Görme Organları

Dorsal Osellus

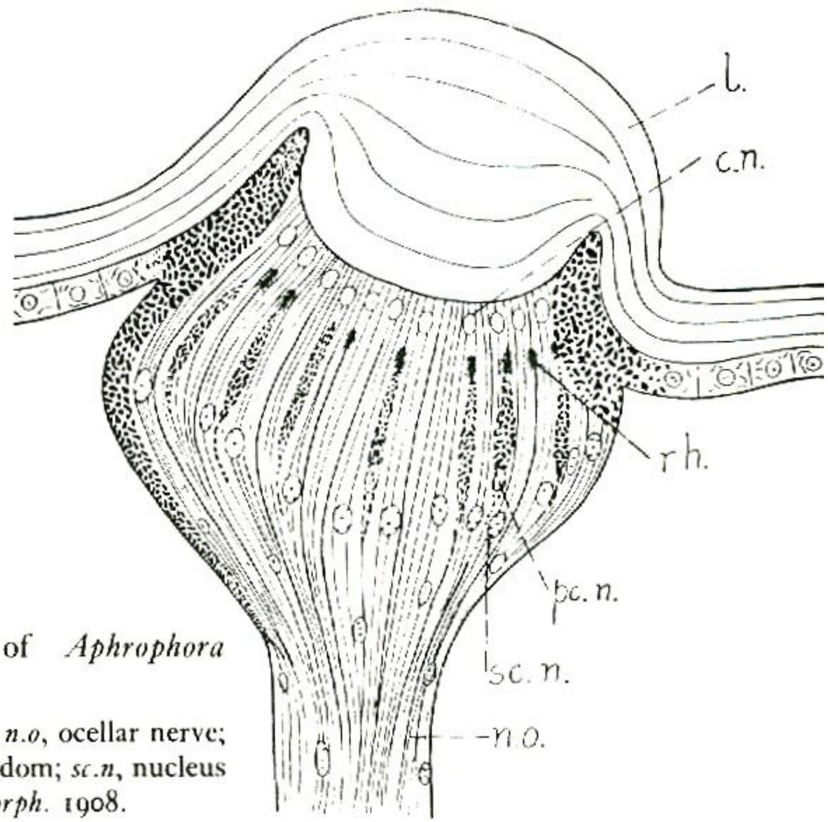


FIG. 81

Section through an ocellus of *Aphrophora spumaria*

c.n, nucleus of corneagen cell; *l*, lens; *n.o*, ocellar nerve; *pc.n*, nucleus of pigment cell; *rh*, rhabdom; *sc.n*, nucleus of retinulae. *After* Link, *Zool. Jb. Morph.* 1908.

Dorsal Osellus

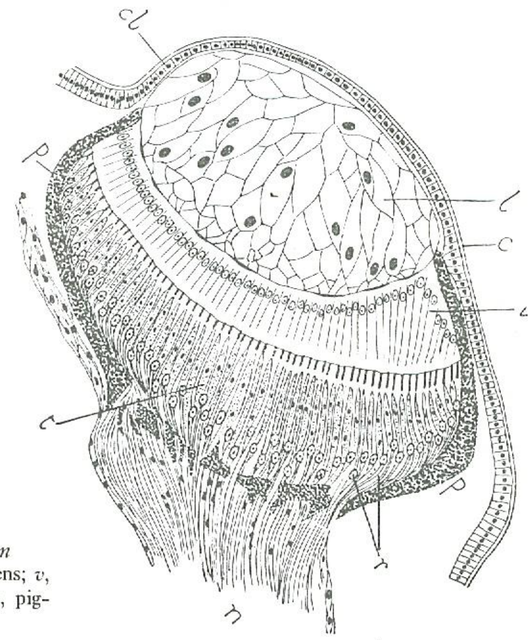
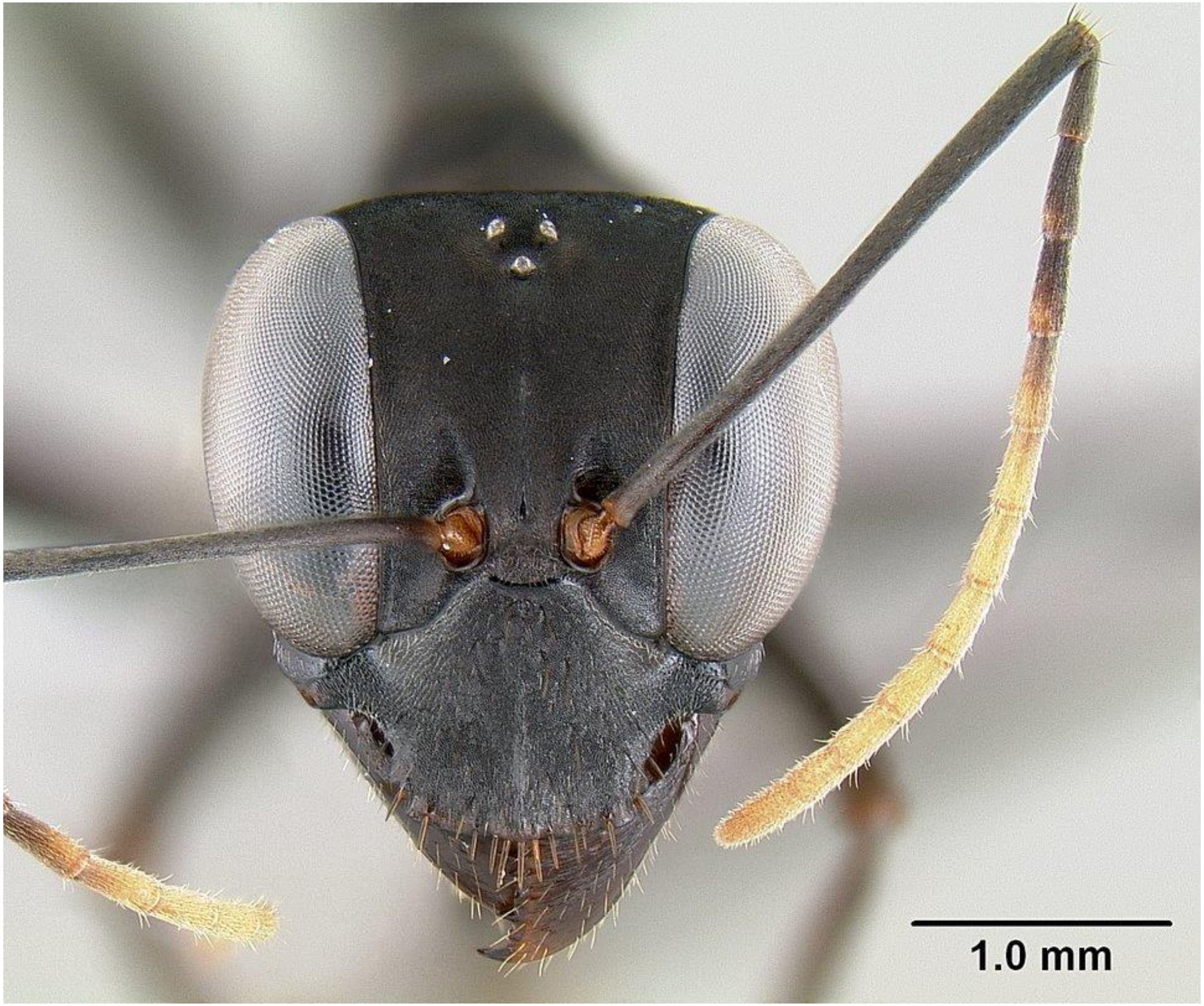


