Mosquito Eggs IX

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Genus Opifex Hutton

This interesting monotypic genus is noted especially for its remarkable mating behaviour, involving capture by the males of emerging females and copulation on, or even temporarily under, the water surface[144,145,146]. This involves various gross morphological specializations easily recognized as such. Other peculiarities have been regarded as primitive[147,148,149] but I have some reservations about these. The point which seems to me to have received inadequate attention (except by Marks[145]) is that the mating behaviour as a whole can only be one of a syndrome of behaviour characters adaptive to life on a windswept, rocky shore and parallelled in other littoral insects. Until we know more about their functional significance it seems to me unwise to be too dogmatic as to whether such characters are genuinely primitive or atavistic.

Through the kindness of Jim Haeger I have been able to examine eggs of Opifex fuscus Hutton from the colony formerly established at Vero Beach. With the above considerations in mind I have tried to examine these, and review the literature relating to them, with an open mind while at the same time noting anything which may seem to have a bearing on the primitiveness or otherwise of the species concerned.

Oviposition

Edwards[150], reviewing the paper by Kirk[144], suggested that females of O. fuscus enter the water for egg-laying as do some Simulium. I would think it more probable, however, from Kirk's account that the eggs are laid just below the water line, only the tip of the abdomen being inserted for the purpose. Haeger and Provost[146] confirm that the eggs are usually laid under water but give no indication as to how far below the surface they are found.

The only other mosquito genus known to me in which the eggs are laid below the water line is Mansonia Blanchard. It is interesting that, whereas one section of this genus lays its eggs by inserting the tip of the abdomen below the water, the other lays them on the surface in rafts. It might therefore be supposed that the mode of oviposition found in Mansonia and Opifex represents an advance, in a particular direction, on the deposition of eggs on the water surface as in most known sabethines and many culicines. However, it seems that Aedes aegypti, at least, normally alights on the water before depositing its eggs and that a proportion of these are commonly laid on the water surface[132,151,152]. My own hypothesis would be that Opifex and Aedes had diverged in different directions from a more primitive sabethine mode of oviposition and that it is only in this sense that the Opifex mode could be regarded as primitive.

Haeger and Provost[146] note that, as in Aedes, rough oviposition substrates are "preferred". Kirk[144] provided alternative substrates in the form of a smooth oyster shell and a piece of sandstone. Eggs laid on the shell were easily detached and he makes the very interesting observation that when this happens they float vertically in the water with the broader anterior end uppermost. I know of no other genus in which this orientation is assumed except Toxorhynchites Theobald[130]. Eggs of the sabethine Trichoprosopon digitatum (Rondani) float vertically but with the anterior end downwards as do those of the raft forming culicines when supported in the raft.

Particular interest attaches to Kirk's observation that the larva contained in one of the floating eggs had attempted to emerge downwards into the water, failing, presumably, because the diameter of the more pointed posterior end of the egg was too narrow to permit the passage of the thorax (Fig. 1a). That it should have succeeded in detaching a cap at the posterior end at all is remarkable having regard to the supposed necessity for a preformed line of weakness at the anterior end of the egg in Aedes[153,154]. Both Kirk and Haeger and Provost observed dehiscence to be of the normal, apical type and the former's impression that emergence of the larva took place tail first was derived from a single larva which he apparently failed to realize was escaping from the posterior end of the egg, though this is quite clear from his drawing. If, as seems possible, floating eggs are regularly incapable of normal dehiscence then I would regard the type of orientation found in Opifex as primitive, in so far as it involves wastage, and as possibly harking back to that level of evolution which I have designated as the toxorhynchitine grade[155]. Other aedine eggs when detached from the substrate or laid on the water surface either float horizontally or sink and hatching is not precluded.

Oddly enough Miller[156] emphasised the affinity between Opifex and Toxorhynchites though I do not think any present day taxonomist would attach much significance to the characters which he cites. I have, however, pointed elsewhere to some resemblances between larvae of Toxorhynchites and those of Aedes subgenus Leptosomatomyia[130]. Apropos of this Dr. Marks (in litt.) has pointed out to me that two species of Aedes (Finlaya) also have ventral brush setae of toxorhynchitine type. These are Ae. (F.) purpureus (Theobald) (Lee[157], as pecuniosus) and Ae. (F.) auridorsum Edwards[158].

