

THE OVERWINTERING OF *Aedes aegypti* L. IN STILLWATER, OKLAHOMA

L. E. ROZEBOOM
Oklahoma A. and M. College

The yellow fever mosquito, *Aedes aegypti* L., is essentially a tropical and subtropical species. Howard, Dyar and Knab, (1912, 1917) and Howard (1928) divide its range into two regions: a "permanent region" where the temperature remains high enough to permit continuous breeding, and a "temporary summer region" into which the mosquito may spread during warm weather, but is killed by cold during the winter. Howard states, "The permanent distribution is limited in a general way by the frost line. Where frost does not occur the species generally may breed permanently. As has already been shown, this mosquito does not thrive below a temperature of 80° F., so that in a uniform climate with a temperature much below 80° the species will not continue to exist. Such climates are rare, however, in regions where frost never occurs." Carter (1931) recognizes a third "border-line" zone in which hibernation takes place in the egg stage. Various experiments have shown that adults of *A. aegypti* are quite susceptible to low temperatures, and although the larvae are able to resist freezing at -2°C. for two to ten hours, eleven hours of exposure to this temperature are fatal (Bliss and Gill, 1933). The eggs are considerably more resistant to cold; Davis (1932) found that -5.5°C. killed them in about 48 hours, but that some hatched after being exposed to 0°C. for eleven days. Carter considers the northern limit of Merriam's (1894) Lower Austral Zone to be "not far from that of the permanent life-zone of *aegypti* as fixed by detailed observations, although, we believe, determined by different factors." The chief factor in determining whether the species is a permanent resident of a border-line locality would be its ability to withstand winter temperatures in the egg stage.

During the summer months *Aedes aegypti* may be carried far from its permanent breeding zone, and before Gorgas and others showed how yellow fever can be controlled, it caused epidemics of this disease as far north as Philadelphia, New York, and Boston. In 1933 Jones and Coyner reported to this Academy the presence of *A. aegypti* in Edmond, Oklahoma. During the summer of 1937, Mr. Eddy, an entomology student, found the mosquito on the A. and M. College campus. Because of its continuous invasion of the temporary breeding zone, the presence of *A. aegypti* in northern Oklahoma is not particularly surprising, but as Stillwater is not far from the northern limit of Merriam's Lower Austral Zone, it was believed that the ability of the insect to hibernate in the egg stage in Stillwater is of sufficient interest to merit a report to this Academy.

A laboratory colony of the *A. aegypti* found in Stillwater was established, and on November 9, 1937, two batches of eggs from this colony, which had been stranded and dried on pieces of paper towel, were placed in a wide-mouth four-ounce bottle containing some sand. The eggs were not counted, but each batch consisted of two or three hundred eggs. A sample of the eggs hatched readily. The uncorked bottle was taken to an old screened shed and placed on a shelf about one and one-half feet from the ground, almost against a screened opening, so that there was no protection from outside temperatures, although there was some protection from snow and rain. The eggs were allowed to remain in the shed until April, 1938, when they were taken to the laboratory and immersed in water. The

large number of larvae hatching from these eggs indicated that few, if any, had died during the winter. These larvae developed into vigorous adults, which mated and deposited viable eggs.

On December 14, 1937, a third batch of eggs, stranded and dried on a bit of paper towel, was put into a wide-mouth four-ounce bottle, which was then placed on the ground on the east side of the insectary. A sample of the eggs hatched readily. The bottle was not corked; so the eggs received only partial protection from snow and rain. In April, 1938, the eggs were taken into the laboratory and immersed in water. Only one egg hatched; the larva pupated but the pupa died. The great mortality among these eggs perhaps was due not so much to atmospheric winter temperatures as it was to exposure to snow and rain; alternate rains or thaws and freezing periods might have coated the eggs with a layer of ice.

The Experiment Station meteorological records show that several freezes occurred in Stillwater during the winter of 1937-38 subsequent to the time the eggs were exposed. There were several periods during which the minimum temperatures dropped considerably below freezing for four or five to nine days in succession; at times the maximum temperatures also remained below 32°F. throughout the day. The coldest weather occurred on January 31, when the maximum was 32° and the minimum 8°F.

A. aegypti seems to be fairly common in Oklahoma, and in Stillwater it becomes an annoying household pest during the latter part of the summer. The distribution of mosquitoes in Stillwater during the summer of 1938 indicates that not only in my bottles, but also in many other containers, eggs passed through the winter in a viable state. The above observations were made on eggs exposed to outside winter temperatures, and it is possible that an unusually severe winter would destroy all of the eggs exposed to such conditions. However, being a domestic mosquito, *A. aegypti* prefers to breed in artificial containers in and around houses and barns, where there may be considerable protection against winter weather, which further insures its permanent residence in this locality.

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