THE 1957 STATUS OF YELLOW FEVER IN THE AMERICAS

FRED L. SOPER *

The professor of infectious diseases in a medical school, located in a city once the scene of a disastrous epidemic of yellow fever, inquired recently if the disease still exists in the Americas.

The statistics of the Pan American Sanitary Bureau list 77 cases officially reported during 1957, surely an insignificant number when related to the hundreds of millions of population of the Western Hemisphere. One might, then, be tempted to answer the query with a statement to the effect that yellow fever virus still exists in the Americas but that it is a public health problem of very minor importance. Such a reply would overlook these facts: these 77 cases come from seven countries, (Fig. 1), Bolivia, Brazil, Colombia, Guatemala, Panama, Peru and Venezuela; field studies have proven yellow fever virus to be present in British Honduras, where human cases were not observed during the year; and the range of the virus during 1957 from northwest to southeast has been over 3,500 miles.

A look at yellow fever in the Americas through the eyes of foreign health administrators might alter the indifference of the professor of infectious diseases.

The Committee on International Quarantine of WHO and the World Health Assembly, in meetings devoted to the preparation, adoption and modification of the International Sanitary Regulations, between 1949 and 1956, encountered greater difficulty in harmonizing the views of different countries, and groups of countries, on regulations for yellow fever than was encountered in the solution of all other differences.

During early 1956, the WHO sponsored a visit of representatives of Egypt, Philippines, Indonesia, British Africa, Belgium, Africa, India, France, and Iraq to several countries in America to get first hand impressions of yellow fever here. After one day at the Pan American Sanitary Bureau in Washington the group visited Cuba where there is an active campaign for the eradication of the Aedes aegypti mosquito as a part of the continent-wide program to permanently prevent all urban yellow fever in the Americas. Then on to the then recently reactivated jungle fever zone of Honduras (Fig. 2) where it was learned that after an apparent silence of 15 months, yellow fever virus had not only persisted in Honduras but had moved northward into Guatemala (3).

In moving from Honduras to Guatemala yellow fever virus had left the range of its most widespread vector in the forests of South and Central America, Haemagogus spegazzinin, and had demonstrated its adaptability to Haemagogus mesopentatus (2) whose range extends well up into Mexico (Fig. 3).

In Costa Rica the group visited the San Juan de Dios Hospital where scores of cases of jungle yellow fever were under direct observation in 1951-52, and learned from those who had handled the cases that the clinical picture and high mortality of the jungle disease are in all ways similar to those of urban yellow fever.

In Panama the group learned the details of the cases of jungle yellow fever infected in 1948 only some ten miles from Panama’s International Airport at Tocumen, and of the 1949 to 1951 march of the epizootic through Western Panama to the frontier with Costa Rica. It was noted that the five hospitalized cases of 1948 were diagnosed post-mortem two months after the first case and two weeks after the last one, and then only because the Santo Tomás Hospital has a full time pathologist. The group could not but wonder how many similar episodes may

---

* Director, Pan American Sanitary Bureau, Regional Office of the World Health Organization.
Fig. 1.—Number of cases of yellow fever from countries of the Americas, by political divisions and years, 1954 to 1957.
have passed unnoted during the four decades yellow fever had been absent from the records of Panama and the Canal Zone. That this may have happened is suggested by the appearance in August 1956, of a case of yellow fever in the Santo Tomás Hospital (3), originating in the same jungle area which supplied the cases in 1948.

In Bogota, Colombia the visitors saw, at the Carlos Finlay Institute, the record of repeated and continuing incidence of yellow fever, year after year, and visited the yellow fever study area at San Vicente de Chucuri, Santander (Fig. 4), where in spite of repeated intensive vaccination campaigns, yellow fever cases have been confirmed in twelve of the last twenty-two years. San Vicente de Chucuri is apparently a permanent enzootic focus, in which, interestingly enough, monkeys are not present in numbers sufficient to maintain the virus unless there be some as yet unidentified reservoir or long-lived insect vector. Marsupials are suspected.

At Trinidad, B.W.I., the group learned of the early serendipitous discovery of yellow fever virus in jungle areas in April 1954, four decades after the last report of yellow fever from the Island, and of the urbanization of the jungle infection at Port-of-Spain some months later. Port-of-Spain was the first city in twelve years to report *aegypti*-transmitted yellow fever and the first maritime port in America to be infected in 25 years. Here, also, it was possible to see the intimate contact, through well paved roads, which exists between jungle and urban areas. The *Aedes aegypti* mosquito has been widespread in human habitations along the rural highways, near the infected forests. In Trini-
Fig. 3.—Northern limits of the range of monkeys in Central America.

