are in progress at the electron microscopic and biochemical levels in order to determine the mechanism and fine structural foci of activity[16,17].

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Zusammenfassung. Nachweis, dass im Ratten-Striatum die Reserpin-induzierte Dopamin-Depletion mit einer Erhöhung der ATPase-Aktivität verbunden ist.

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The Histology of the Retina of *Pomatoschistus* (Gobius) *microps* (Krøyer)

In nearly all members of the teleosts there are 3 types of visual cells: rods, single cones and twin cones. The twin cones are found only in teleosts. In 1911 HESS[1], having studied different retinae, noted that in no other vertebrate class is there such a variety in structure and distribution of rods and cones. Subsequently, the teleost retina has received only scant attention[2–4].

Various teleostean retinae are currently being studied both histologically (light and electron microscope) and histochemically in this department. In this paper the structure of the retina, particularly of the photoreceptors, of *Pomatoschistus microps* is given.

Material and methods. Pomatoschistus microps is a katadromous fish, found from October to March in the Salt Marsh, Bull Island, Dublin[5]. The fish were decapitat-

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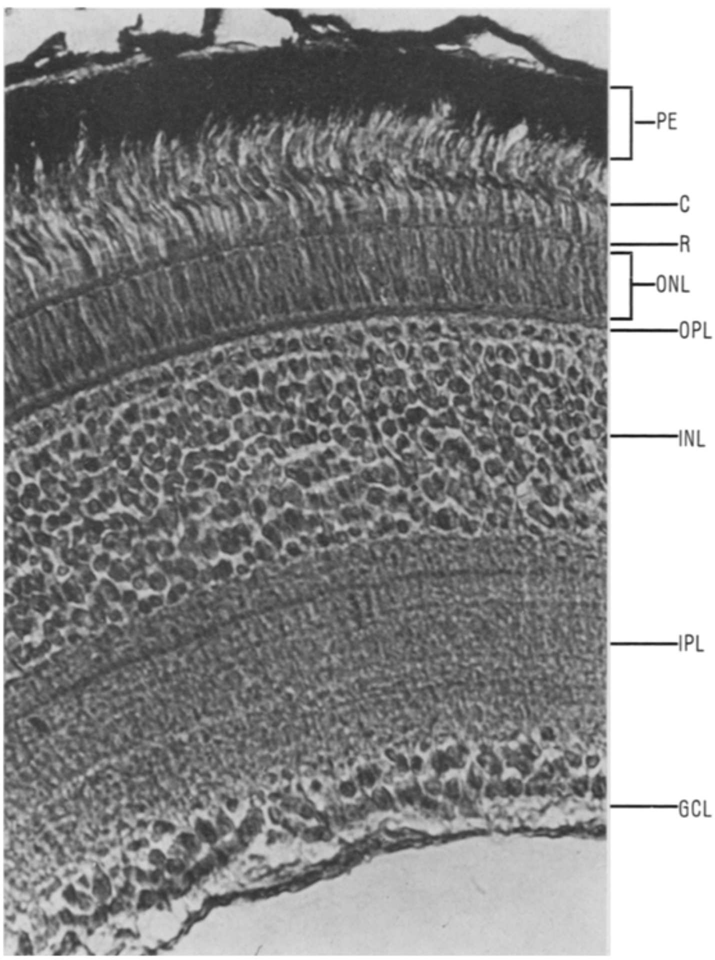

Fig. 1. Retina of *Pomatoschistus microps* (dark adapted). C, cone; GCL, ganglion cell layer; INL, inner nuclear layer; IPL, inner plexiform layer; ONL, outer nuclear layer; OPL, outer plexiform layer; PE, pigment epithelium; R, rod.

ed and the heads fixed in Bouin Duboscq or formol-alcohol, then dehydrated and embedded in paraffin. Sections were cut at 6 μm and stained with azan after Heidenhain. In addition, the pigment was bleached from the retinal epithelium in several specimens for better visualization of the rods (chlorine gas method after Maier). To obtain dark adapted eyes, the fish were kept prior to treatment for 3 h in a dark room; they were then decapitated and fixed with the aid of a red light. A Wild-20 microscope with drawing tube was used for observations.

