Mosquito Eggs I.

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I recently undertook, as a spare time occupation, a critical review of the literature relating to mosquito eggs. This is a large task since the eggs of more than 400 species have been described, but it seems timely. There is probably no other branch of mosquito studies in which so much fascinating information has become lost in the literature. At the same time there are serious gaps in our knowledge arising, it seems, partly from failure to appreciate the comparative ease with which eggs can be obtained in the laboratory (and even in the field) and partly from lack of awareness of the characters which it is desirable to include in a description of the egg. There has also, I believe, been a failure to realize the great potential interest of these eggs with respect to taxonomic relationships. The problem here is chiefly one of the detection of evolutionary convergence and the key must lie in the understanding of functional morphology. Electron scan microscopy promises to be very helpful in this connection[1,2] but even at the level of gross morphology there are many provocative indications. The following notes are of a preliminary and tentative kind. I shall be greatly obliged to anyone who can supply me with unpublished information which may help to amplify them.

I. Tribe Toxorhynchitini

Only the eggs of T. (Toxorhynchites) brevipalpis Theobald[3] and T. (Lynchiella) rutilus (Coquillett)[4,5] are attributable with certainty. Various descriptions are currently attributed to T. (Toxorhynchites) splendens (Wiedemann)[6,7,8,9] but in the present confused state of the taxonomy of Oriental species it is impossible to be sure whether these refer to one or more than one species. There are small differences in size but the length/breadth ratio is approximately the same in all cases. Published figures suggest a possible small difference in the chorionic papillae but this is at most slight. For the present it seems best to refer all these descriptions to T. splendens. To this and the other two species may be added an unidentified species, probably of Lynchiella, from Trinidad represented by a few eggs in the British Museum and the species from Brazil with eggs attributed by Goeldi[10].

The eggs of T. brevipalpis are slightly more elongated than these of T splendens and are provided with a micropylar cup, recalling in a general way that of Culex[1,11], surrounded by rugose, papilliform outgrowths of the chorion (Fig. 1a). Interestingly, however, they float with the anterior end uppermost and not downwards as in Culex. Over the rest of the surface the chorionic ornamentation takes the form of a cellular honeycomb. This type of ornamentation, and the corolla, are unique, so far as known, in the genus. In T. splendens the chorion is densely covered with small rugose papillae (Fig. 1b). In both species dehiscence is transverse but in T. brevipalpis it is subapical whereas in T splendens it is equatorial. As a corollary to this the eggs of T. brevixpalpis float low in the water with only the apical part exposed while those of T. splendens float entirely above the water and are blown across the water surface by the slightest air current.

The eggs of T. rutilus resemble those of T splendens closely except, apparently, in one very important respect which is that in the former species dehiscence is longitudinal[5]. This, if true, would be strongly suggestive of sabethine affinities

since so far as I am aware, this type of dehiscence is otherwise known only in Trichoprosopon[1,2]. To judge by other material collected at the same time, the eggs from Trinidad referred to above are probably those of T. (Lynchiella) theobaldi (Dyar & Knab). They resemble those of T. rutilus and T. splendens in size and shape and in being densely covered with minute papillae of various sizes (Fig. 1c). These papillae are strongly rugose as in T. splendens (not described for T. rutilus). When the stripped chorion is viewed by transmitted light under phase contrast they present a very characteristic "cog-wheel" appearance. There is no apical cup or corolla.