Fig. 4.—Intervals between the appearance of yellow fever in specific areas. (Courtesy American Journal of Tropical Medicine and Hygiene.)

National Yellow Fever Service and heard the story of the 1928–1931 struggle to free South Brazil of endemic yellow fever, (Fig. 5), which followed the reinfestation of Brazil’s beautiful capital, 20 years after Oswaldo Cruz’ first victory over the disease in 1908 (Fig. 4).

As stated, the objective of the trip was to give the group a first-hand opportunity to see the conditions under which yellow fever occurs in the Americas, in order to judge the threat which yellow fever here may be to other regions. The hope that the trip might result in an immediate lessening of the fear in the Orient of infection from America was not fulfilled. On the eve of his departure one member of the group declared that his anxiety regarding the possibility of the infection of Asia with yellow fever had doubled during the trip. This may well have been the reaction of the entire group, visiting
Following the confirmation in 1900 by the Reed Commission of Carlos Finlay's theory of the transmission of yellow fever by the *Aedes aegypti* mosquito, dramatic results were obtained by the reduction of the breeding of this mosquito in endemic centers such as Havana, Panama, and Rio de Janeiro. There was a striking disappearance of the disease, not only from the cities where anti-mosquito measures were applied, but also from surrounding and tributary areas. And in 1915, on the basis of this experience, the International Health Board of the Rockefeller Foundation, under the leadership of Wickliffe Rose and General Gorgas, sponsored a program for the eradication of yellow fever from the Americas, (Fig. 6), based on the reduction of the *Aedes aegypti* breeding in the endemic centers until the disease should spontaneously disappear. As a result of this program, the last focus of self-sustain-

the Americas in a year during which only 28 cases of yellow fever have been reported.

The indifference of the American professor of infectious diseases contrasted with the great concern of the health authorities of other regions emphasizes the need of an objective statement of the status of yellow fever in the Americas at the end of 1957.

With yellow fever, as with many other infectious diseases, long-term observations are needed for any objective appraisal of the situation, care being taken to make due allowance for any changes which may occur in basic epidemiological conditions.

During the century and a half previous to 1900 yellow fever occurred on both the Atlantic and Pacific coasts of North, Central and South America, and was very active in the Caribbean and Gulf areas. All countries of the Americas, not excepting even Canada, suffered incursions of yellow fever.

---

**Fig. 5.—**Localities known to have had cases of yellow fever following the 1928-1929 outbreak in Rio de Janeiro.

**Fig. 6.—**Areas reported with yellow fever 1900 to 1931. (Courtesy The Jefferson Medical College of Philadelphia.)
ing man-*aegypti*-man yellow fever infection disappeared from the rural endemic area of northeast Brazil in 1934 (Fig. 7).

![Map showing areas reported with yellow fever, 1932 to 1937](image)

**Fig. 7**—Areas reported with yellow fever 1932 to 1937. (Courtesy The Jefferson Medical College of Philadelphia.)

As the man-*aegypti*-man yellow fever was being eliminated, observation led to the discovery (4) in 1932 and succeeding years, of enzootic and epizootic yellow fever of the tropical forests of America. This was jungle yellow fever, the discovery of which gave a ready explanation of the source of virus for some previously unexplained *aegypti*-transmitted outbreaks in cities and towns isolated from any known source of infection: Rio de Janeiro, Brazil, in 1928; Socorro, Colombia 1929; Guasapati, Venezuela 1929; and Santa Cruz de la Sierra, Bolivia 1932 (5).

This discovery showed that the dream of eradicating yellow fever VIRUS was chimerical. The almost simultaneous perfection of methods for the eradication of the highly domesticated *Aedes aegypti* led inevitably to a program for the eradication of this African invader from the Americas.

Even though conditions in the period between 1900, when the *aegypti*-transmission of yellow fever was confirmed, and 1934, when the last series of urban outbreaks ended, were quite different from those of the period following 1932, the year in which jungle yellow fever was confirmed and *aegypti*-eradication began, it is instructive to compare the distribution of yellow fever in these two periods.