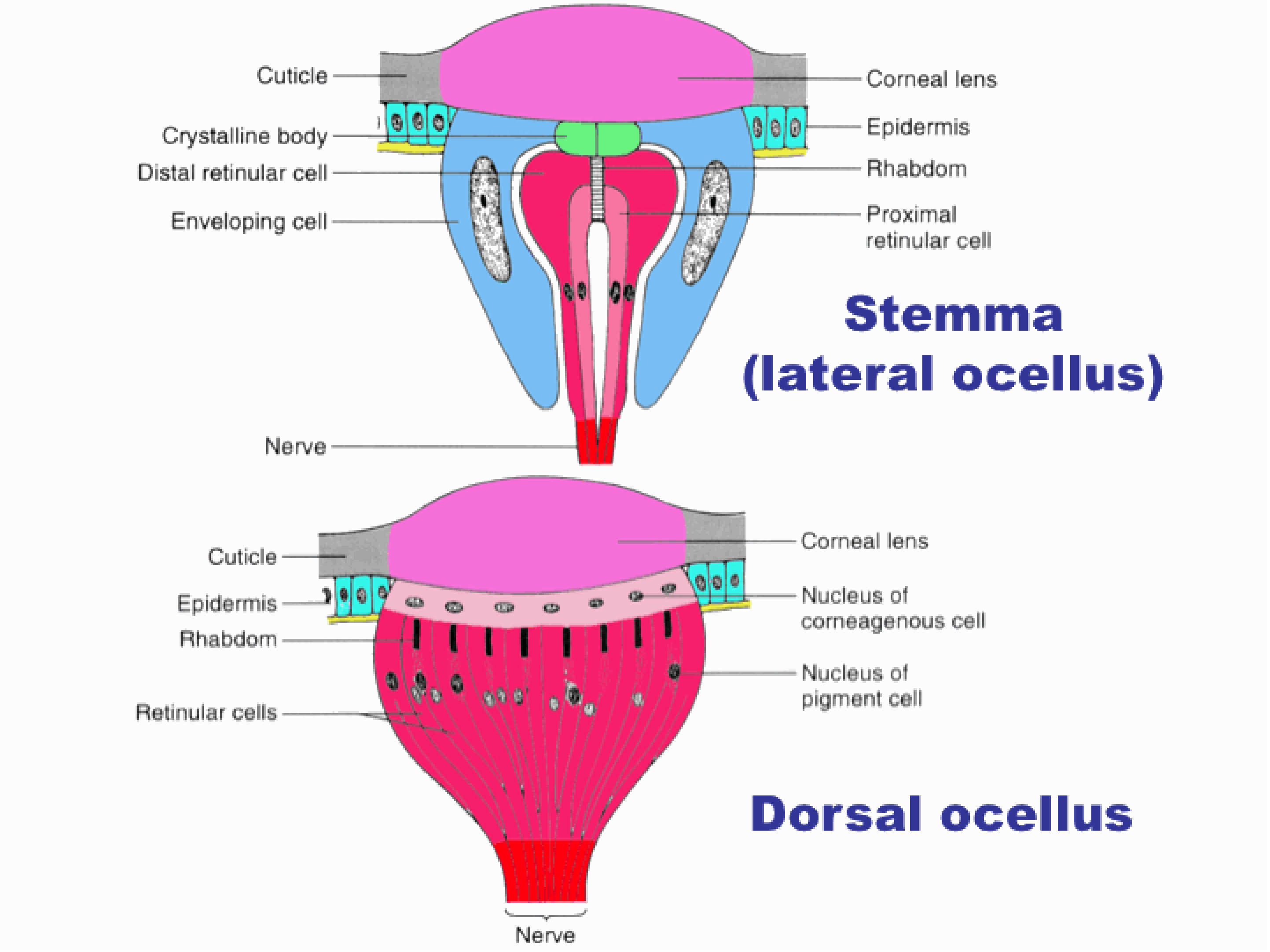
FIG. 82
Section of the median ocellus of *Cloeon*
c, cuticle; *cl*, corneagen layer; *l*, cellular lens; *v*, vitreous layer; *r*, retinulae; *t*, tapetum; *p*, pigment; *n*, ocellar nerve. *After* Hesse, 1901.

eral

Dorsal osellus



Camponotus – (Formicidae)


Cuticle
Crystalline body
Distal retinular cell
Enveloping cell
Nerve
Corneal lens
Epidermis
Rhabdom
Proximal retinular cell
Stemma (lateral ocellus)
Cuticle
Epidermis
Rhabdom
Retinular cells
Corneal lens
Nucleus of corneagenous cell
Nucleus of pigment cell
Dorsal ocellus
Nerve

Lateral Osellus (Boyuna kesit)

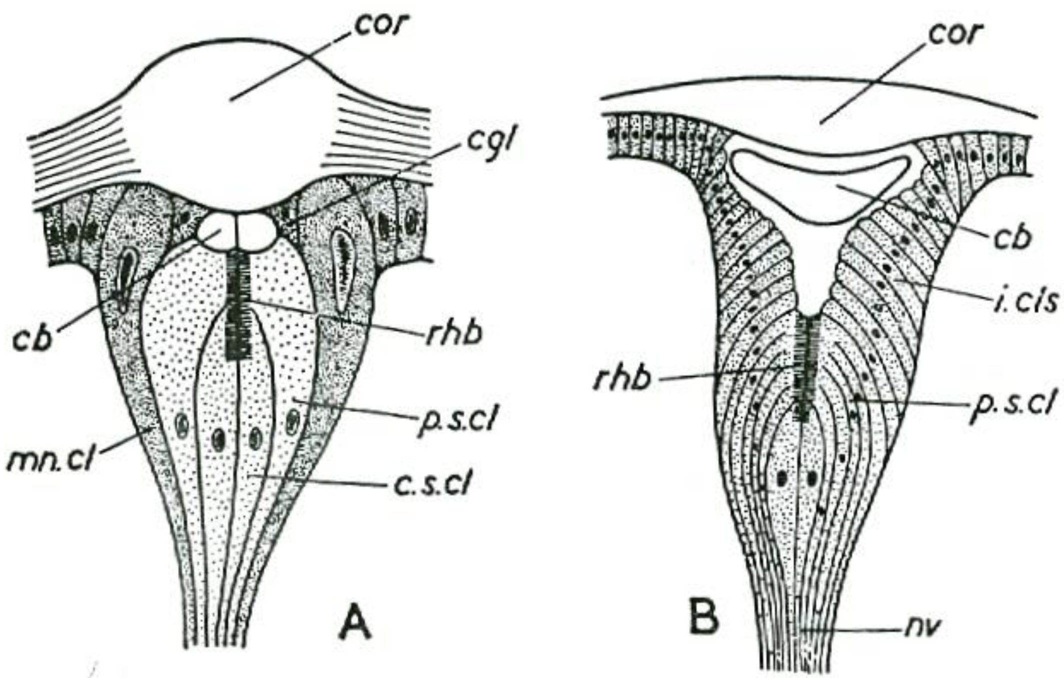
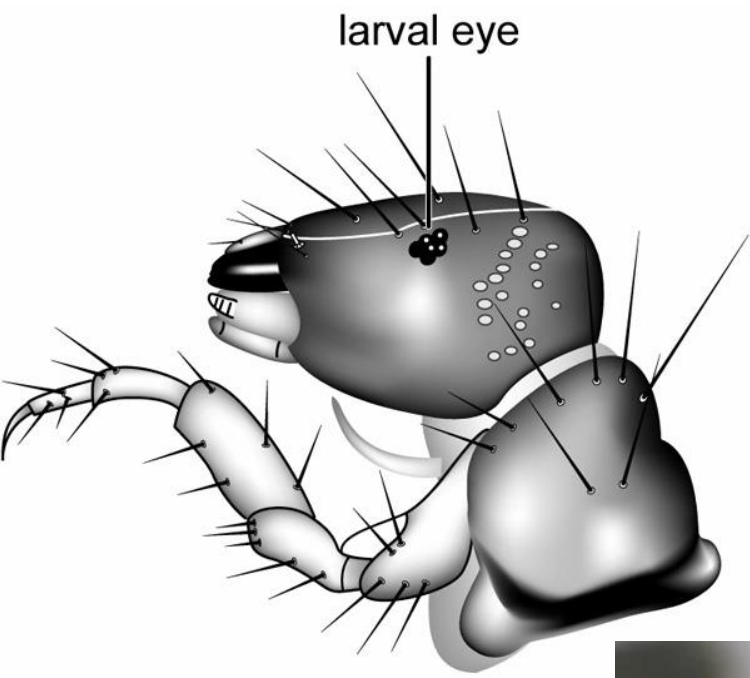
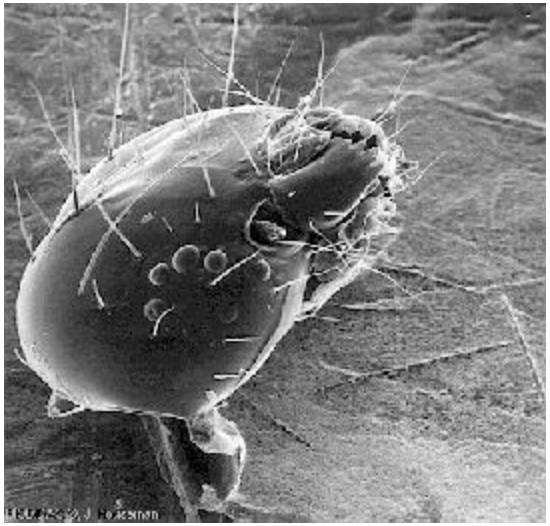