Morphology of the egg

The eggs are elliptical, somewhat broader at the anterior, and more pointed at the posterior, end and flattened on the lower (dorsal) surface (Fig. 1b). Fertile eggs appear more or less black by reflected light but by transmitted light they are seen to be less black than those of many Aedes. Infertile eggs are paler in colour and tend to split longitudinally as in other aedine genera. The dorsal surface is ornamented with unusually large and prominent outer chorionic papillae (Fig. 1c). In contrast those of the upper and lateral surfaces are minute (Fig. 1d). The sides of the egg exhibit a rather faint inner chorionic reticulation (Fig. 1d) which, so far as I can see, does not extend onto the dorsal surface unless, perhaps, at the extreme ends. The anterior end is provided with a micropylar cup similar to that of most Aedes but shallower and the micropyle itself is surrounded by a small sclerotized disc (Fig. 1e), possibly recalling the micropylar apparatus described in Toxorhynchites brevipalpis Theobald[3,130] or Uranotaenia sapphirina (Osten Sacken)[118,155], neither of which I have seen, but unlike anything which I have seen in Aedes. I would imagine this to be a primitive feature.

Egg physiology

Those eggs which I have seen appear to me to be less strongly sclerotized than in most Aedes. They collapse more readily in hypertonic gum solutions (though not more so than those of Ae. subgenus Mucidus[159]). Nevertheless they can clearly withstand a wide range of osmotic pressures in nature since the larvae have been found both in fresh water[147,160] and in hypersaline pools with salinity up to 9% NaCl[161] in rapidly fluctuating physical conditions[162]. McGregor[163] found that oxygenation of the water inhibited hatching and concluded that a decrease in oxygen would provide a hatching stimulus as in other aedines. However, Haeger and Provost found that they did not respond well to oxygen reduction by replacement with nitrogen. Haeger and Provost inferred that maximum survival in storage might be expected to be about six months and McGregor[163] obtained survival for this length of time at room temperature (and presumably room humidity). The function of the outer chorionic papillae, whether in Opifex or in the other aedine genera, is obscure and no convincing suggestion has as yet been put forward. Haeger and Provost employed wet cheesecloth as oviposition substrate and note that ovipositing females felt "for the crevices in each mesh with their flexuous abdomens before laying each egg" (a conspicuously aedine type of behaviour). The eggs were tucked quite deeply into the crevices of the mesh and the papillae on the lower surface were observed to be covered with a gelatinous glue rendering detachment from the cheesecloth relatively difficult. It might be thought from this that the papillae served to increase the area of adhesion between egg and substrate. In Aedes aegypti, however, in which a similar glue is secreted, the enlarged papillae are confined to the upper surface of the egg and the lower surface is at most finely granular[164].

It may be that comparative studies will throw further light on this problem and I shall attempt these in later papers but I am not very hopeful.

Summarising the phylogenetic aspects of the egg, I would think both this and the oviposition behaviour are clearly aedine but that the egg, in particular, shows some primitive features. These would be consistent with a divergence from the main aedine stock at a fairly early stage in its differentiation as suggested by most previous authors.

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Editor's Note. Mr. James S. Haeger, Entomological Research Center, Vero Beach, Florida, after reading the manuscript of Dr. Mattingly's article on the egg of Opifex, sent in the following note concerning the depth of egg-laying beneath the water's surface: "Female opifex walk on the water's surface (where the depth is 2-5 mm), and by bending the entire abdomen in a 90° angle they feel for the submerged substrate of sand, oyster shells, limestone or cheesecloth, where the eggs are deposited and remain glued and submerged due to the gelatinous material in the area of protuberances on the flat side of the egg; the legs and thorax are not submerged in the process." VII-28-1970.