The yellow fever reported between 1900 and 1931 (Fig. 6), was distributed around the periphery of South America, around the Caribbean Sea and the Gulf of Mexico, and along the Pacific Coast of Mexico, and Central America. It was almost entirely urban yellow fever although the contemporaneous description of the Trinidad outbreak of 1914 clearly identifies that episode as jungle yellow fever. The reports for this early period are almost entirely of outbreaks diagnosed clinically and epidemiologically, whereas the reports for the later period 1932 to 1955 (Fig. 7), have come in large part as the result of routine viscerotomies and the histopathological confirmation of unsuspected cases. This is true even of the few cases of *Aedes aegypti* transmitted yellow fever which have been reported. Yellow fever has been found widely distributed in the interior of the continent and even when reported close to the coast has only in one instance (Port-of-Spain 1954) infected any international port. The *aegypti*-transmitted yellow fever reported during this period was of two types: endemic rural yellow fever; and isolated urban outbreaks occurring very close, and secondary, to known infected jungle districts. The rural endemic yellow fever of northeast Brazil was terminated in 1934 by extending anti-*aegypti* measures to large rural areas and has not recurred.

In the period from 1932 to 1955 a huge amount of epidemiological information about both urban and jungle yellow fever was collected and studied (6). This period includes the last three years.
TABLE 1—Reported Cases of Yellow Fever in the Americas, 1948–1957

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>54</td>
<td>174</td>
<td>391</td>
<td>312</td>
<td>341</td>
<td>89</td>
<td>97</td>
<td>42</td>
<td>28</td>
<td>78</td>
<td>1606</td>
</tr>
<tr>
<td>Argentina **</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Bolivia</td>
<td>30</td>
<td>156</td>
<td>354</td>
<td>3</td>
<td>1</td>
<td>18</td>
<td>2</td>
<td>7</td>
<td>6</td>
<td>9</td>
<td>596</td>
</tr>
<tr>
<td>Brazil **</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>50</td>
<td>221</td>
<td>39</td>
<td>9</td>
<td>8</td>
<td>2</td>
<td>10</td>
<td>352</td>
</tr>
<tr>
<td>British Guiana **</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>British Honduras</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Colombia **</td>
<td>12</td>
<td>3</td>
<td>12</td>
<td>26</td>
<td>16</td>
<td>11</td>
<td>12</td>
<td>22</td>
<td>16</td>
<td>35</td>
<td>165</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Guatemala</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Honduras **</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Nicaragua **</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Panama</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Trinidad and Tobago **</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Venezuela **</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

*Jungle yellow fever, with the exception of 3 cases in Trinidad in 1954.
**All cases with laboratory confirmation.
***Evidence of activity of the virus of yellow fever in howler monkeys (Alouatta spp.).
Fig. 9. Number of cases of yellow fever from countries of the Americas, by political division and by years, 1945-1953.
(County divisions joined by black lines)
from any previous reported focus of infection and only some 50 miles from the
Capital.
In Panama, as already noted, yellow fever appeared in 1948 as a jungle infection east of the Canal, spread during the next five years across the Canal and up
the Isthmus to Costa Rica and Nicaragua (7).
The events of the next three years, 1954, 1955, 1956, (Fig. 1), were to show that
jungle yellow fever had not yet exhausted its ability to surprise the epidemiologists.
In Central America, in 1954, (Fig. 2), the enzootic which had previously been traced easily in Costa Rica and Nicaragua by the finding of sick and dead monkeys, was followed with difficulty across Hon-
duras to the Ulua Valley near the frontier with Guatemala.
During 1955, no yellow fever activity, either in man or in monkeys, was reported
in Central America. Surprisingly, early in 1956, activity among monkeys was re-
ported in Honduras, in the same area where the activity had ceased 15 months
before (1). Simultaneously, yellow fever among monkeys was observed across the
border in Guatemala indicating progres-
sion of the epizootic wave. The year
1956 was one of considerable yellow fever activity in monkeys in Guatemala, without
the occurrence of reported human cases.
The activity in monkeys continued in
1957 in Guatemala and British Honduras; though human cases were confirmed in
Guatemala.
The recurrence in Panama of jungle yellow fever in 1956 (3) and 1957 in the
same districts where cases occurred in
1948, and the present epizootic wave, which has now reached Guatemala, when
taken together raise the question of
whether a second wave may follow the
preceding one so soon in Central America
where the susceptible monkey population
was greatly reduced by mortality from
yellow fever just a few years ago.
In Brazil, the 1950–51 outbreak in the
Southern States stopped unexpectedly.
Apparently drought conditions curtailed
this epizootic before it completed its sweep
through the forests of southern Brazil, practically all of which were invaded dur-
ing the 1934 to 1940 epizootic. The only
cases reported in Brazil during 1954 were
found through routine virus isolations in
an otherwise silent area near Belém at the
mouth of the Amazon. In 1955 likewise
yellow fever reported from Brazil was
limited to this same area. In 1956 and
1957 there were a few scattered cases in
the Amazon Valley.
The cumulative reports of yellow fever
since 1932 and the unfolding picture of
yellow fever since 1948, reveals clearly the
absolute necessity of continuous observa-
tion and study if any appreciation, even
approximate, of the sweep of epizootic
cycles is to be obtained, for some of these
cycles require a decade or longer for com-
pletion.
Even the 25-year period has been too
short (Fig. 7), to give the whole picture of
jungle fever in the Americas. This is
due to the relatively long intervals which
have occurred in certain areas between
epizootic waves, as well as to the failure
to recognize and report many, if not almost
all, of the resultant human cases. The pro-
gress of a wave depends upon at least
three coincident factors: the introduc-
tion of the virus; the existence of an ade-
quate population of susceptible vertebrates; and
weather suitable to multiplication and maintenance of adequate numbers of
mosquito vectors. The study of the intervals
between the appearance of yellow fever in
specific areas indicates that yellow fever
persists almost constantly in certain small
areas, returns repeatedly after short periods
of freedom in other areas, and recurs only
after long and irregular absences in yet
others.
Rio de Janeiro, already referred to as
having been reinfected by jungle yellow fever virus in 1958, twenty years after the
city had been freed of endemic yellow fever by Oswaldo Cruz, was again bom-
barred by jungle virus in a number of
known infectious cases coming into the
city from nearby infected areas in 1958.
During the past 10 years jungle yellow fever has not been observed in areas close to Rio nor have recognized cases appeared from further afield. Other areas have reported the recurrence of yellow fever after intervals of two or three years up to ten, twenty and even forty years.

