Compound Eye of the Cooloola Monster, *Cooloola ziljan* Rentz (Insecta, Orthoptera)

Takayuki NAGASHIMA [1] *and David C.F. RENTZ*[2]

[1] *Laboratory of Entomology, Tokyo University of Agriculture, Setagaya, Tokyo 156, Japan*

[2] *CSIRO, Division of Entomology, G.P.O. Box 1700, Camberra, Australia*

The family Cooloolidae was proposed by Rentz(1980) for a single species, *Cooloola propator* Rentz, found in the southeast Queensland, and two new species were added by him in 1986. They are cricket-like insects, and are thought to be a highly aberrant member of the suborder Ensifera in Orthoptera. They have been collected from areas of sandy soil, and burrow in the ground but build no tunnels or burrows. The females of the insects are wingless or apterous, and the males are brachypterous.

We have investigated the structure of the compound eye of female adults of *Cooloola ziljan* Rentz. The insects used in this study were fixed in a prefixative solution of 2% paraformaldehyde and 2.5% glutaraldehyde in the field for TEM observation. Then the eyes were removed from the head and postfixed in cacodylate-buffered 1% O_3O_4 solution. They were embedded in Epon 812 after dehydration.

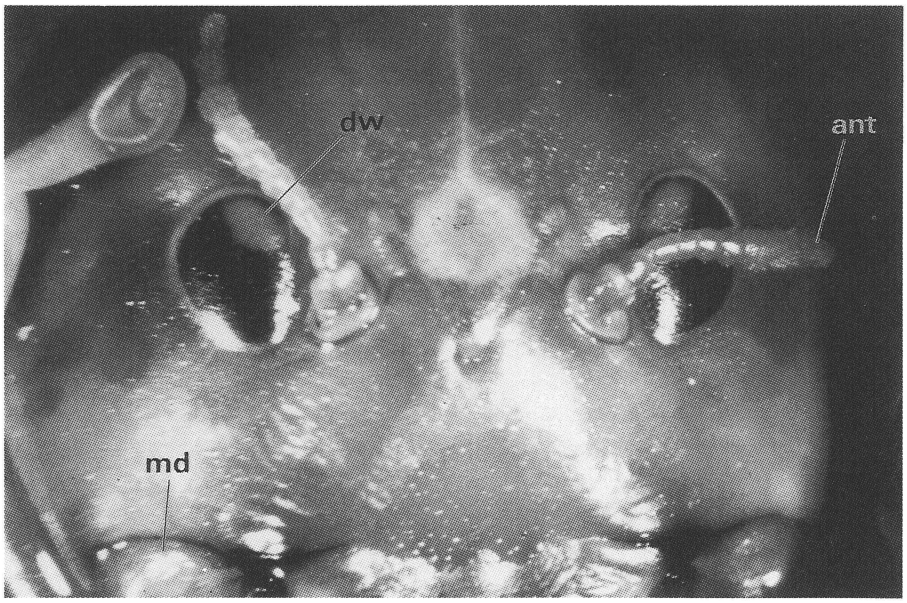

Fig. 1 Frontal view of the head of *Cooloola ziljan*. ant : antenna, dw : dorsal window, md : mandible.

The females of *C. ziljan* have only slightly bulging eyes with closely arranged and darkly coloured facets, and ocelli are absent(Fig. 1). The eyes are almond-shaped broadening toward the dorsal part, and the dorsal quarter of them contains no pigment granules, and the part is known as the 'dorsal window' in other crickets (Egelhaaf and Dambach, 1983).

The ventral main part of the eye is composed of hexagonal cornea-facets. However, their shape gradually changes into irregular polygons toward the dorsal edge of the part , and in the part the eye consists of irregular cornea-facets.

1. Ommatidia of the ventral main part of the eye

The structure of the ommatidia in the ventral main part is fundamentally the same as in other other orthopteran eyes-(Fig. 2). In the part the cornea is very thick, flat and not subdivided into facets. Underneath there are four

