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MAN, MOSQUITOES AND MICROBES.

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THE CONTROL OF MOSQUITOES IS A MATTER OF INCREASING CONCERN IN THE STATE OF FLORIDA. A BRIEF DESCRIPTION OF THE LIFE CYCLE, VARIOUS SPECIES, CONTROL, AND DESCRIPTION OF DISEASES TRANSMITTED BY THE MOSQUITO WAS PRESENTED. THE ARTICLE CONCLUDED THAT MOSQUITO CONTROL IS NOT ONLY A HEALTH PROBLEM, BUT ALSO A MATTER OF IMPROVED ECONOMICS IN RELATION TO POPULATION GROWTH. THIS DOCUMENT IS AN ISSUE OF "FLORIDA HEALTH NOTES," VOLUME 59, NUMBER 5, MAY 1967. (JS)

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Man, Mosquitoes and Microbes

(Cover photo) A salt marsh mosquito, AEDES SOLLICITANS, takes a meal of blood from a human finger. If the mosquito has a virus, it would pass it on to the human through a salivary fluid which the mosquito injects into the human during the meal.

Arthropod-borne diseases are normally carried by mosquitoes from one bird to another or to a rodent. These serve as reservoirs for the diseases. When horses or men are bitten by a virus-carrying mosquito, they become ill and sometimes die.

Man, Mosquitoes and Microbes

It's summertime in Florida!

At one time summer meant "mosquito-time" and life was considered unbearable; pestilences raged; a member of Congress said that the state could never be developed, was not a fit place to live, and described it as a land of swamps, alligators, frogs and mosquitoes. Today, only a few decades later, mosquito control has made Florida a year-around tourist's paradise, a retirement place and a desirable spot for enjoyable living.

Ever since the Spaniards, and recorded history, touched these shores, man and the mosquito have been bitter enemies. This insect has been known as a biting pest for centuries, but only since the beginning of the 20th Century has man known that yellow fever, malaria, dengue fever and some viral encephalitides were arthropod-borne diseases.

Mosquitoes have always been considered one of the unpleasant things in life. The knowledge of how to eradicate these pests and the diseases they carry is being acquired through research carried on by the State Board of Health, the U. S. Public Health Service, the U. S. Department of Agriculture, mosquito control districts, private philanthropic foundations and other governmental agencies.

This issue of **Florida Health Notes** will tell you about

- the dangers engendered by the mosquito;

- the fight to make the state pleasantly livable for you, for the six million other residents of the state and for 17 million annual visitors; and

- the research being conducted to find the intimate secrets of a mosquito's life and to control arthropod-borne diseases.

Man - The Victim

From the earliest days mosquitoes have been a nuisance in Florida. They have played a prominent part in the slow development of this subtropical gem called Florida, even though the state otherwise had much to offer its residents and visitors. The beauty of the Sunshine State has been marred by 67 species of mosquitoes, several of them carrying disease and/or otherwise making life intolerable.

The mosquito was such a plague when the Spaniards arrived that they named what today is Ponce de Leon Inlet, or Mosquito Inlet, "Barro de Mosquitos." Since the time of the earliest maps, one of which dates from 1615, some of Florida's inlets, lagoons and sections have borne the name Mosquito. In the 18th Century, the part of Florida lying between the St. Johns River and the coastal lagoons north of Cape Canaveral was called "The Mosquito Country," or "The Mosquitoes."

Two lagoons in the area were named North and South Mosquito Lagoons. When the British owned Florida, they tried to improve the nomenclature by naming the north lagoon after the Earl of Halifax and the south lagoon after the Earl of Hillsboro. Later in the 19th Century, these names became official but the Hillsboro River was changed about 40 years ago to North Indian Lagoon to avoid confusion with a stream near Tampa.

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Hundreds of thousands of mosquito pupae clog a ditch. Unless they are destroyed, adult mosquitoes will emerge within a few hours and take flight at twilight.

In 1824 when Mosquito Country was made into a county which included a large portion of peninsular Florida, governmental officials could think of no more appropriate name than "Mosquito County." The Florida Legislature changed the disagreeable name to Orange County in 1845.

The insect was feared by armies that fought across Florida. Soldiers were so beset by mosquitoes during skirmishes that the men were unable to fight.

For many years settlements were restricted to the northern section of the state. The southern portion was a series of swamps, lakes, rivers and hammocks populated mostly by hoards of mosquitoes and other biting insects. Even though northern Florida was settled, it suffered from disease, hardship and poverty. With the exception of Key West, the major cities—Tallahassee, Jacksonville,

St. Augustine and Pensacola—were in this area, which was known as the "malaria belt."

Every year deadly fevers spread consternation throughout the region. Shops were closed; fear of the epidemic and the stifling heat caused those who could afford the expense to migrate North to more healthful climates for the months of August, September, October and November. Those who were forced to stay behind suffered through the pestilent seasons or were buried in the large cemeteries which marred the beauty of the region.

When the statehood of Florida was being debated in Congress, John Randolph of Virginia stated that Florida could never be developed, nor would it ever be a fit place to live. He described the region as "a land of swamps, of quagmires, of frogs and alligators and mosquitoes."