FIG. 83 Two types of lateral ocelli. A. Lepidopteran larva. B. *Dytiscus* larva (*after* Snodgrass, 1935)

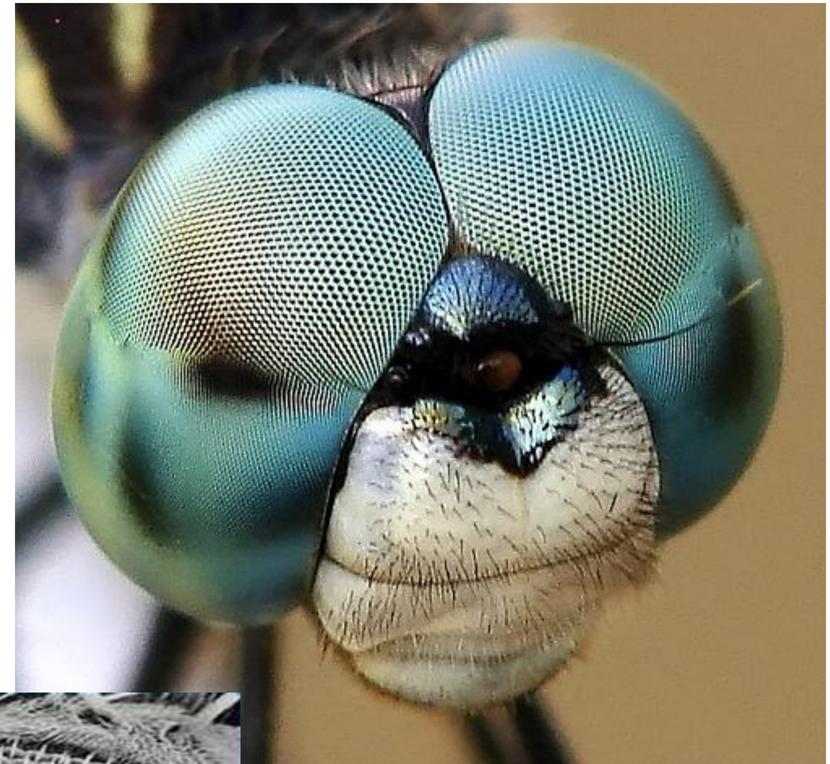
cb, crystalline body; *cgl*, corneagen cell; *cor*, corneal lens; *c.s.cl*, central retinal cells; *i.cls*, pigmented iris cells; *mn.cl*, mantle cell; *nv.*, ocellar nerve; *p.s.cl.*, peripheral retinal cells; *rhb*, rhabdom.

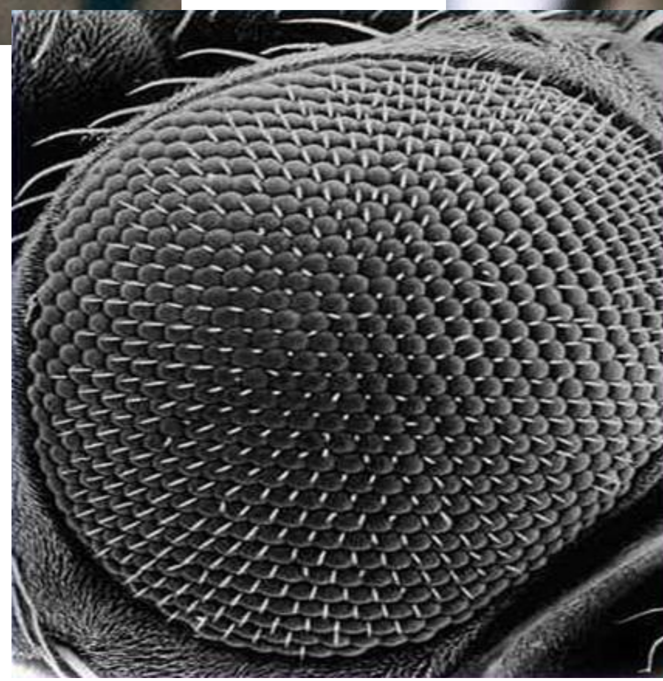


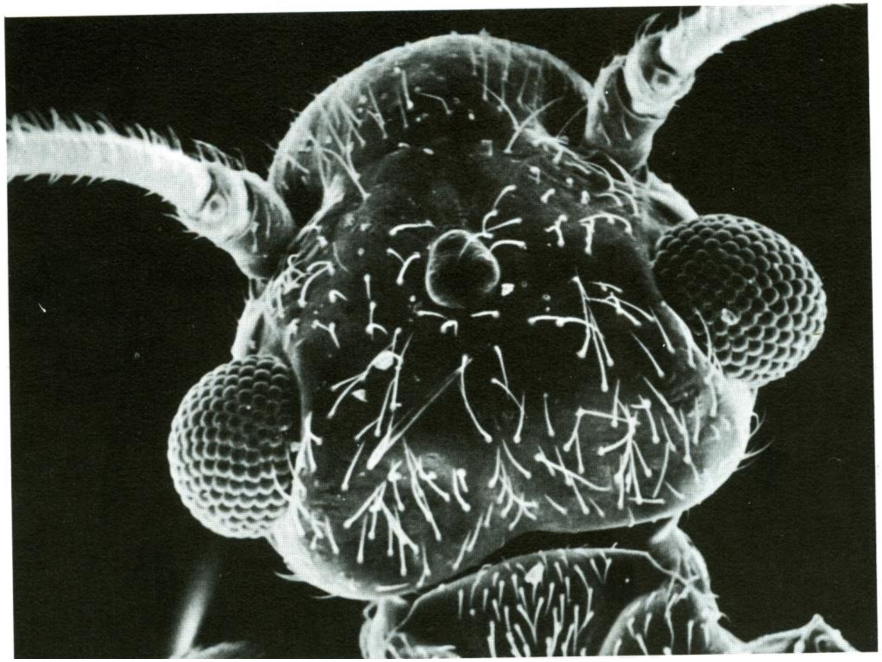
Stemmata



PETEK GÖZ







Head of Psocoid *Graphopsocus cruciatus*
(Bulbus compound eyes)

