ANOPHELES NEIVAI HOWARD, DYAR & KNAB: LABORATORY OBSERVATIONS ON THE LIFE CYCLE AND DESCRIPTION OF THE EGG STAGE (DIPTERA: CULICIDAE)[1]

Anopheles (*Kerteszia*) *neivai* is a seasonally common canopy-feeding mosquito throughout the mountain forests of Panama. It is readily attracted to human bait, has been incriminated in the transmission of malaria (Deane et al., 1968, Rev. Inst. Med. Trop. São Paulo **10:** 335–41; Baerg & Galindo, unpubl. data), and has been found infected with yellow fever and other viruses (de Rodaniche et al., 1957, Amer. J. Trop. Med. Hyg. **6:** 681–85; Lee & Sanmartin, 1967, Amer. J. Trop. Med. Hyg. **16:** 778–81). As given in reviews by Trembley (1955, AMCA Bull. No. 3, 73 p.) and Gerberg (1970, AMCA Bull. No. 5, 109 p.) there is little published on the laboratory biology of members of the subgenus *Kerteszia*, and we have found no references detailing the development of *A. neivai*. The present report will summarize our preliminary rearing experiments and, for the first time, describe the egg of this species.

As part of continuing investigations on natural vectors of monkey malaria in Panama, specimens of *A. neivai* were routinely obtained for laboratory study. Periodic collections of adults from human bait and immature stages from bromeliads were made in 1970–1972 at Altos de Pacora (60 km east of the Canal Zone at elevations reaching 670 m), and 2 coastal areas on the Atlantic side of the Isthmus, Mojinga Swamp and Portobelo (type-locality of *A. neivai*).

Rearing. Adults were held in both 0.5-liter (1-pint) and 11-liter (3-gal.) screened cartons. In addition, a 38 × 38 × 38-cm mosquito cage was used for varying periods of time in attempts to achieve natural mating. The room temperature averaged 23 °C, with high RH and the natural photoperiod. Raisins served as a carbohydrate source, and a human blood meal was offered 1 or more times daily. Although some females survived for more than 30 days, adults were difficult to maintain in this laboratory environment. No mating occurred in the cartons or cage in trials with as many as 100 stock specimens. Induced copulation was tried, following techniques modified from Ow Yang et al. (1963, Mosquito News **23:** 34–35). Males were at least 4 days old, and females represented all stages of physiological development. This procedure yielded a single viable egg batch in attempts with 65 males and 80 females; the infertility was demonstrated by nonviable eggs or negative spermathecal dissections. Clasping, observed in approximately 20% of the male *A. neivai*, persisted over periods of 15 sec. to 2 min. A total of 127 wild-caught (mated) females was collected for obtaining progeny in the current study.

The majority of reared or field-collected females did not produce eggs until after the 2nd or 3rd complete blood meal in the laboratory. This characteristic did not appear to be related to mating or size of the holding container. Females were gravid 4–5 days after blood engorgement. Whole or incomplete batches were deposited, and in some instances the eggs were withheld and resorbed. Oviposition was voluntary or was induced by dealation, but was achieved best in small cartons on filter paper moistened with bromeliad water. More than 100 eggs were seen in a few individual batches, with an average count of less than 50 per female resulting from pooled (including non-laying) specimens.

Viability of the eggs was not affected by retaining them on wet filter paper for several days preceding flooding. All eggs hatched on water in 4–6 days. From 100 to 300 larvae were placed in small enameled pans (30 × 19 × 5 cm) partially exposed to constant incandescent light. Filtered, dilute bromeliad water containing dead leaves was provided. Brewer's yeast paste and powdered larval food (Baerg, 1971, J. Med. Ent. **8:** 180–82) were added sparingly. Considerable die-off, approximating 50%, occurred principally in the early instar larvae when reared from eggs, whereas a low of 30% mortality was observed in series initiated as field-collected immatures of mixed age. Late instars tended to form dense aggregates, but without any apparent deleterious effects due to overcrowding. Larval growth required from 20 to 30

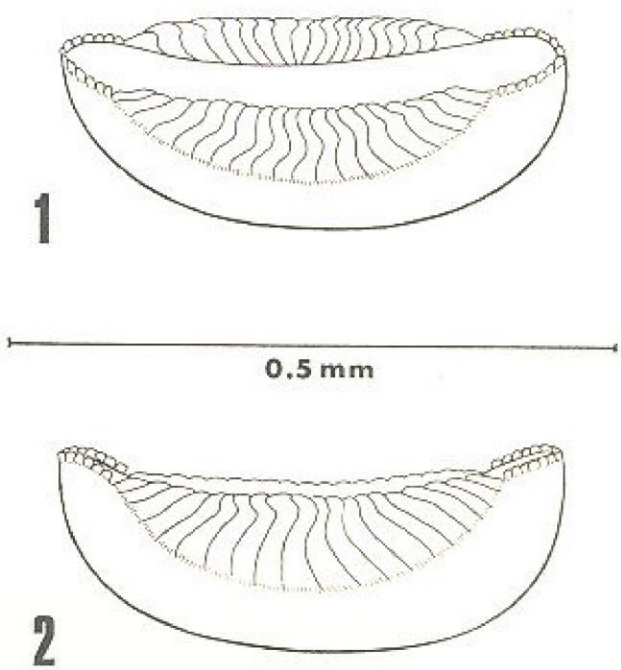

FIG. 1–2. *Anopheles neivai* egg. (1) Oblique view, (2) Lateral view.

[1]Supported in part by Research Contract No. DADA 17-72-C-2031, from the U.S. Army Medical Research and Development Command and by the Health Bureau, Canal Zone Government. This is contribution No. 1247 to the Army Research Program on Malaria.

days from hatch. Normally, the majority of larvae pupated within a few days after the appearance of pupae in a given brood. Eclosion in all cases followed in 4 days. Duration of the aquatic cycle of *A. neivai* (egg to adult) under the described conditions ranged from 4 to 5 weeks. This is considerably longer than the 20 days reported for *A. (K.) cruzii*, a malaria vector in Brazil, at comparable temperatures (Correa, 1943, Folia Clin. Biol., São Paulo **15:** 64–68).

Description of egg stage. The adult, pupa, and larva of *A. neivai* have been described; taxonomic summaries for this species can be found in Stone et al. (1959, Thomas Say Found., Vol. VI, 358 p.) and Zavortink (1973, Contrib. Amer. Ent. Inst. **9:** 1–54). The following is a description of the *A. neivai* egg from ova deposited by adults collected at Altos de Pacora.

(FIG. 1–2). Measurements based on 12 specimens. Egg dorsum convex, venter concave, curvature slight to moderate. Surface smooth. Egg length 400–425 μ ($\bar{x} = 420$ μ); width, including floats, 125–163 μ ($\bar{x} = 147$ μ). Floats long, 325–375 μ ($\bar{x} = 360$ μ), as shown, with about 20 float chambers. Poles similar, both with frill evident on ventral aspect. Color light brown with darkly pigmented poles in alcohol-preserved specimens, exochorion nearly black in fresh material.

We wish to give recognition to the field personnel S. Puga, E. Alvarez, M. Reyna, and J. Bonilla of Gorgas Memorial Laboratory and to P. Chaves and I. Leguia of the Division of Sanitation, Canal Zone Government.—
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