The Story of Yellow Fever

For years yellow fever brought fear and panic to many Florida cities which were visited by ships from the Caribbean and Central and South America. Commerce and passengers arriving in Florida ports seemed to be accompanied by wave after wave of yellow fever. Many strange remedies were recommended. Mail and cargo were

An air plant, or bromeliad, is the breeding place of several species of mosquitoes, including AEDES AEGYPTI, the yellow fever carrying mosquito.

fumigated; cannons were fired; lime was spread in the streets, houses and shops; bonfires were lit at night.

The 1877 yellow fever epidemic in Fernandina and Jacksonville was described by historians as the state's greatest holocaust. Fernandina, with a population of 1632, had 1146 persons ill with the fever. Twenty-four died. In 1887, yellow fever epidemics raged in Key West, Tampa, Plant City and Manatee. The panic was so widespread in Tampa that lighted lamps were left and stoves were still burning when people fled the city in haste. The 1888 epidemic in Jacksonville saw some 10,000 persons (out of a population of 26,800 in Duval County) flee the city in carriages, drays, wagons, trains and ships laden to capacity.

The yellow fever epidemics brought about the creation of the State Board of Health. Although nobody knew it at the time, the public health programs of Florida had their beginning in the mosquito. By 1901 this insect was discovered to be the transmitter of yellow fever. Following an epidemic in Pensacola in 1905, the quarantining of ships which were thought to be bringing the vector from foreign ports, the screening and spraying of homes, the destruction of adult mosquitoes and the prevention of mosquito breeding brought about an end to the fearsome epidemics.

The mosquito was also incriminated in the transmission of dengue fever and malaria. Although obervations were made by the first State Health Officer, Dr. Joseph Y. Porter, that attacks of malaria were more deadly along the river bottoms, marshlands and in the flatwoods, no concerted efforts were made to control malaria until World War I when drainage and larviciding were carried out at Camp Johnson by the joint efforts of the U. S. Army, the U. S. Public Health Service and the State Board of Health.

Mosquito Control's Beginning

The first malaria control program was undertaken by the State Board of Health in Perry in 1920. At the time it was the largest project of its kind in the country. A total of $28,000 was spent and 47,000 cubic yards of dirt moved to make drainage ditches and canals. The cost of the project was borne by the City of Perry,

Taylor County and the Burton Swartz Cypress Company with the State Board of Health supplying technical supervision. The resulting better health of the people of the area proved the benefits of the project.

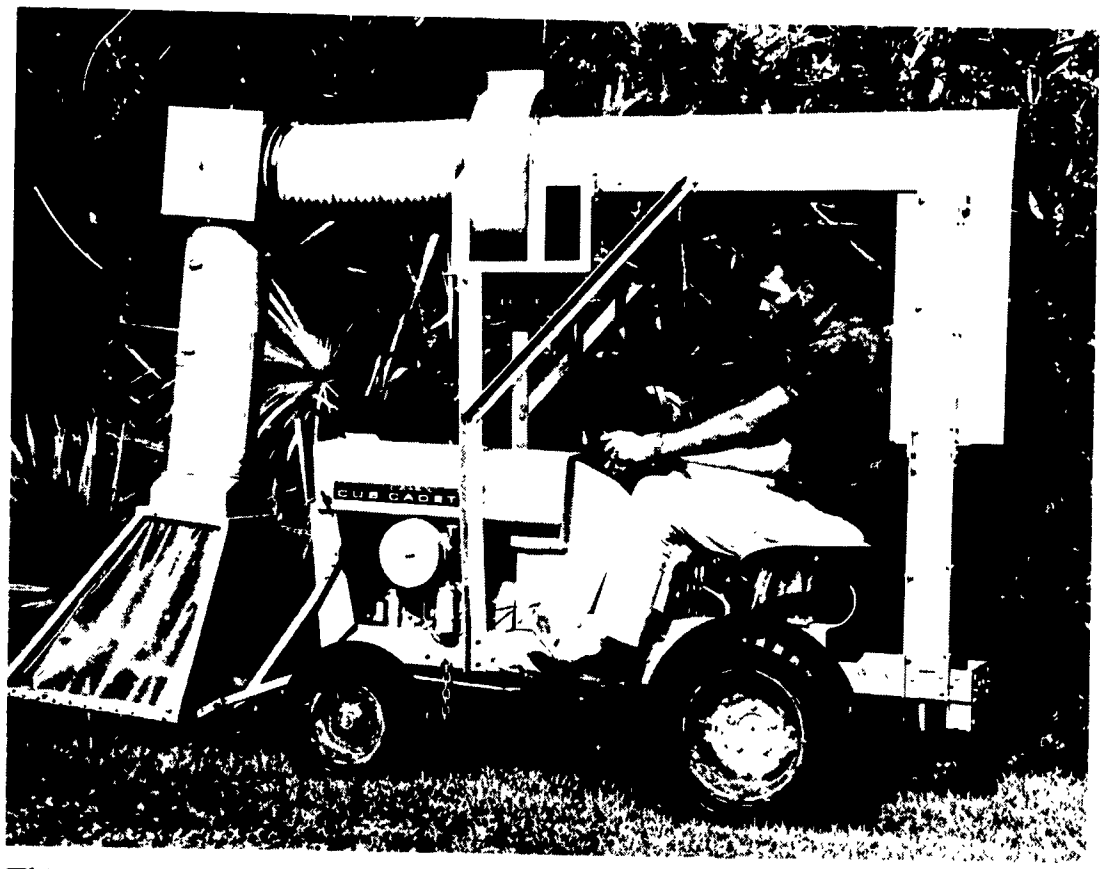
Further progress in controlling malaria, and subsequently mosquitoes, was made when the Rockefeller Foundation established a malaria control research station at Tallahassee in 1931. This station, working in conjunction with the State Hospital at Chattahoochee and the State Board of Health, gave inestimable value to work in the malaria field. A mosquito control research station was also established in Orlando in 1932 by the U. S. Department of Agriculture and later moved to Gainesville.