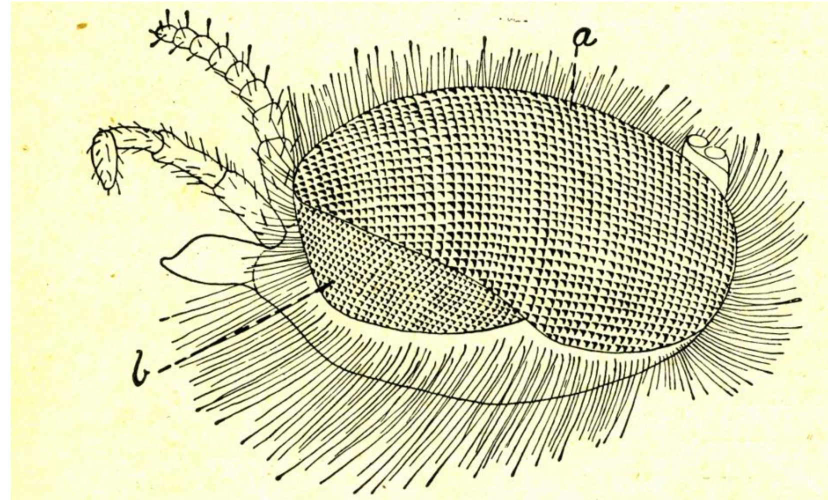


FIG. 79.—HEAD OF *BIBIO MARCI* (MALE), SHOWING DIVIDED EYE (LEFT).

a, upper division of eye ; *b*, lower division

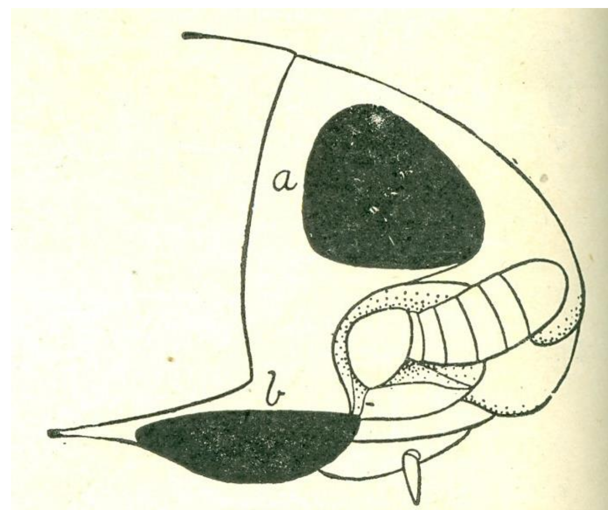


FIG. 80.—HEAD OF *GYRINUS NATATOR*, SHOWING DIVIDED EYE (RIGHT).

a, upper division of eye ; *b*, lower division.

Petek Göz yapısından boyuna kesit

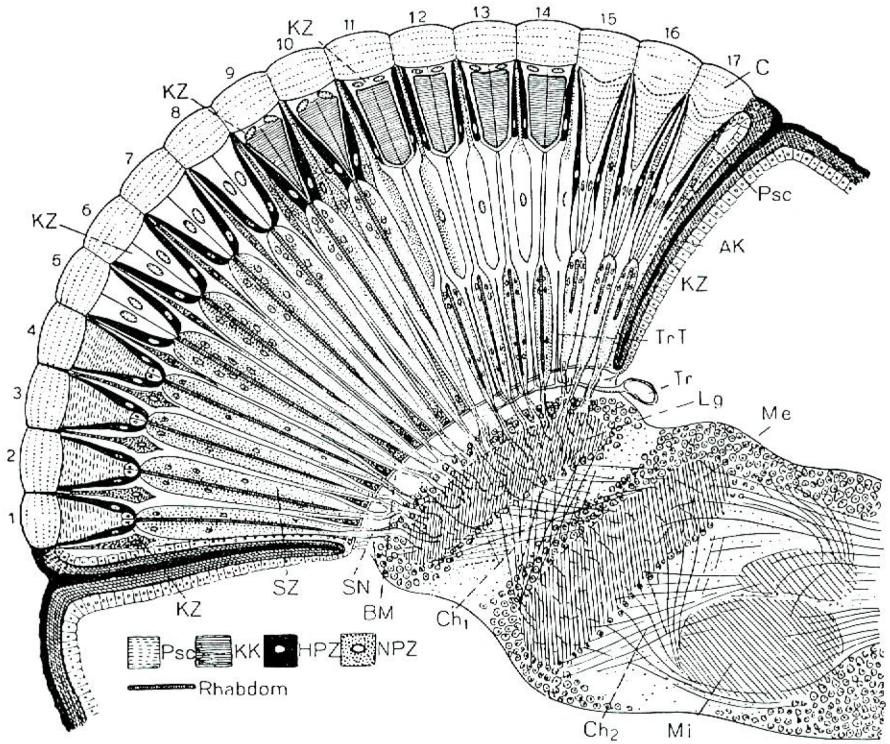
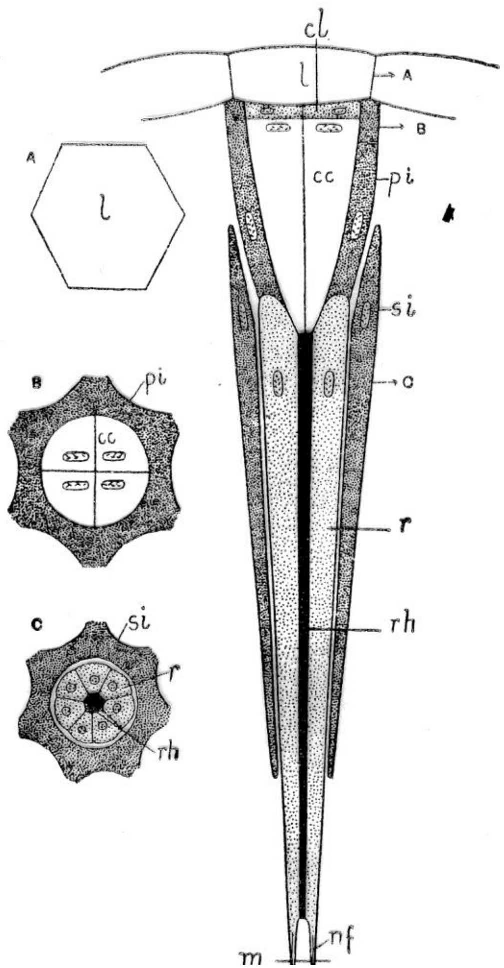


Fig. 74: Kombiniertes Schema eines Schnittes durch ein **Komplexauge und** den zugehörigen **Lobus opticus.**

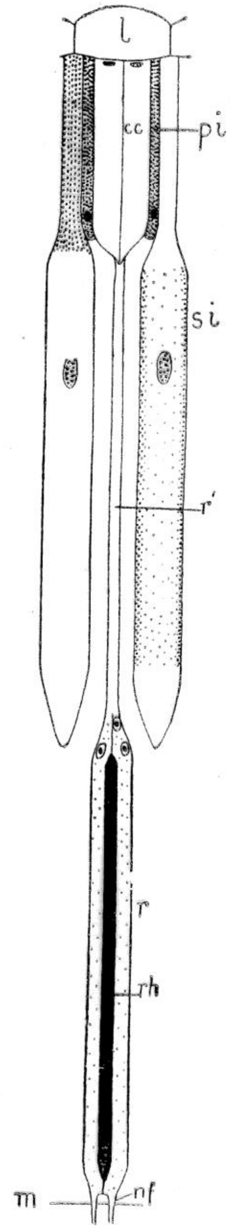
Die Ommatidien **1–4** sind pseudokon mit weichem Konus, **5–8** akon, **9** und **10** eukon mit terminalem, **11–14** eukon mit zentralem Kristallkegel, **15–17** pseudokon mit kutikularem Konus. **1–10** Appositionsauge, **11–17** Superpositionsauge, das Ommatidium **11** zeigt Helladaptation.

