PHS, 1948												
A-4908-Salaries-Lab. Tech. Services												
A-4921-Misc. Exp.Exc.Travel-Lab. Tech. Services												
Total Appropriation 7580348.001												
7580110(03)-Traveling Expenses, F. S. A.												
Direct CDC Travel Allotments												
A-3148-Training		1,657.88										1,657.88
A-3161-Operation of CDC		6,344.96										6,344.96
A-3162-Cont. of Mal. & D. T. O.		12,242.59										12,242.59
A-3164-Murine Typhus Fever Control		4,399.61										4,399.61
A-3165-Virus Disease Invest. & Cont.		3,279.85										3,279.85
A-3166-Diarrheal Dis. Invest. & Cont.		546.26										546.26
A-3167-Lab. Technological Services		368.60										368.60
A-3169-Plague Control-Atlanta		97.50										97.50
A-3184-Control of Tuberculosis		200.00										200.00
Total		29,137.25										29,137.25
Increases to Dist. or other Div. Allotments from CDC Travel Apportionment												
A-3152-Travel Expenses-Dist. No. 2		118.22										118.22
A-3153-Travel Expenses-Dist. No. 3		356.94										356.94
A-3154-Travel Expenses-Dist. No. 4		532.10										532.10
A-3157-Travel Expenses-Dist. No. 7		638.76										638.76
A-3163-Travel Expenses-Dist. No. 6		252.45										252.45
Total		1,898.47										1,898.47
Total Appropriation 7580110(03)		31,035.72										31,035.72
Grand Total - All Appropriations	1,188,172.32	32,686.48	30,024.72	5,485.16	23,210.12	23,014.19	1,242.00	15,692.01	415,376.42	328,977.04	1,097.50	2,064,977.96