The State Board of Health created the Bureau of Malaria Control in 1941 to study and make recommendations for controlling malaria in the state. This became the Bureau of Entomology in 1946 and the scope of activity was made to cover all work pertaining to all arthropods transmitting human diseases or annoying man by their bites.

The State Board of Health's Entomological Research Center at Vero Beach was established in 1955 to study Florida's biting insects, particularly mosquitoes, sand flies and yellow flies. The aim was to eliminate these nuisances from the Florida scene. The Encephalitis Research Center was established at Tampa in 1962 following an epidemic of St. Louis encephalitis to investigate the viruses carried by arthropods and, if possible, bring about some kind of control. The work of these centers will be discussed later in this issue of **Health Notes.**

Mosquito - The Villain

The mosquito is a long-time, undesirable resident of Florida. Humans living in the state have been swatting mosquitoes for generations but eradication is most difficult. There are 67 species in the state and each has its own particular mating and breeding habits, living and resting areas, and its own preference for food—



This motorized vacuum machine has been developed by staff members of the State Board of Health to collect blood-engorged female mosquitoes from their resting places among woodland debris.

which may be human blood. Seven of the 67 species have been implicated in the carrying of arthropod-borne diseases which are seriously affecting humans and animals.

The Female is Deadly

As everyone knows, the female mosquito is the one that causes the problems because she is the one that bites and carries disease. The male mosquito spends his short life on the edge of breeding areas, mating with any female that comes near, sipping nectar from flowers and performing his "twilight dances."

Life for mosquitoes begins as an egg laid on water or moist soil, or inside a can, tire, air plant, tree hole or most anything that holds water. The larvae, curled up inside the eggs, hatch at once if in water or may stay that way for weeks or months until rain or tidewater covers them. The free-swimming larvae, or wigglers, grow through several changes of skin in about five to seven days and change into pupae which look like animated commas. In a couple of days, the pupa's skin splits up the back and out emerges the winged and "lance-equipped" adult mosquito.

Mosquitoes are identified and counted in several laboratories of the State Board of Health.

The newly-emerged mosquito must wait six to eight hours before it can fly away from the place of its birth. Then, if it is dark, it may migrate from two to 10 miles. Entomologists, using radioactive means of marking mosquitoes, have found some species that will migrate up to 25 miles. The migrations appear to be mechanical — an urge to go somewhere. Following the migration, the female mosquito settles down to a life of obtaining food, waiting for her eggs to mature and then laying them. She goes through several cycles of this and then expires at the ripe old age of two or three weeks. Frequently the female needs a blood meal for her eggs to mature but this is not true of all species.

The elimination of the mosquito from the Florida scene is being researched and carried out in all stages of its life — the egg, larvae, pupae and adult. The first three stages can be accomplished by natural enemies of the mosquito, such as fish, or with larvicides; removal of breeding places, such as ditching and draining of swamps; or removal of water-holding containers left by humans.

The eradication of the adult is necessary because of the biting habits of the female or because of a sudden epidemic of encephalitis that does not allow time for the reduction of mosquitoes in their breeding places. Fogging and spraying therefore become necessary.

All techniques to control mosquitoes must be safe for man and be harmless to valuable forms of life in the mosquito's environment. For example, when controlling pasture-breeding mosquitoes, other forms of wildlife must be considered at the same time that mosquito production is halted. When draining, filling or flooding marshes, other life in the swamps must be considered. While useful forms of life must be preserved, the application of insecticides, such as the spraying of homes in malaria control, may have a beneficial side effect by destroying other domestic pests — flies, roaches and ants.

Where Do Mosquitoes Breed?

As previously stated, each mosquito species prefers its own breeding place. Some are domesticated and breed in and around the dwelling places of humans or on lands converted to human use, such as pastures, groves, ditches, drains or even in polluted waters. Other mosquitoes prefer wild lands, such as swamps, ponds and woodland pools—far away from man and his habitats. Some species are not particular and will breed in both places.

The Domestic Mosquito

Aedes aegypti, the mosquito that carries yellow fever and dengue fever, is the most domesticated. It breeds around man's home in cans, old tires, bird baths, drains, vases, tree holes, air plants — anywhere water can collect. The eggs are laid on the side of the container, just above the water line. The adult seldom flies from its breeding place. At the present time there is an intensive federally-

supported program in Florida to eradicate **A. aegypti.** This campaign is part of a nationwide program being carried out to fulfill a commitment under international treaty with South and Central American nations to eradicate the yellow fever carrying mosquito from the Americas.

Culex nigripalpus, the mosquito implicated as the carrier of St. Louis encephalitis in Florida, is a wide breeder. It likes all kinds of man-made places — agricultural fields, irrigated pastures and groves, fallow fields, grassy and drainage ditches, floating exotic plants, home premises and polluted waters.

Culex quinquefasciatus, which transmits bird malaria, fowl-pox and other diseases, breeds in temporary receptacles, drainage ditches and polluted water. It is also a carrier of St. Louis encephalitis throughout the United States, but it has not yet been incriminated in Florida.