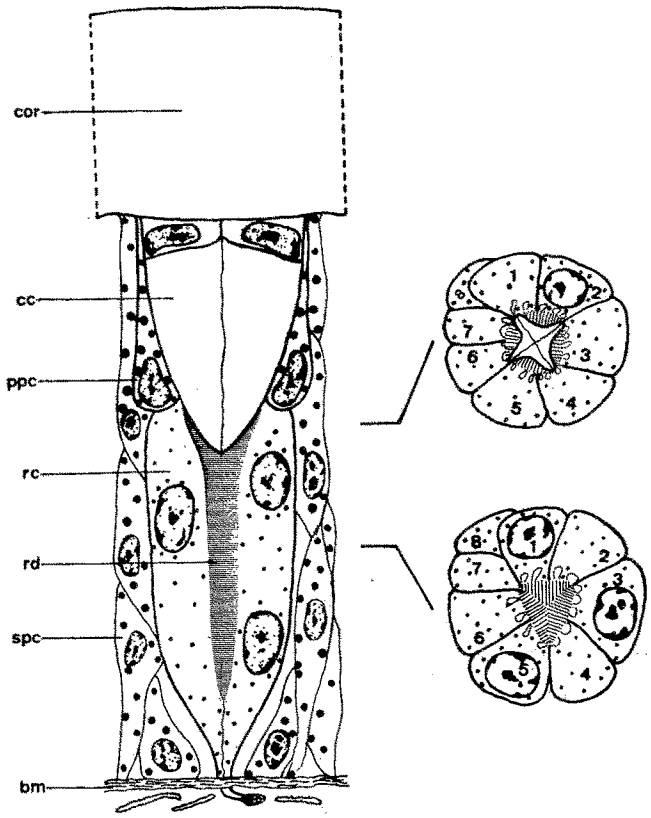

Fig. 2 Semi-diagrammatic drawing of the ommatidia from ventral main part of *Cooloola ziljan* eye. Longitudinal sections with representative cross sections at each level (the scale is not same). bm : basement membrane, cc : crystalline cone, cor : cornea, ppc : primary pigment cell, rc : retinula cell, rd : rhabdom, spc : secondary pigment cell.

crystalline cone cells (Semper cells), which enclose the crystalline cone. Seven of the eight retinula cells embrace their rhabdomeres in the proximal end of the crystalline cone just where it tapers off as observed in other orthopteran eyes, and the six cells take part in forming the triangular rhabdom which shows no regularity in cross section(Fig.3).

The microvilli of the rhabdom are not closely packed and retinula cells contain many small pigment granules (Fig.3). The primary pigment cells which contain relatively large pigment granules as in the secondary pigment cells span over the distal half of the crystalline region, and the secondary pigment cells extend from the basis of the ommatidium to the cornea.

The ommatidia in the ventral main part of the eye of *C.ziljan* mentioned above are of a typical eucone apposition type (Fig.2). In addition, their structural characteristics are common among those of Orthoptera and other orthopteroid insects except Dermaptera (Mclean and Horridge, 1977). However, the thick cornea, short retinula cells and irregularity of rhabdomic form in the ommatidia are the characteristic features of *C.ziljan*. In these ommatidia, the perception of image is probably not essential, because the insects are not flying but fossorial except when adult males seek for females. The modified ommatidial structures of this species may have been induced by the influence of their life mode.

2. Specialized dorsal part or dorsal window of the eye

In *Cooloola* alone the pigment granules are lacking but other structures are always present as in *Gryllus bimaculatus* of Gryllidae (Hoff,1985). In *Cycloptiloides canariensis* of Gryllidae, however, the dorsal part of the compound eye has a completely different structure comparing with the remaining ventral part. In the part the biconvexed cornea, crystalline cones, primary pigment cells and pigment granules are lacking, but the flat cornea and large rhabdom are present (Egelhaaf and Dambach, 1983). This specis is endemic to the Canary Islands, and is not flying and most probably a nocturnal or twilight-active insect (Egelhaaf and Dambach, 1983).

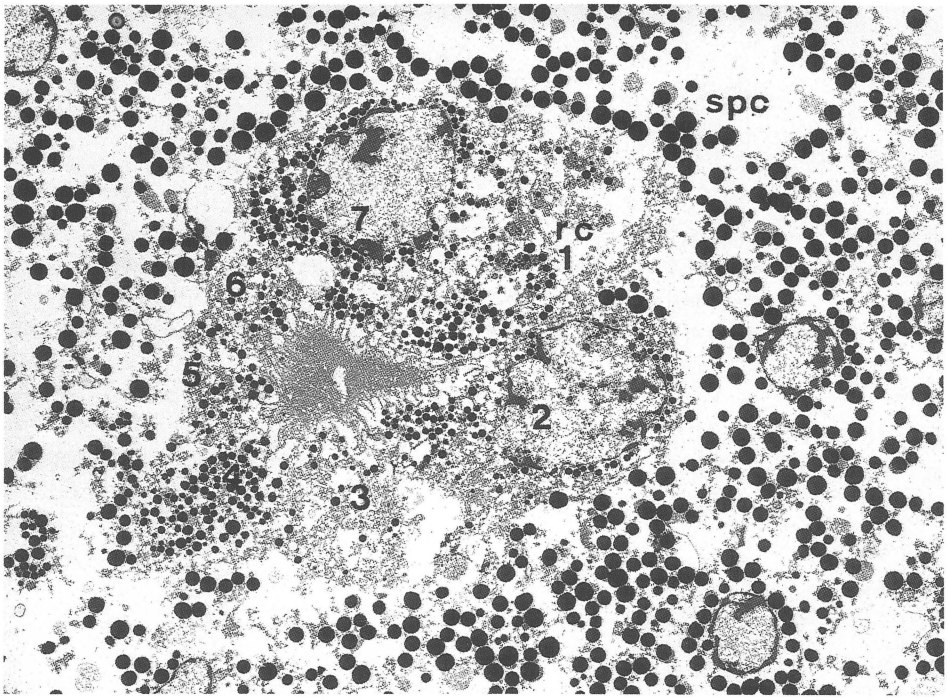

Fig. 3 Ultrastructure of the ommatidium of *Cooloola ziljan* (cross-section). Seven retinula cells of the ommatidium can be seen. rc : retinula cell, spc : secondary pigment cell.

References

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