Results. The observations refer to the central part of the retina proceeding from the inner or vitreal to the outer or scleral surface (Figure 1). The vitreal surface of the retina is supplied with hyaloid vessels, which do not penetrate it. The ganglion cell layer (GCL) is 2–3 cells thick. The inner plexiform layer (IPL) is of a similar thickness to the inner nuclear layer (INL). The cells of this layer are sharply differentiated as to size, shape and chromatin distribution: There are 3 rows of amacrine cells, with large lightly staining spherical nuclei; the nuclei of Muller's fibers are also contained within this region. The amacrine cells are followed by 6 rows of bipolar cells, with smaller and more deeply staining nuclei. The bipolar cells are bordered sclerally by a row of horizontal cells. Adjoining these, and embedded within the outermost bipolar cell row, are cells with a larger, ovoid, lightly staining nucleus, evenly spaced so that there is one such cell to every fourth horizontal cell. The outer plexiform layer (OPL) is the thinnest layer of the retina. It is followed by the outer nuclear layer (ONL), which is composed of 2 rows of nuclei: one row of small heavily stained rod nuclei, and the other of larger, spindle shaped cone nuclei with a loose chromatin network.

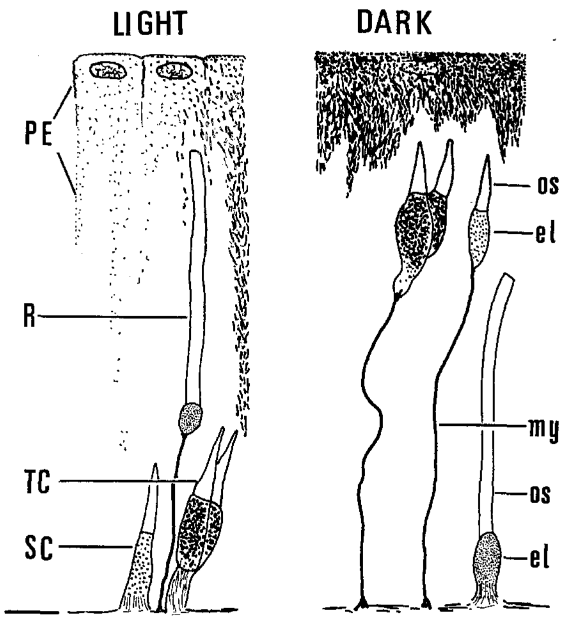

Fig. 2. Pigment epithelium and photoreceptors in light and dark adapted retina; far left, pigment bleached; el, ellipsoid; ELM, external limiting membrane; my, myoid; os, outer segment; SC, single cone; TC, twin cone.

The photoreceptor layer (C+R) contains rods, single and twin cones. The approximate numerical ratio of cones to rods is 5:4. The ellipsoid of the rods is very slender and stains uniformly; the outer segment appears to consist of a series of transverse discs. The single cones lie nearer the external limiting membrane than the twin cones. The ellipsoid of the single cone stains uniformly and is more slender than that of the twin cone. The outer segment of the single cone is thinner than that of the twin cone and stains pink with azan. The ellipsoids of the twin cones stain heavily and display a coarse granulation, which is more concentrated in the scleral two thirds of the ellipsoid. One outer segment of each twin cone stains pink and the other blue. The pigment epithelium (PE) is packed with spherical and needle shaped fuscin granules.