The Salt Marsh Mosquito

Two of the greatest pest mosquitoes, **Aedes sollicitans** and **Aedes taeniorhynchus,** usually breed in areas along the coast, marshes, swales and mangrove swamps, which may be flooded by rain or high tides (not normal tides) for a week or longer. The most plentiful of any species, these two can fly up to 25 miles.

The Freshwater Swamp Mosquito

Aedes infirmatus and **Aedes atlanticus,** which are capable of carrying California encephalitis, and **Aedes vexans,** which transmits heart worms in dogs, are found in temporary freshwater pools and on river plains flooded by heavy rains. Some **Psorophora** species are also found in flooded fields, irrigated ditches and groves, and rain pools.

The malaria mosquito, **Anopheles quadrimaculatus,** is found in maple and gum swamps, freshwater marshes and ponds, lime sinks, flooded fallow fields, drainage ditches and floating exotic plants. **Anopheles crucians** is found only in cypress and maple-bay swamps, fresh marshes and ponds, grassy ditches and borrow pits.

The Tree-Hole and Air-Plant Mosquito

Where trees and air plants are found in great numbers, **Aedes triseriatus** and two **Wyemoyia** species, **mitchellii** and **vanduzeei,** breed and are found in vexing abundance.

The Intimate Life of the Mosquito

The control of the mosquito can be carried out in many ways but research can tell what is the best and most economical way to do it. Improvement in mosquito control has been the direct result of research. The Entomological Research Center was set up by the State Board of Health 12 years ago to further research and control.

Much needs to be known about the insect to be controlled. Unfortunately, because of her widespread movement, only a small fraction of the female mosquito's life has been known in the past — mostly about her birth and the moment she bites you. How much knowledge of the intimate life of the mosquito — where she goes, where she feeds, mates and lays her eggs — has been acquired, but more needs to be known to bring her under man's control.

Mosquitoes are first studied in their natural habitat. These field studies bring out what needs to be clarified and verified in the laboratory. Through the raising of captive mosquito colonies, the process is refined. Problems are then brought back to the field for experiment and study in nature.

Out of this interplay between field and laboratory comes an improved understanding of the mosquito's total natural history. The mosquito is as complicated a creature as man and studies of the whole insect need the inclusion of such areas as endocrinology and metabolism before a complete understanding is reached.

This research is carried on in four sections at the famous Entomological Research Center in Vero Beach.

The Ethology Section studies the life histories and habits of the mosquito. Among the special projects undertaken is a study of salt-marsh mosquito migration. The breeding, emerging and exodus

Mosquitoes are marked prior to being released from the rearing pens of the Entomological Research Center.

of the mosquito from the marsh is well understood, but the actual migratory flight occurs only at night which makes its study difficult. The final distribution of marked salt marsh mosquitoes has been determined but the scientists are attempting to learn the whys and wherefores of long and short migrations.

You may think that mosquitoes will bite anything in sight. Studies are being made to find out whether certain kinds of animals attract certain mosquitoes. Blood specimens from engorged mosquitoes caught in the wild are matched with blood samples from birds and animals captured in the same area to see if any real preferences exist. It is also important to know the flight habits of the female once she has had a blood meal, and the type of shelter she seeks in which to rest.

The Ecology Section is concerned with the mosquito's environment and the effects of weather, tides, vegetation, soils and anything else that influences the mosquito's distribution and abundance.

The Physiology Section studies the biological functions for a better understanding of the mosquito's behavior. Inquiries are being made into why some mosquitoes need blood to make eggs while others do not. This is tied up with nutrition and hormones which are also under study. The nutrition studies call for the rearing of larvae with precision methods in controlling temperature, light and diet.

The Biochemistry Section looks into the metabolic functioning of the female mosquito — such as what does she do with nectar meals and blood meals. Answers to such questions as to how long can a newly-emerged adult fly before needing food, how long can a mosquito live without nectar to feed on, and how long can a mosquito live on its fat reserve have been found in the laboratory. Now the Entomological Research Center needs to establish the answers in the field.

All of this research is related to control measures. Basic research takes time. The practical, temporary control measures of applied research are sought at the West Florida Arthropod Research Laboratory near Panama City. At this laboratory, the work is divided into two sections: mosquito control and control of biting flies. The scientists look for temporary measures, such as insecticides and land and water management, to control the biting insects. The application of insecticides in different concentrations and by different methods is studied to find the effect chemicals have on the larval stage in swamps and on adults in their resting places.

Temporary measures include:

The use of larvicides to kill mosquitoes in the early stages. These are applied by air and ground equipment. Applications must be thorough but heavy vegetation, winds and heat currents place limitations on this type of control.

The use of adulticides — applied as diluted mixtures of chemicals and oil by aircraft, ground blowers or fogging machines — to kill adult mosquitoes in a specific area. Limitations, such as heavy canopy of trees, hot ground or wind, can restrict the effectiveness of these pesticides.

The methods of killing the villainous mosquito are not 100 per cent effective and there are always some mosquitoes left to assure more large broods — which also periodically must be destroyed.

Research on the control of chironomid midges, sometimes called "blind mosquitoes" is carried on at the Midge Control Laboratory in Winter Haven.