Stone et al[13] attribute to T. (Lynchiella) guadeloupensis (Dyar & Knab) a description of the egg by Van der Kuyp[14]. A careful reading of his paper shows, however, that the only material of this species collected by him was a single larva. It is quite evident that his description is no more than an extrapolation from published descriptions of Toxorhynchites eggs in general. The only other species to which eggs can be attributed even provisionally is T.(Lynchiella) haemorrhoidalis (Fabricius). The eggs figured by Goeldi[10] as those of T. haemorrhoidalis ssp. separatus (Arribalzaga) are surely among the most interesting ever described (Fig. 1d). They were found in an abandoned cooking pot together with undoubted Toxorhynchites larvae which Goeldi also figures. As, however, they were already hatched the association must remain provisional, particularly having regard to the predatory habits of Toxorhynchites larvae. Nevertheless I consider there are good grounds for believing them to be eggs of Toxorhynchites. The shape seems at first sight inconsistent until it is realized that the embryo and pre-larva are probably confined to the posterior, unsclerotized portion. The existence of apical sclerotization is in contrast to all other known Toxorhynchites eggs which are entirely unsclerotized. In my opinion, however, this is more than offset by the rugose papilliform ornamentation of the chorion, different from but strictly comparable to that of the Lynchiella eggs described above. There is a strong suggestion of aerodynamic streamlining which may not be wholly illusory. So far as is known all Toxorhynchites deposit their eggs while hovering on the wing and there is good evidence that in some at least they are projected rather than merely dropped[15]. It seems that this habit is associated with the injection of the eggs into very small tree holes[8] or bored bamboos[16] with apertures too small to admit the ovipositing female, again as in some Sabethini[17,18]. Goeldi's eggs hatched by longitudinal dehiscence, a feature which could suggest either Lynchiella or Trichoprosopon. Whatever be the truth of the matter it is clearly very desirable that these eggs should be rediscovered. They are unlikely to be difficult to obtain. Being dark above they are likely to be much less conspicuous than those of other Toxorhynchites which are entirely white. (Paine[8] found the egg to be the easiest stage of all in which to collect T. splendens in large numbers). Probably the best solution would be the employment of traps (cut or bored bamboo internodes, coconut husks, calabashes or even cooking pots) with the proviso that these must be placed in situations known to be frequented by Toxorhynchites adults. The latter are notoriously particular in this respect[19].

It will be seen from what has been said above that evidence from the eggs lends strong support to those favouring sabethine affinities for Toxorhynchites[20], particularly with Trichoprosopon[21]. At the same time it should be pointed out that there is evidence also for some aedine affinities. The recently discovered Aedes (Huaedes) wauensis Huang[22] has a larval ventral brush strongly reminiscent of Toxorhynchites (and to some extent Anopheles) but quite unlike that of any other culicine known to me. The larvae also resemble those of Toxorhynchites in their deep red colour (not mentioned in the original description but observed both by Dr. Marks and by myself in larvae collected by us at the same time and in the same locality in New Guinea as the type series). The terminalia are also of a simpler kind than commonly found in Aedes but decidedly reminiscent of Toxorhynchites and Trichoprosopon.

It may seem unwise to attempt to draw any far reaching conclusions from so simple an object as the mosquito egg. It must be realized, however, that the egg stage is of profound ecological significance, serving as it does as a bridge between the environmental "preferences' and behaviour of the adult and the environment of the larvae forced on them by their parents. (I hope this is not too anthropomorphic!) The resemblances and differences noted above are suggestive of a former widespread holarctic extension of Toxorhynchites and the development of specialized forms in the southern continents on both sides of the Atlantic. This is wholly consistent with the occurrence of a fossil Toxorhynchites in the Oligocene of the Isle of Wight[23], together with a subtropical or warm temperate flora with Malaysian affinities, and with the existence of a relict species (still known only from one immature larva) in Greek Macedonia[24], It will be interesting to see how far the taxonomic revision of the other stages, long overdue, bears this out.

Footnote: By a happy coincidence Goeldi's assistant, Senhor Adolphus Ducke, also earned his garment of immortality by bequeathing to science a batch of eggs. He thought they were Toxorhynchites eggs but internal evidence shows them to have been those of Psorophora. This has no bearing whatever on the identity of Goeldi's eggs and should not be allowed to confuse the issue though it may have had something to do with the fact that the description of these remarkable objects was lost in the literature for more than fifty years.