Light adapted eye: During light adaptation, the majority of the needle shaped granules migrate vitreally and occlude the outer segments and ellipsoids of the extended rods. The spherical granules remain concentrated in the basal part of the epithelium. The cones move towards the external limiting membrane and their contracted myoids become almost as broad as the ellipsoids. Dark adapted eye: During dark adaptation the needle shaped pigment granules move sclerally. The rods contract vitreally so that their ellipsoids come to lie on the external limiting

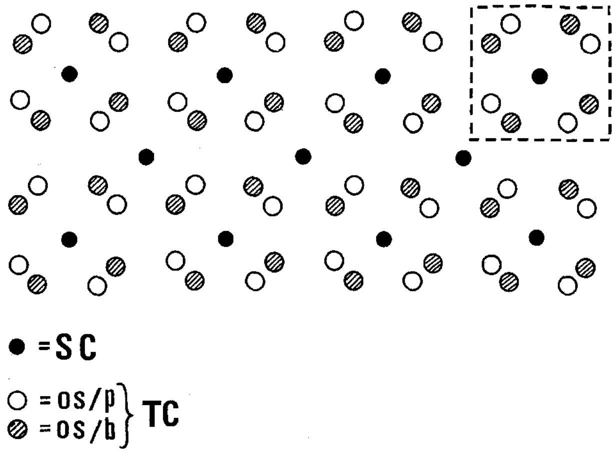

Fig. 3. Regular mosaic pattern of single and twin cones (outer segments). The field of Figure 4 is outlined. os/b, outer segment staining blue; os/p, outer segment staining pink.

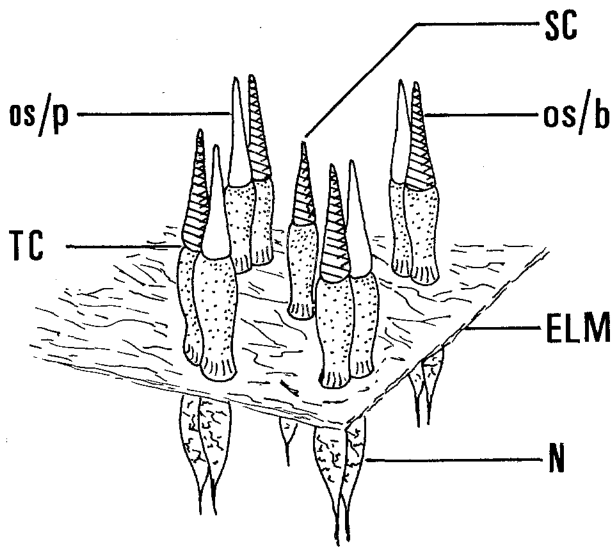

Fig. 4. Diagram showing 3-dimensional arrangement of mosaic unit. N, nucleus.

membrane. The cones extend sclerally to the same extent as do the rods in the light adapted eye. (Figure 2).

Tangential sections reveal that the single and twin cones form a regular mosaic pattern (Figure 3). The single and twin cones are arranged in alternate rows: single cones forming straight lines, twin cones forming zig-zag lines. Moreover, sections trough the outer segments show that in the zig-zag lines a segment of the twin cone staining pink always lies opposite a blue staining one. The mosaic unit of twin cones/single cones is shown (Figures 3 and 4). The rods occupy at random all the spaces between the cones.

Discussion. Pomaotschistus microps is a bottom-dwelling fish; behavioural observations suggest that the perceptual world of gobies is essentially one of visual and vibrationary ('distant-touch') stimuli[6]. It is evident that the retina of *Pomatoschistus microps* is of a pronounced diurnal type. The cones are dominant in number. The pigment epithelium amounts to roughly 1/5 of the entire thickness of the retina; the outer nuclear layer is thin; the inner nuclear layer is relatively thick and the ganglion cell layer compact – all these features are characteristic of a 'cone retina'.