Microbe - The Killer

If mosquitoes were merely biting pests, they would be bad enough. But the fact that they carry disease is far more important. There are several arthropod-borne diseases which have proved fatal to man and animals in Florida, in addition to previously mentioned yellow fever, dengue fever and malaria but which, in contrast to these historic three, are still with us. These are the "arbovirus" encephalitides (sleeping sickness), St. Louis, California, Eastern, Venezuelan and Western. Another virus, Tensaw, has also been marked by epidemiologists as a potentially dangerous mosquito-borne disease.

These viruses are threats to man because the human population is rapidly spreading into areas which were until recent decades uninhabited. Now abounding in drainage ditches, catch basins, artificial water receptacles and impounded lakes and streams in addition to natural breeding places of mosquitoes, these areas add to the mosquito populations where men live.

Suckling mice are raised in the virology laboratory for the testing for arboviruses.

Florida is also strategically located on the eastern flyway of migratory birds traveling from the Northern and Southern continents. Some of these birds are thought to be reservoirs of certain arthropod-borne viruses.

The epidemics of St. Louis encephalitis in the Tampa Bay area resulted in the establishment of the Encephalitis Research Center in Tampa which carries out and coordinates studies of arthropod vectors, vertebrate reservoirs and human and animal hosts of encephalitis viruses.

A colony of mosquitoes, which have been raised in captivity, can be seen in the small cage. (On opposite page) A worker places a pan of pupae in a large cage where adult mosquitoes will emerge. The clock on the table regulates the amount of light the mosquitoes receive.

Statewide surveillances by the State Board of Health in Florida include work by

- the Division of Veterinary Public Health, in the Bureau of Preventable Diseases, which maintains chicken sentinel flocks around the state to detect any activity of encephalitis viruses and collects reports from veterinarians of equine encephalomyelitis and possible encephalitis in game birds;

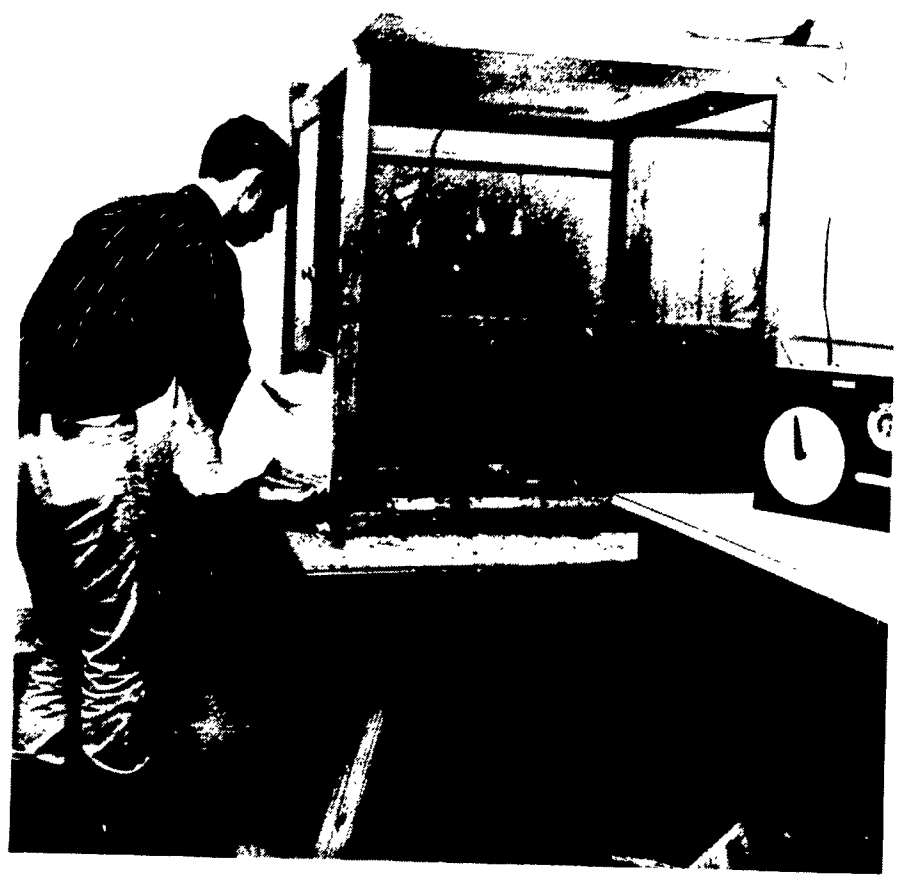
- the Division of Epidemiology, also in the Bureau of Preventable Diseases, which collects reports of suspected cases of arthropod-borne viruses in humans from physicians, hospitals and County Health Departments;