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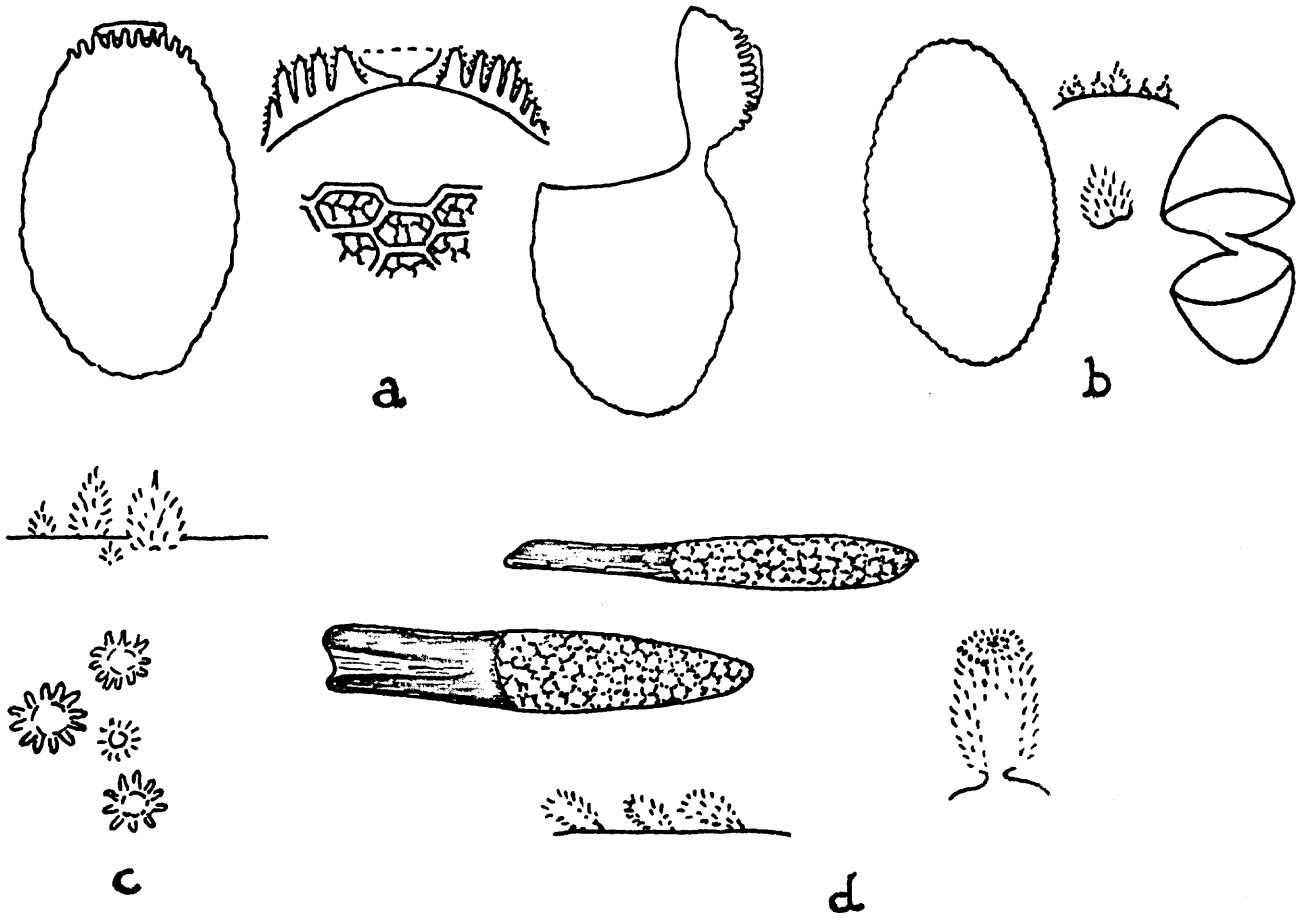

Fig. 1. Toxorhynchites eggs, showing mode of dehiscence and details of chorionic ornamentation. a. T. brevipalpis, b. T. ? splendens, c. T. ? theobaldi, d. T. ? haemorrhoidalis.
a. After Muspratt, b . After Banks, d. After Goeldi.