This discussion of the status of yellow fever in 1957 has been largely limited to the official reports of the distribution of jungle yellow fever.

Since endemic aegypti-transmitted yellow fever no longer exists in the Americas, the problem of yellow fever during the past 20 years has been related to enzootic and epizootic yellow fever as a source of virus for jungle yellow fever cases, and to jungle yellow fever cases as a source of infection for Aedes aegypti-infested towns.

The questions to be answered in assessing the yellow fever situation as a threat to man are: What is the importance of jungle yellow fever to rural populations of tropical America? What is the threat of the urbanization of jungle yellow fever virus in cities and towns in enzootic and epizootic areas? What is the international threat of jungle yellow fever?

Jungle yellow fever is clinically and pathologically indistinguishable from urban yellow fever and is just as dangerous to the person infected in or near the forest as to the city victim. The jungle disease is however generally limited to those living or working in or very close to the tropical forest or entering the forest for recreation or travel. Figure 9 shows the transmission cycle of jungle yellow fever in tropical America.

Where the homes are closely surrounded by forest in a permanently enzootic focus (Ilheus, Brazil) or where Indian tribes live in the forest, the people get infected with yellow fever even during the early years of life. Where road or lumber gangs enter the forest and where the forest is being cleared for agriculture the disease becomes almost occupational in its distribution and attacks a high percentage of young adult males at their most productive period (Espiritu Santo, 1940; 108 deaths, 100 in males over 16) (San Vicente de Chucurí, Colombia 1936-1955; 55 deaths, 45 farmers, 7 women, 3 children).

Where relatively light work, such as coffee picking, brings both women as well as men close to the forest, the disease tends to attack both men and women and even a considerable number of the children who accompany their parents to the fields. Thus it is clearly not necessary to chop down a tree to get yellow fever.

The development of a satisfactory yellow fever vaccine in 1936 greatly reduced the threat of jungle yellow fever, and has, in fact, practically eliminated it for those who are vaccinated.

The American nations are fortunate in having free access to vaccine, produced in the Oswaldo Cruz Institute, in Brazil, and in the Carlos Finlay Institute, in Colombia, in both with the collaboration of the Pan American Sanitary Bureau. Vaccination produces long lasting, probably permanent, immunity.

What is the threat of urbanization of
Fig. 10.—Status of the *Aedes aegypti* eradication campaign in the Western Hemisphere on December 31, 1957. (From the Annual Report for 1957 of the Director, Pan American Sanitary Bureau.)
jungle yellow fever virus near infected forests?

All observed urbanization of jungle yellow fever virus has occurred in towns relatively close to infected forests. The possibility of the introduction of yellow fever virus from forest to urban areas has been greatly reduced by the vaccination of large blocks of the populations living in jungle yellow fever areas: in Brazil, Colombia, Venezuela, Trinidad, Panama, Costa Rica, Nicaragua, Honduras, Guatemala and Mexico. However, vaccination is never complete, and absolute protection of towns can come only from the eradication of the Aeëdes aegypti mosquito.