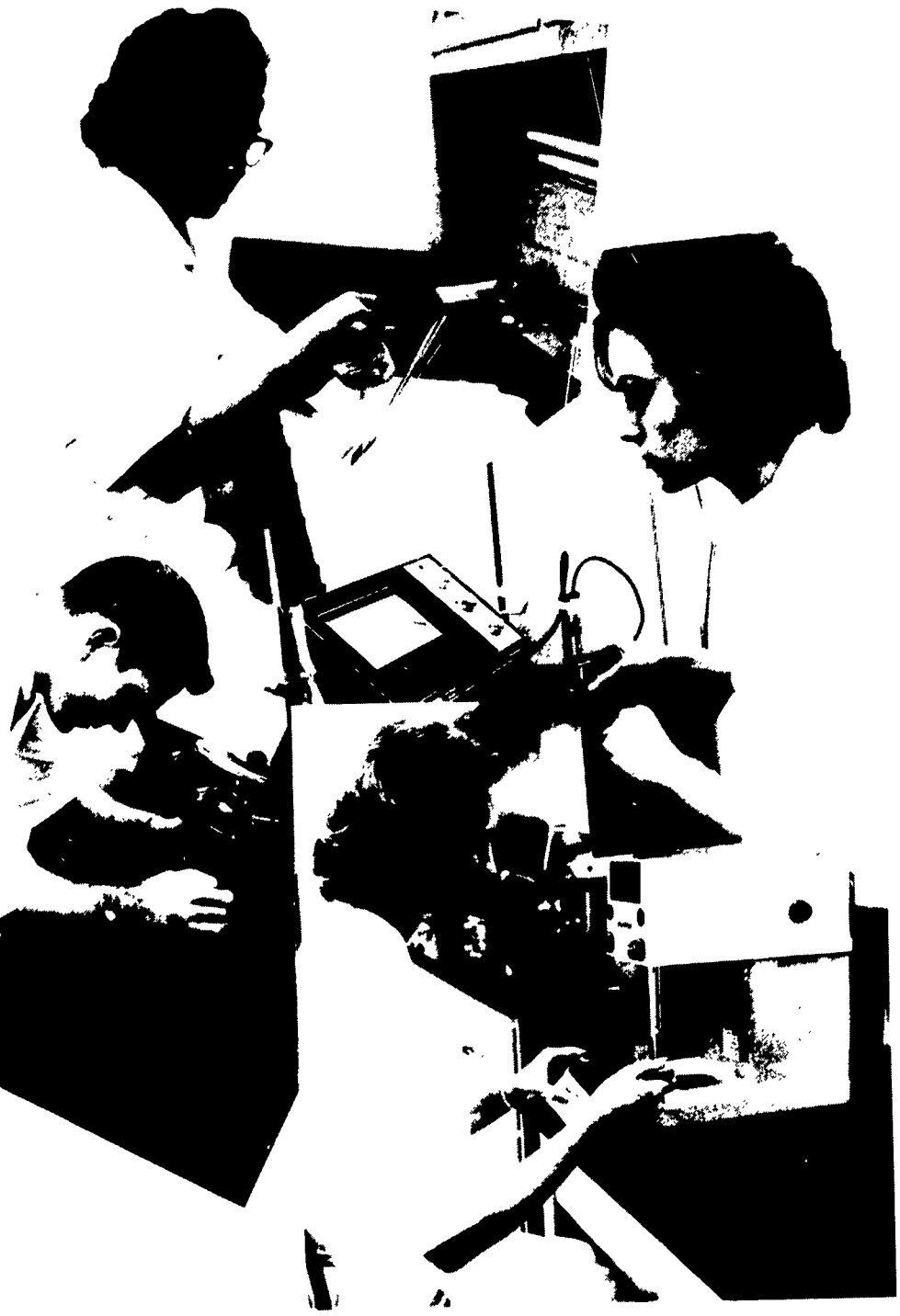
- the Bureau of Entomology, which through a group of co-operators, collects, identifies and measures the density of adult female mosquitoes, and prepares pools of mosquitoes for viral studies; and

- the Bureau of Laboratories, which examines human and animal diagnostic specimens and mosquito pools for arthropod-borne diseases.

The Viruses

The St. Louis encephalitis virus, which was responsible for three epidemics in the Tampa Bay area in 1959, 1961 and 1962, involving some 300 persons and 50 deaths, is still a major threat despite the fact that it has not been detected in Florida in th· past four years. The reason for this constant threat is that the mosquito **C. nigripalpus,** which has been declared the vector, is prevalent in both rural and urban areas of Florida. Migratory birds, or birds from the Everglades, are presumed to be the reservoirs for this virus. Older people, who hav·e retired to Florida, have a marked susceptibility to the disease. Mortality averages one in three cases and survivors have neurological or emotional defects for two to three years following the illness. St. Louis encephalitis is a milder disease in younger people. The control of this disease is important to our tourist-oriented economy.





A battery of tests is performed in order to isolate and identify arboviruses in the Encephalitis Research Center's virology laboratory.

Eastern encephalitis is with us all of the time and appears to circulate in a certain type of swamp mosquito, **Culiseta melanura.** This insect rarely bites man or mammals unless they wander too close to the swamps. Seven persons have been stricken in the last two years with this disease which has a 50 to 70 per cent mortality rate in national statistics. Although a vaccination for horses has been developed, there are an average of 100 equine cases caused by Eastern encephalitis each year. The virus also damages flocks of game birds, particularly pheasants and chukars — a type of partridge. The virus apparently stays localized in swamps but with housing projects being built closer to these areas, the danger to man is increasing.

California encephalitis is a newcomer to Florida and was not recognized prior to 1963. Four Florida persons (three of whom came from North Carolina after exposure there) have been attacked by the virus. Epidemics have occurred in Wisconsin, Ohio and Indiana during the last five years. Surveys show that five to six per cent of Florida's population have antibodies which indicate that they have been infected sometime in the past. The mystery is: Why are not more people ill with the disease? The answer is possibly because laboratory tests sensitive enough to detect the virus have not been found. Mammals, such as small ground squirrels and wild rabbits, have been reported as reservoirs for the virus in other parts of the United States but it is not known what the reservoir is in Florida. The vector mosquitoes are freshwater **Aedes,** and California virus has been found in them throughout the state.