AK = Augenkapsel, BM = Basalmembran, C = Cornea, $Ch_{1,2}$ = äußeres und inneres Chiasma, HPZ = Hauptpigmentzelle, KK = Kristallkegel, KZ = Kristallzelle, Lg = Lamina ganglionaris, Me, Mi = Medulla externa, interna, NPZ = Nebenpigmentzelle, Psc = Pseudokonus, SN = Sehnervenzone, SZ = Sehzellen, Tr = Trachee, TrT = Tracheentapetum.

A



B

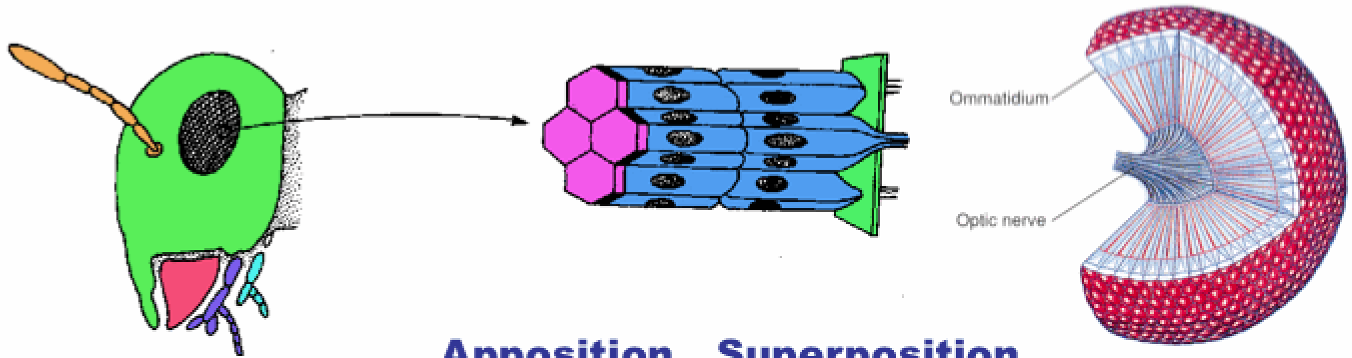


Apozisyon göz'de genelleştirilmiş bir ommatidyum diyagramı

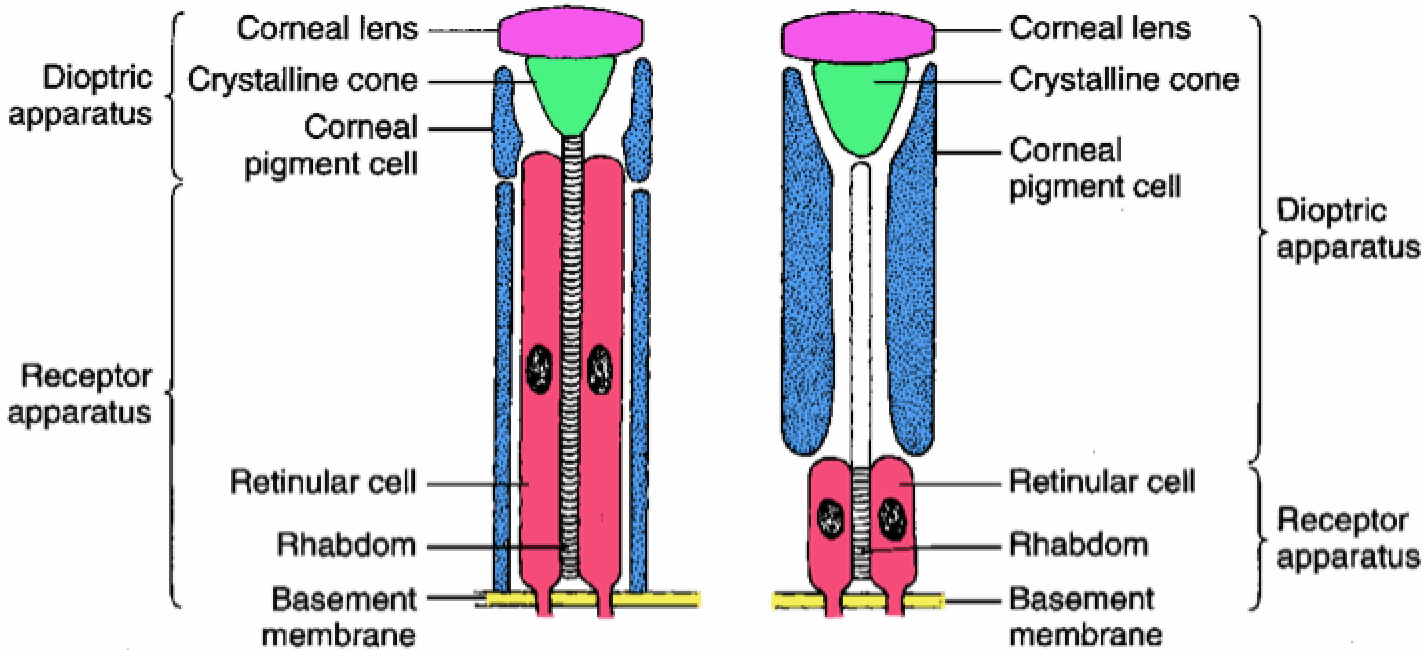
A. l. kornea (mercek) ; cl. Korneagen tabaka; cc. Kristal koni; r. retinula ; m. delikli membrane; pi: primer iris hücreleri; rh.rabdom; si. Segonder iris hücreleri. nf: sinir lifleri; A,B,C, Ommatidyum üzerinde yapılan enine kesitlerdeki görüntüler

B. Superpozizyon gözde genelleştirilmiş bir ommatidyum diyagramı.

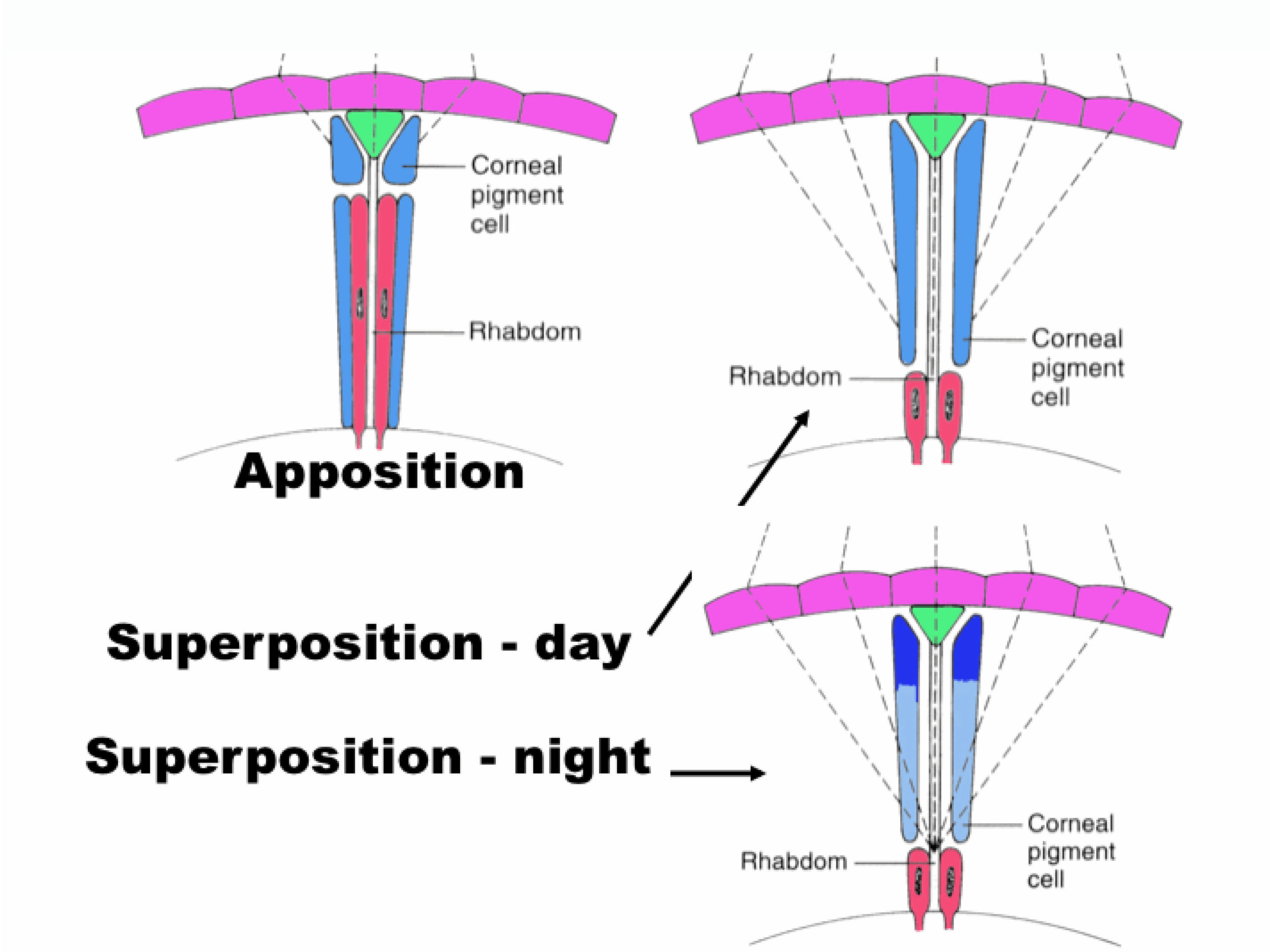
Sol tarafta gece, sağ tarafta gündüz görmede pigmentlerin konumu. r'. retinulayı Kristal koni ile bağlantılı kılan flamentler. Diğer harfler soldaki şekilde olduğu gibi aynı kısımları tanımlıyor.



