In: N Elsner and FG Barth (eds) Sense Organs: Interfaces between Environment and Behaviour. Proc. 16th Göttingen Neurobiology Conference p 215 G. Thieme Verlag, Stuttgart (1988)

VISUAL FIELDS AND OPTICAL PROPERTIES OF THE OCELLI OF THE BLOWFLY CALLIPHORA

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Apart from the compound eyes *Calliphora vicina* (= *C. erythrocephala*) has three ocelli, each with a cuticular lens. The retina of the lateral ocellus contains 200 - 300 receptor cells (Rosser, unpublished). In *Musca domestica* the photoreceptors of the three ocelli are coupled to the dendritic tufts of 12 large L-neurons, 8 of which make functional contact with a pair of DNOVS-neurons situated in the ventrolateral protocerebrum (Bassemir 1986). These neurons could contribute to the control of head attitude (Strausfeld, Bassemir 1985). In *C. vicina* L-neurons have terminals also in the ventrolateral protocerebrum (Nässel, Hagberg 1985); the role of ocellar input in this area remains to be elucidated: Hengstenberg (1985) points out that during flight the influence of the ocelli on head movements around the roll axis is negligibly small, and there is no further behavioural evidence for ocellar control of head posture in *C. vicina.*

In optical studies Cornwell (1955) showed that the visual fields of ocelli in *C. vicina* are not directed towards the horizon as in locusts (cf. Wilson 1978) but are pointing upwards. We illuminated the ocelli from different directions and could confirm Cornwell's results by analysis of the simultaneously recorded electroocellogram:

1. The angular widths of the visual fields of both the median ocellus and the lateral ocelli are about 180°.
2. In the walking animal an image of the frontal horizon is formed within the visual field of the median ocellus. The horizon is imaged about 45° above its lower border. The lateral horizon is seen by the median ocellus and by the lateral ocellus on the respective side. The horizon is imaged about 15° above the lower border of their visual fields.
3. During flight the head is tilted backward and the borders of the visual fields are shifted relative to the horizon. The head of animals flying in a cage of 50 x 50 x 50 cm" is tilted by 29° (±15° s.d.). At a pitch angle of 29° the angles between the axes of the ocelli and the vertical are about 30° - 45°.- During flight the combined visual fields of the 3 ocelli cover the whole celestial hemisphere. This leads us to assume that ocelli of *Calliphora* are functionally different from those of locusts and dragonflies which are mainly used as horizon detectors mediating compensatory head and body movements (Taylor 1981; Stange, Howard 1979).

There is some evidence that in walking flies ocelli take part in course control: According to Wehrhahn (1984) *Musca* can orient towards contrast borders and relatively small bright objects using only its ocelli. *Calliphora* Shows no orientation towards bright objects by means of the ocelli alone (Cornwell 1955; Wehrhahn, pers. comn.). However, an additional ocellar input improves the phototaxis mediated by the compound eyes (Cornwell 1955). Wellington (1953) found that *Sarcophaga* adjusts its path to the plane of vibration of polarized light having its ocelli intact but the compound eyes covered.

An attempt is made to determine the spatial resolution of the ocellar system. In the ocellus of *Calliphora* the image formed by the lens is located "far" behind the layer of photoreceptive structures. Within this layer the image is out of focus but also the defocussed image permits the resolution of details of higher spatial wavelength. The photoreceptive structures lie close to the lens. So it must be asked for the degree of spatial resolution near the lens: In a plane at the inner surface of the lens a sinusoidally modulated grating can be transfered with a contrast ratio of 10% when its spatial period is about 34°. This value has to be compared with the anatomical resolution of the ocellus. For an visual field of 180° and 200 - 300 receptor cells the angular receptor spacing is about 10°. This means that object structures with a spatial period of 34° can be resolved by the retina. Hence the ocellar system of *Calliphora* is likely to register more than only large field luminance variations.