The Venezuelan encephalitis is found repeatedly in the Everglades by teams from the U. S. Public Health Service. The virus appears to circulate constantly between mosquitoes and small rodents. About 27 per cent of the Seminole Indians, and a small number of rangers from the Everglades National Park, have antibodies which indicate they have been infected. Carried by the pest mosquito, **A. taeniorhynchus,** the virus produces widespread epidemics in Central and South America. Symptoms are similar to influenza. If the virus ever got into Florida's plentiful salt marsh

The best method of preventing mosquito biting and possible infection is to:

- **use repellents,**
- **wear protective clothing,**
- **avoid areas and times of mosquito activity (mostly at dusk or dawn) and**
- **get rid of standing water (breeding places) around your home.**

mosquito, public health authorities would have a major problem on their hands.

Western encephalitis has been found consistently in Florida since 1960. Antibodies in birds show that it is present in the biological environment but to date the only mammals involved have been horses. In the Great Plains and the West, the virus has caused a great deal of sickness in humans and horses.

Lesser Microbes

The Tensaw virus, found in **Anopheles** mosquitoes, is presumed to have a mammal-mosquito cycle. Only one human case has been found in Florida despite the fact that it is abundant throughout the state and antibodies are found in three to five per cent of the population. The virus was also found in a dead fox submitted for rabies studies. It does not appear to present a human or animal health problem at the present time.

Yellow fever and dengue fever have ceased to be a threat to Florida although they are found in the Caribbean Islands. Yellow fever was last seen in Pensacola in 1905 and dengue made its last appearance in Miami and the Tampa Bay area in 1934. However, in 1964, two Florida residents came down with dengue fever after returning from Puerto Rico and Jamaica where epidemics were raging. The last case of malaria was contracted in southwest Florida in 1948.

Surveillance for Viruses

Utilizing reports from physicians, hospitals and County Health Departments in the Tampa Bay area, the Encephalitis Research Center keeps a watch over people and animals in the West Central area of the peninsula. Approximately 1600 persons have been screened for arthropod-borne diseases in the last four years. Because the viruses do not always produce illnesses in people, specimens are taken from approximately 400 healthy persons in the Tampa Bay area once a year to see if they have developed silent infections or antibodies.

Mosquitoes are collected at regular intervals from various kinds of traps geographically scattered throughout Pinellas, Hillsborough, Manatee and Sarasota Counties. Over one million mosquitoes have been trapped in the past four years and all species have been examined for viruses. The mosquitoes are separated into species and then separated by sexes. The females are put into pools of 50 and 100 mosquitoes, which are mixed together and inoculated into baby mice. If the mice become sick and die, the virus is believed to be present. If subsequent tests are positive, the viruses are isolated and identified. Seven viruses can be identified in the Encephalitis Research Center's virology laboratory; other types are sent to the U. S. Public Health Service, Communicable Disease Center laboratories, Atlanta, a national laboratory at the University of Pittsburgh, or the international laboratory at Yale University. In the past four years, three previously unknown viruses have been discovered in Florida in ticks, mosquitoes and cotton rats through the efforts of the Encephalitis Research Center.

Biologists at the Center in Tampa attempt to detect current and past virus infections in mammals, birds and amphibians. Chickens, rabbits and pigeons have been placed in cages in wild areas to detect arboviruses in wild mosquitoes. Wild animals and both resident and migratory birds are collected, bled, tagged and released. No harm is done to the birds and sometimes the same bird is caught repeatedly. Over a period of three years one small bird was caught and bled 18 times without harm by the biologists. The blood

samples from these animals and birds are examined for the presence of virus or antibodies to viral infections.