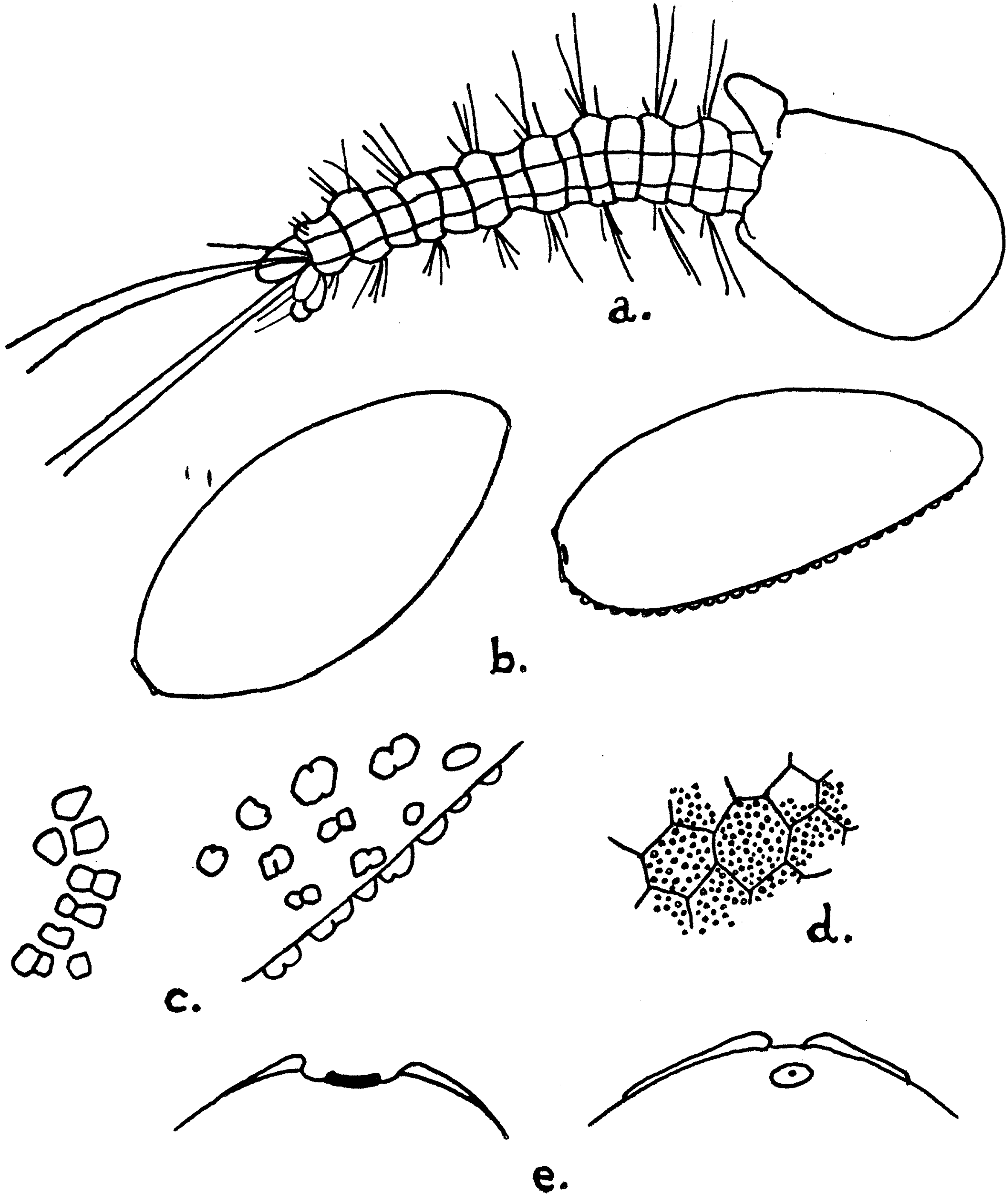

Fig. 1. Opifex fuscus. Egg. a. Abnormal hatching, b. Whole egg in dorsal and lateral view, c. Detail of two parts of dorsal surface, d. Reticulated subventral inner chorion with overlying outer chorion, to same scale as c., e. Anterior end showing apical collar and micropylar disc. a. After Kirk. Remainder original.