

being increased by contraction of Brucke's muscle, which causes the ciliary body that surrounds the lens to press against it and deform it. In fact, the lens must be the major structure involved in accommodation in birds that dive and feed under water, for once submerged the cornea becomes optically inoperative, since its index of refraction is very similar to that of water. It is interesting, in this respect, that in diving birds the cornea is very much thicker than in other birds, and Crampton's muscle is very poorly developed. This is in contrast to the situation in hawks and owls in which the cornea is observed to alter greatly in curvature during accommodation and in which Crampton's muscle is very well developed.

III. Aspects of the Retina and Visual Perception

A. RETINAL ORGANIZATION

The retina is the true *raison d'être* of the eye. It is the organ that first senses the light, integrates the information, and then passes this information onto the brain in the form of nerve impulses. The other structures of the eye are designed to serve only to present the image to the retina. Accordingly, much of the discussion in this chapter will necessarily involve this complex receptor system.

The retina of the bird has been said to represent the ultimate in retinal organization (Walls, 1942), but in general it is not unlike the retinas of the other vertebrate classes. As illustrated in Fig. 3, the vertebrate retina can be divided up into several layers. Although the first of these, the pigment epithelium, is an interesting and incompletely understood layer, it does not appear to have a direct role in perception per se, and therefore we will say nothing more about it here.

The receptor cells actually span three retinal layers. They have their outer segments, which contain the visual pigment, in what might be referred to as the visual cell layer. Their nuclei are located in the outer nuclear layer, and their synaptic connections to more proximal cells are made in the region of the outer plexiform layer. The avian retina, as is true of that of most animals, is duplex in nature and thus contains both rods, responsible for dim light or scotopic vision, and cones, responsible for acute, bright light or photopic vision. The cones also serve to mediate color vision where this capability occurs. Not surprisingly, therefore, birds such as the diurnal predators and the passerines have retinas that are heavily dominated by cones, the rods being few in number and usually relegated to the periphery. The owl