Apposition **Superposition**

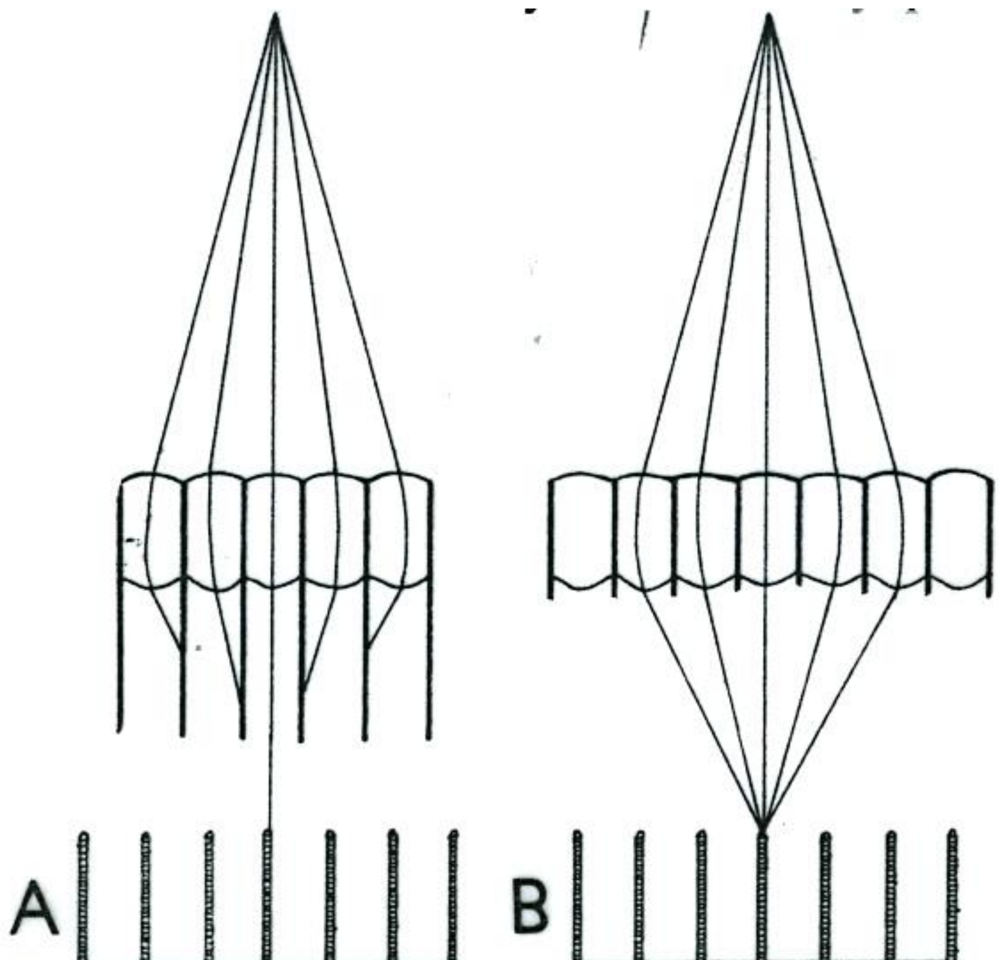


Petek Göz

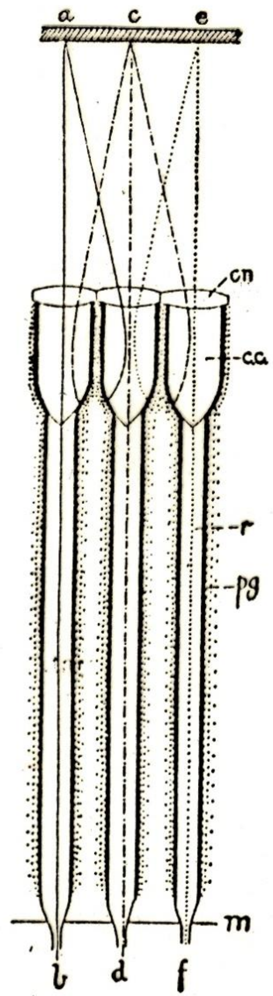


Corneal
pigment
cell
Rhabdom
Apposition
Rhabdom
Corneal
pigment
cell
Superposition - day
Superposition - night
Corneal
pigment
cell
Rhabdom

Hayal oluşumu



Şekil 48. Apozisyon (A) ve superpozisyon (B) gözlerde hayal oluşumunun klasik izahı.