The tiered arrangement of cones, such as observed here, has previously been described for *Lebistes reticulatus* and *Phoxinus laevis*, both diurnal fish[7]. A functional explanation for this arrangement of cones has not as yet been found. It has been suggested, but not confirmed, that the tiered arrangement of the *Lebistes* cones minimizes, or even completely corrects, the chromatic aberration, thereby resulting in a greatly increased acuity[8]. It is interesting to note that in *Pomatoschistus microps*, as well as in *Lebistes reticulatus*, the twin cones form the most scleral tier. Twin cones are, according to WALLS[2], clearly associated with exposure to bright light.

Regular cone mosaics are a typical phenomenon of the teleost retina. Aside from the teleost retina, regular cone arrangements have been described in a species of bird[9]. Only the cones have been considered to form a regular pattern, with the rods occupying the remaining space, until the studies of DUNN[10]. He shows that in the pure rod retina of the gecko (*Coleonyx variegatus*) single, twin and triplet rods form a regular rectilinear mosaic. The functional significance of the photoreceptor mosaic is obscure. It has been suggested that in teleosts it is advantageous for the perception of fast-moving prey[11]. There is also in *Pomatoschistus microps* a regular spatial arrangement in regard to the blue and pink staining outer segments of the cones. These may reflect functional differences. It has been shown by microspectrophotometry of single goldfish cones that there are 3 cone types each containing 1 of 3 photopigments which is maximally sensitive in a particular region of the spectrum[12]. Since photoreceptors and pigment epithelium constitute a functional system[13], it would be interesting to investigate, by electron microscopy, if a corresponding mosaic arrangement of organelles within the pigment epithelium exists. This is currently being done in this Department.

Zusammenfassung. Der histologische Bau der Netzhaut von *Pomatoschistus microps*, insbesondere der Sehzellen in Hell- und Dunkelstellung, wurde untersucht. Die Zapfen sind gestaffelt und bilden ein regelmässiges Mosaik: Reihen von Zwillingszapfen alternieren mit Reihen von Einzelzapfen. Die Aussenglieder der Zwillingszapfen unterscheiden sich färberisch voneinander und sind ihrerseits regelmässig in das Mosaik eingeordnet.

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Cycloheximide-Induced Ultrastructural Changes in the Corpus Luteum of Rats

Cycloheximide, a potent inhibitor of protein synthesis at the translation level[1], produces fine structural alterations (mitochondrial abnormalities, nucleolar segregation, as well as formation of intracytoplasmic myelin figures and large laminated whorls) in the rat adrenal cortex[2,3]. To determine whether these changes also occur in other tissues, primarily in steroid-secreting cells, we studied the ultrastructure of the corpus luteum in rats treated with this drug.

Twelve female ARS/Sprague-Dawley rats, with a mean body weight of 200 g, were given 10 mg of cycloheximide (Upjohn), dissolved in 1 ml isotonic NaCl, through the jugular vein under light ether anesthesia. These animals were killed 2, 4 or 6 h later, without anesthesia, by dislocation of the cervical spine. 6 untreated rats were used as controls.

Immediately after the animals were killed, specimens were taken from the corpus luteum, fixed in a 2.5% glutaraldehyde solution, postfixed in Caulfield's buffered osmium tetroxide, dehydrated in graded ethanol, and embedded in Epon resin. Ultrathin sections were cut from selected areas in a Porter-Blum MT-2 ultramicrotome, stained with uranyl acetate and lead citrate, and examined with a Philips 300 electron microscope. The ultrastructure of the corpus luteum of the normal rat ovary has been described sufficiently elsewhere[4]. Hence, it would be redundant to report our findings here.

Two h after cycloheximide treatment, several large laminated intracytoplasmic dense bodies and compact aggregates of agranular membranes were detected in the corpus luteum cells (Figure 1). At 4 h, these aggregates seemed to have increased in number. Some of them displayed a crystalloid pattern; others were transformed into smooth fingerprint-like structures. The number of laminated dense bodies was still significant at this stage (Figure 2). 6 h after cycloheximide treatment, only a few dense bodies were visible in the corpus luteum cells; however, many of them lay free in the extracellular space

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