The program for the eradication of the Aeëdes aegypti mosquito from the Americas has progressed to the point (Fig. 10), where there is very little opportunity for cases from infected jungle areas to infect cities without undertaking an international trip. From Argentina to Guatemala, the aegypti mosquito has either been eradicated or is under heavy attack in all of the countries where jungle yellow fever has been reported in the past 25 years. To prevent reinfection of those areas which have been, or are being, cleared of Aeëdes aegypti it is essential that aegypti be eradicated also from the United States, Cuba, the Dominican Republic, Haiti, Puerto Rico, Jamaica, and the other Caribbean islands—where conditions for jungle yellow fever do not exist—as well as from Mexico where jungle yellow fever could occur, and which also has Aeëdes aegypti.

What is the international threat of jungle yellow fever? In its extra-human reservoir the virus of yellow fever apparently moves through contiguous or nearly contiguous forest areas quite independently of man. The forest areas may all be in one large country like Brazil, or in half a dozen small ones like the Central American countries. The virus takes cognizance only of ecological boundaries, not of national ones (8).

It so happens that jungle yellow fever has never been observed to move internationally along human routes of travel. But in Venezuela in 1954 a man in the early—i.e., infectious—stage of jungle yellow fever traveled by plane from Sucre State to Caracas, a distance of several hundred miles. Facilities for both highway and air travel are constantly improving in the outlying areas of jungle yellow fever countries. This places those areas in closer contact, through man, with heavily used national and international routes of travel. Aegypti-infested countries, that could formerly rely on relative isolation from virus-infested jungles to protect them from yellow fever, may soon find that they are no longer effectively isolated.

SUMMARY. Yellow fever virus is always present, with variable year-to-year distribution, throughout the tropical and subtropical forests of America from Mexico to Argentina.

In the decade 1948–1957 there was laboratory evidence of virus activity in 15 countries and territories. From four to eight countries were known to be involved each year. In three instances the presence of the virus was observed only in howler monkeys (Alouatta sp.). The countries involved were British Honduras, Guatemala and Honduras, in the years 1956 and 1957.

Jungle yellow fever is a serious threat to rural populations and is a permanent source of virus for the reinfection of such cities and towns, as may be infested with Aeëdes aegypti, in the same country with infected forests and even of such cities and towns in other countries.

Maximum guarantees against yellow fever depend on the widespread vaccination of rural populations and on the eradication of the Aeëdes aegypti mosquito from all of the Americas.

References


PRIMARY RECORD OF *CULISETA MELANURA* BITING MAN IN NATURE

RICHARD O. HAYES \(^1\) AND OSCAR W. DOANE, JR. \(^2\)

The arthropod borne virus of eastern equine encephalitis (EEE) has been isolated from the mosquito *Culiseta melanura* (Coquillett) collected in Louisiana \(^1\), Alabama \(^2\), New Jersey \(^3\), and Massachusetts \(^4\). The species has been considered a potential vector of the virus, since no other arthropod has been shown by virus isolation to be so closely associated with outbreaks of the disease throughout such a large geographic range. *C. melanura* is thought to be principally an avian feeder, and it has been postulated that it is involved in spreading the infection among the reservoir hosts—wild birds \(^5\). A lack of evidence that it occasionally feeds on humans under natural conditions has precluded any specific hypothesis that this mosquito also spreads the infection to man. As recently as 1956 \(^6\), it was noted that the feeding preferences and hosts of *C. melanura* were unknown. In the laboratory it has been induced to feed upon fowl, occasionally upon rabbits \(^7\), upon mice \(^8\), and once upon man. \(^9\). This report documents observations upon *C. melanura* biting man under natural conditions.\(^9\)

On September 5, 1957 during a visit to a known *C. melanura* habitat in a cedar swamp, located in Raynham, Massachusetts, a female mosquito was seen to alight upon the dorsal forearm of one of us (R.O.H., who had previously been immunized with EEE vaccine). Since it appeared to be *C. melanura*, especial interest was taken in its subsequent activity. The mosquito landed approximately 1.5 hours before sunset and commenced exploratory probing with its proboscis among the hairs of the arm. The exploratory movements were quite slow, and 5 minutes elapsed before it appeared to have successfully penetrated the skin. A: no time during the biting activity did it seem that the mouth parts were being deeply inserted into the skin. This behavior was similar to that previously described for feeding on chicks \(^7\). The proboscis penetration was sufficiently deep, however, to provide a firm attachment to the host, and it was

---


\(^2\) Cape Cod Mosquito Control Project, Hyannis, Massachusetts.

\(^3\) This investigation is part of a joint study on eastern equine encephalitis by the Division of Communicable Disease, Massachusetts Department of Public Health, and the Communicable Disease Center, U.S. Public Health Service.