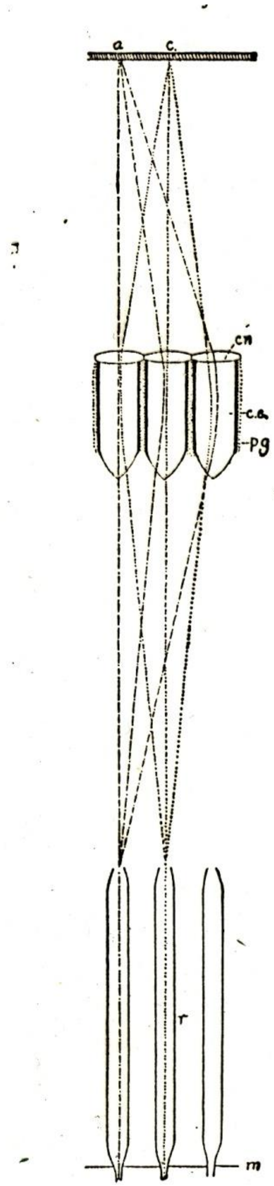
A

A. **Apozisyon görünüm veren göz diyagramı**

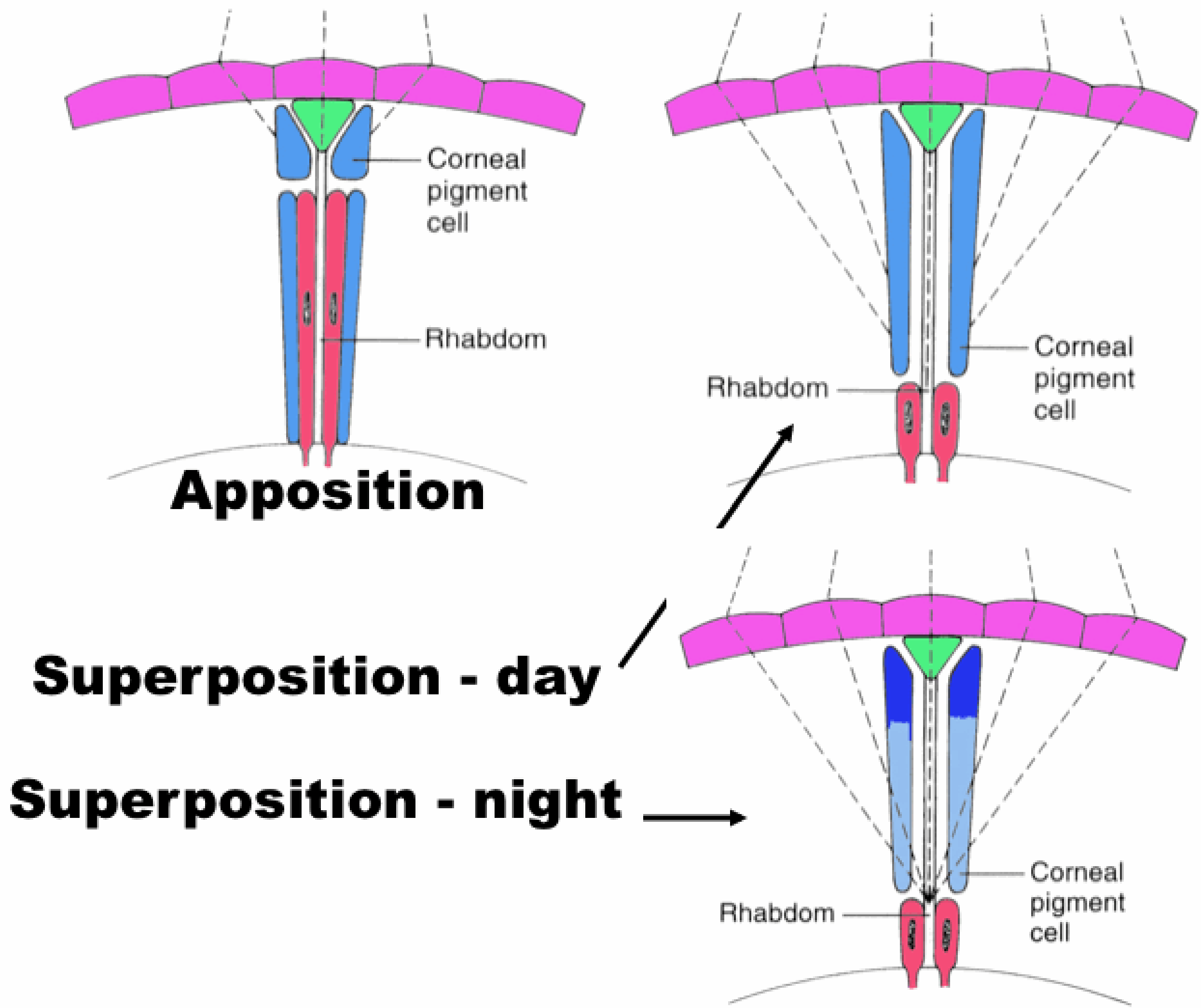
a,b,c objelerinden gelen ışınların sadece ommatidyumun uzun eksenine paralel olanları retina ya ulaşanlardır. Örneğin ab,cd,ef). Ommatidyumun yanlarına çarpan ışınlar pigmentler tarafından emilenlerdir. Cn.kornea, cc.kristal koni, r.retinula, pg.pigment, m. delikli membran, (Exner'e göre)

B. **Süperpozisyon görünüm veren göz diyagramı.**

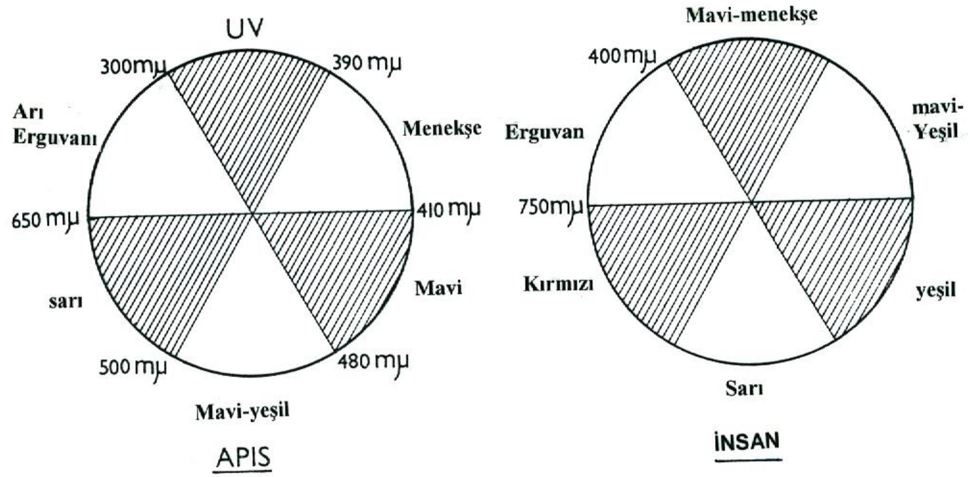
Her bir retina sadece kendi merceğine gelen ışınlardan görüntü almaz aynı zamanda komşu ommatidyumlardan gelen obliq ışınları da alır



B

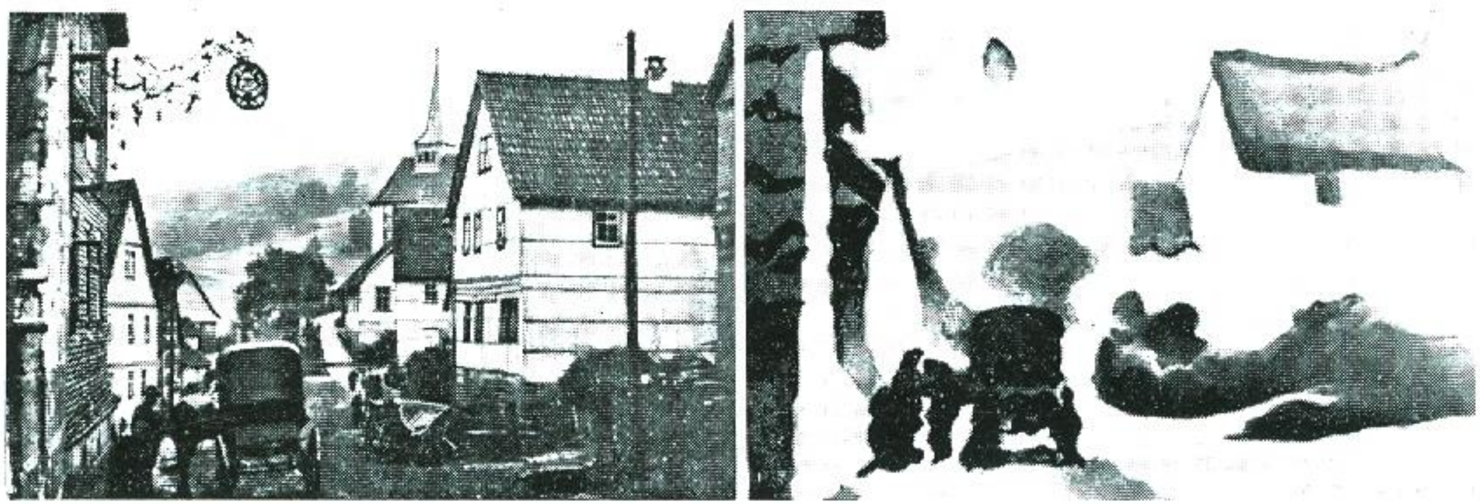

Corneal
pigment
cell
Rhabdom
Apposition
Rhabdom
Corneal
pigment
cell
Superposition - day
Superposition - night
Corneal
pigment
cell
Rhabdom