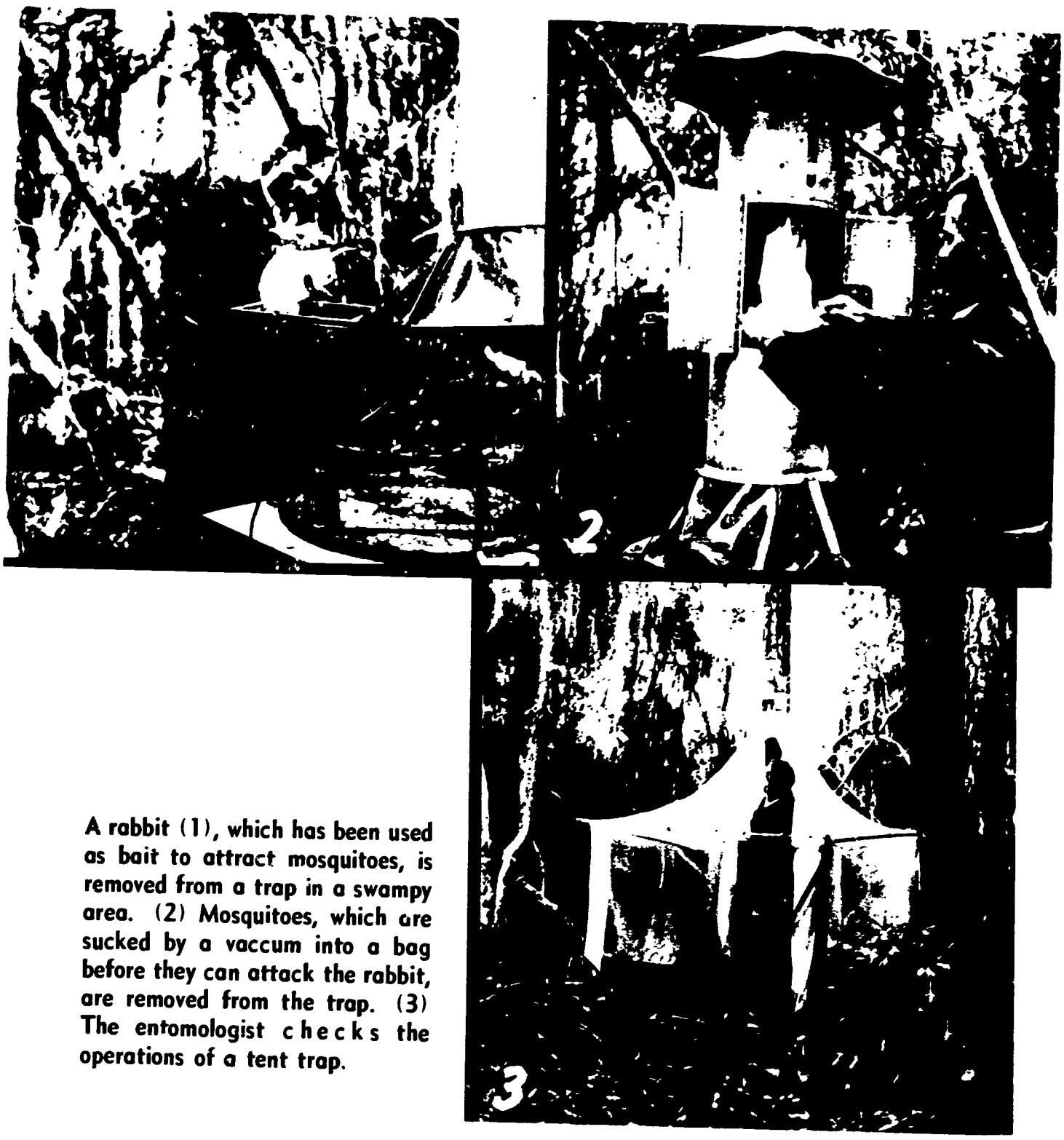
The State Board of Health, through its various bureaus and divisions, continues to look for ways of interrupting the transmission of viruses in the mosquito-bird-man cycle. This seems to be the most practical way of protecting the citizens of Florida from encephalitis.

What Mosquito Control Means to Florida

One of the most important key factors to the expansion of the Florida economy is mosquito control. Such men as Henry Flagler and H. B. Plant, who came to Florida with money to invest, looked to the State Board of Health for proper sanitary regulations that assisted in the building of hotels and the vast railroad systems. Today's tourist industry takes it for granted that the State Board of Health and the local mosquito control districts will not let it down by permitting either mosquitoes or the diseases they carry to take the state over again and keep it in chains as they once did.

There is no question that control of the mosquito helped open up the state to the planting of citrus, mining of phosphate, cutting of virgin pine and cypress and the starting of the cattle industry. Most of all, the control of arthropods and arthropod-borne diseases opened subtropical Florida to people from all over the United States and the world who come to enjoy the climate, good fishing, excellent beaches and unsurpassed beauty.

The State Board of Health, mosquito control districts and the Boards of County Commissioners are spending approximately $8 million annually for control of mosquitoes and other forms of arthropods. Fifty-seven mosquito control districts, operating in 54 of the 67 counties, applied in one year over three million gallons of insecticide formula by air and ground fogging and spraying to



A rabbit (1), which has been used as bait to attract mosquitoes, is removed from a trap in a swampy area. (2) Mosquitoes, which are sucked by a vaccum into a bag before they can attack the rabbit, are removed from the trap. (3) The entomologist checks the operations of a tent trap.

kill adults and over 723,000 pounds of Paris green pellets to kill larvae. Over three million acres were treated by airplanes and over 389,000 miles were traveled by ground fogging machinery. By

contrast, 15 years ago, the State Board of Health and other agencies spent about one million dollars for arthropod control.

It is apparent that time, effort and money expended in controlling the mosquito and the diseases it carries have brought results. But further research and control are necessary. The State Board of Health must maintain protection against mosquitoes and increase its strides in research in order to protect the health and comfort of Florida residents and tourists.

Definitions for Some Terms We Used

Adulticide—an insecticide or pesticide which kills adult insects.

Antibody—a factor (globulin) in the body which is produced by a past infection or the administration of an antigen, such as a vaccine.

Arbovirus—an infectious agent carried by arthropods.

Arthropod—a member of a group of invertebrated creatures with jointed legs and segmented bodies; insects, ticks, etc.

Arthropod-borne diseases—diseases carried by any one member of the arthropod family.

Encephalitis—an inflammation of the brain often caused by the presence of a virus, which may be arthropod-borne, sometimes called sleeping sickness.

Endocrinology—the study of hormones and their effect on the body.

Larvicide—a chemical which kills insect larvae.

Metabolism—the chemical process by which food is burned in the body to release energy.

Microbes—a microorganism (for example, virus, bacteria, rickettsia) which may cause disease.

Reservoir—a creature or animal in which a virus lives and multiplies without doing damage to the host.

Vector—an agent, such as a mosquito, capable of transmitting a disease from one host to another.

Virus—a submicroscopic infectious agent which can cause disease.

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