Balarısı ve İnsan'da renk halkası



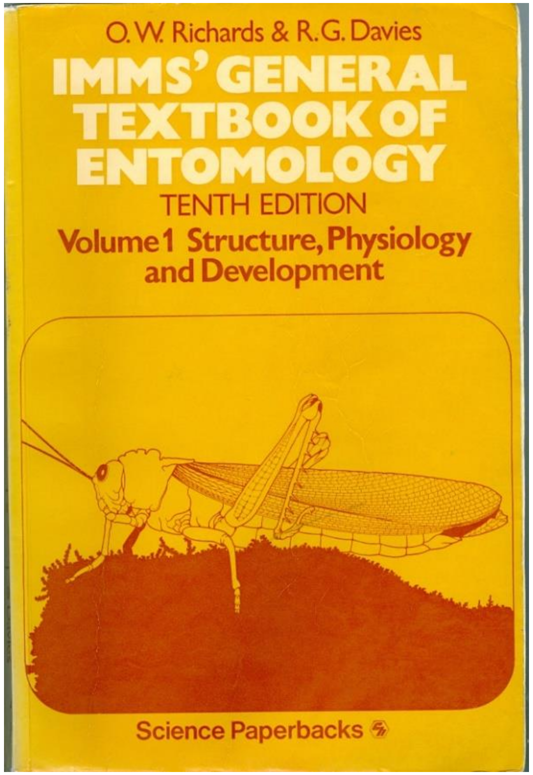
Şekil 49. İnsan ve balarısı (Apis mellifera)'nın renk halkası (Burkhardt,1964, Daumer,1956). İçi taralı olan bölgeler primer renkleri, beyaz bölgeler sekonder renkleri göstermektedir.

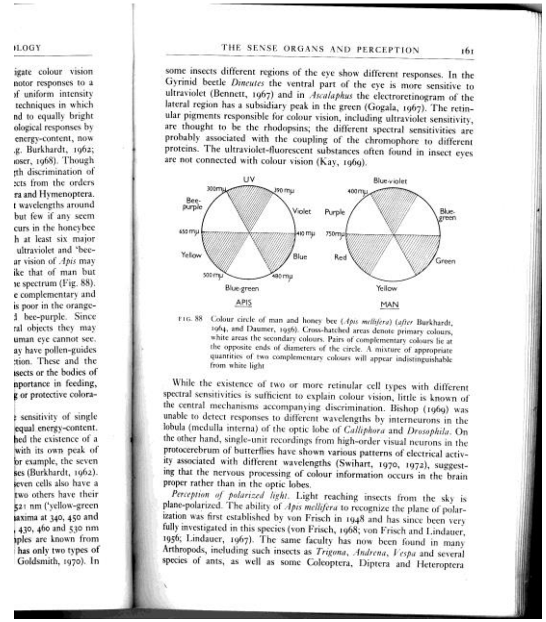
Balarısı'nda hayalin algılanması



a b

Fig. 77: Vergleich der **Sehschärfe** des Auges des Menschen (a) mit der eines Appositionsauges (b). (Nach UEXKÜLL und KRISZAT 1934).





some insects different regions of the eye show different responses. In the Gyrinid beetle *Dineutes* the ventral part of the eye is more sensitive to ultraviolet (Bennett, 1967) and in *Ascalaphus* the electroretinogram of the lateral region has a subsidiary peak in the green (Gogala, 1967). The retinular pigments responsible for colour vision, including ultraviolet sensitivity, are thought to be the rhodopsins; the different spectral sensitivities are probably associated with the coupling of the chromophore to different proteins. The ultraviolet-fluorescent substances often found in insect eyes are not connected with colour vision (Kay, 1969).

FIG. 88 Colour circle of man and honey bee (*Apis mellifera*) (*after* Burkhardt, 1964, and Daumer, 1956). Cross-hatched areas denote primary colours, white areas the secondary colours. Pairs of complementary colours lie at the opposite ends of diameters of the circle. A mixture of appropriate quantities of two complementary colours will appear indistinguishable from white light

While the existence of two or more retinular cell types with different spectral sensitivities is sufficient to explain colour vision, little is known of the central mechanisms accompanying discrimination. Bishop (1969) was unable to detect responses to different wavelengths by interneurons in the lobula (medulla interna) of the optic lobe of *Calliphora* and *Drosophila*. On the other hand, single-unit recordings from high-order visual neurons in the protocerebrum of butterflies have shown various patterns of electrical activity associated with different wavelengths (Swihart, 1970, 1972), suggesting that the nervous processing of colour information occurs in the brain proper rather than in the optic lobes.

Perception of polarized light. Light reaching insects from the sky is plane-polarized. The ability of *Apis mellifera* to recognize the plane of polarization was first established by von Frisch in 1948 and has since been very fully investigated in this species (von Frisch, 1968; von Frisch and Lindauer, 1956; Lindauer, 1967). The same faculty has now been found in many Arthropods, including such insects as *Trigona*, *Andrena*, *Vespa* and several species of ants, as well as some Coleoptera, Diptera and Heteroptera

Perception of polarized light. Light reaching insects from the sky is plane-polarized. The ability of *Apis mellifera* to recognize the plane of polarization was first established by von Frisch in 1948 and has since been very fully investigated in this species (von Frisch, 1968; von Frisch and Lindauer, 1956; Lindauer, 1967). The same faculty has now been found in many Arthropods, including such insects as *Trigona*, *Andrena*, *Vespa* and several species of ants, as well as some Coleoptera, Diptera and Heteroptera

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Octopus Sunglasses Displays Land Naked-Eye Compass Space

The Discovery

It is difficult to single out who first discovered polarized light. Early humans could have noticed a peculiar smudge when looking at the sky in certain directions. Moreover, polarization has lots of quirks and was discovered many times in different contexts: even today it is the subject of much research. But the official story goes like this:

Bartholinus sees double (1669)

Iceland Spar was involved in the official discovery of polarization. This naturally occurring transparent crystal (optical quality Calcite, $CaCO3$) separates an image into two displaced images when looked through in certain directions. In 1669, a Danish mathematician at the University of Copenhagen, Erasmus Bartholinus, not only saw double, but also performed some experiments and wrote a 60-page memoir about the results. This was the first scientific description of a polarization effect (the images are polarized perpendicular to each other), and for his efforts he may be considered the discoverer of this hidden property of light.

Experimenta Crystalli Islandici

Huygens waves Newton (1672)

Opticks

Christian Huygens developed a pulse-wave theory of light that he published in 1690 in his famous optical book "Traite de la Lumiere", while Isaac Newton pushed a corpuscular theory of light in his not less influential book "Optics" (Opticks) (1704) (<u>however, see Note 1</u>). Although in the end both were correct (or wrong) as light has a dual personality (wave AND particle), Huygens was closest to the modern view. Yet, in trying to explain double refraction, Newton asks in Question 26 of Optics: "*Have not the rays of light several sides*, endued with several original properties?"

Traite de la Lumiere

In 1672 Huygens derived the double refraction property of the Iceland Spar from a geometric wave construction, extending the construction method he had employed to explain refraction. The "Huygens Principle" considers each point on a wavefront the source of spherical wavefronts that add up to build the propagating wavefront. Huygens realized that if the velocity of light varied with the direction the spheres would deform to ellipsoids and thus was able to explain the refraction law for crystals such as Iceland Spar.