Ganglion cells

Cell bodies of ganglion cells are found both in the ganglion cell layer and in the inner plexiform layer. Cells of the latter type are often referred to as *displaced* cells. Ganglion cells spread their dendrites in the inner plexiform layer, and extend their axons to the optic nerve fiber layer. When examined in a cross-section (Figure 2-3), ganglion cell axons typically emerge from the cell body at its lower end, and assume a horizontal or level course leading to the optic disk (see section 2.1.2). On the retinal surface, ganglion cell axons are normally unmyelinated[4].

Like amacrine cells, ganglion cells come in a variety of shapes and sizes. One morphological classification scheme for these cells developed from observations of dendritic branching patterns. The *monosynaptic* or midget ganglion cell has a relatively small cell body and dendritic field, and is believed to make synaptic contacts with a single bipolar cell. In contrast, *polysynaptic* ganglion cells have larger cell bodies and dendritic fields. Cells of this second type may be further subdivided according to the diffuse and stratified criterion discussed above for amacrine cells. Examples of midget and diffuse cells from monkey retina are shown in Figure 2-4.

A second classification scheme stems mainly from work on the cat retina. In this scheme, α cells have larger cell bodies, thicker axons, and more expansive dendritic trees than β cells. A general correlation exists between the α and β morphologies and the Y and X functional classes (see section 2.1.3), respectively [59].

Intracellular recordings from mudpuppy retina suggest that ganglion cell responses are closely related to the inputs provided by bipolar and amacrine cells. *On-off* ganglion cells, for example, respond to stimuli in a manner similar to most amacrine cells, with transient depolarizing potentials at light onset and cessation. Other ganglion cells respond in a manner similar to bipolar cells, with sustained potentials and antagonistic center/surround receptive field organization. *On-center* cells depolarize to illumination of their receptive field center, and *Off-center* cells hyperpolarize.

Unlike their bipolar counterparts, ganglion cells produce action potentials. When no stimuli are present, ganglion cell firing is referred to as *spontaneous activity*. Hyperpolarization of ganglion cells is associated with a suppression of spontaneous activity, and depolarization is associated with an increase of cell activity above the spontaneous level. The rate at which ganglion cells fire (measured in spikes per second) is typically dependent on the intensity of the light stimulus generating the response.

Response rate vs. intensity curves for On-center and On-Off ganglion cells are comparable in domain and shape to those exhibited by bipolar and amacrine cells, respectively. The correlation between cell response types indicates that some ganglion cells may receive input primarily from a single type of inner nuclear layer neuron. Additional evidence which supports this view comes from studies of the cat retina, where it has been shown that the dendrites of On-center and Off-center ganglion cells branch at levels of the INL comparable to those at which On-center and Off-center bipolar cells terminate, respectively.

2.1.2 Topographical view of the retina

In addition to its recognizable cross-sectional structure, the retina possesses distinct topographical features. A prominent landmark is the *optic disk*, where ganglion cell axons

[4] In the rabbit, ganglion cell axons are myelinated near the optic disk.

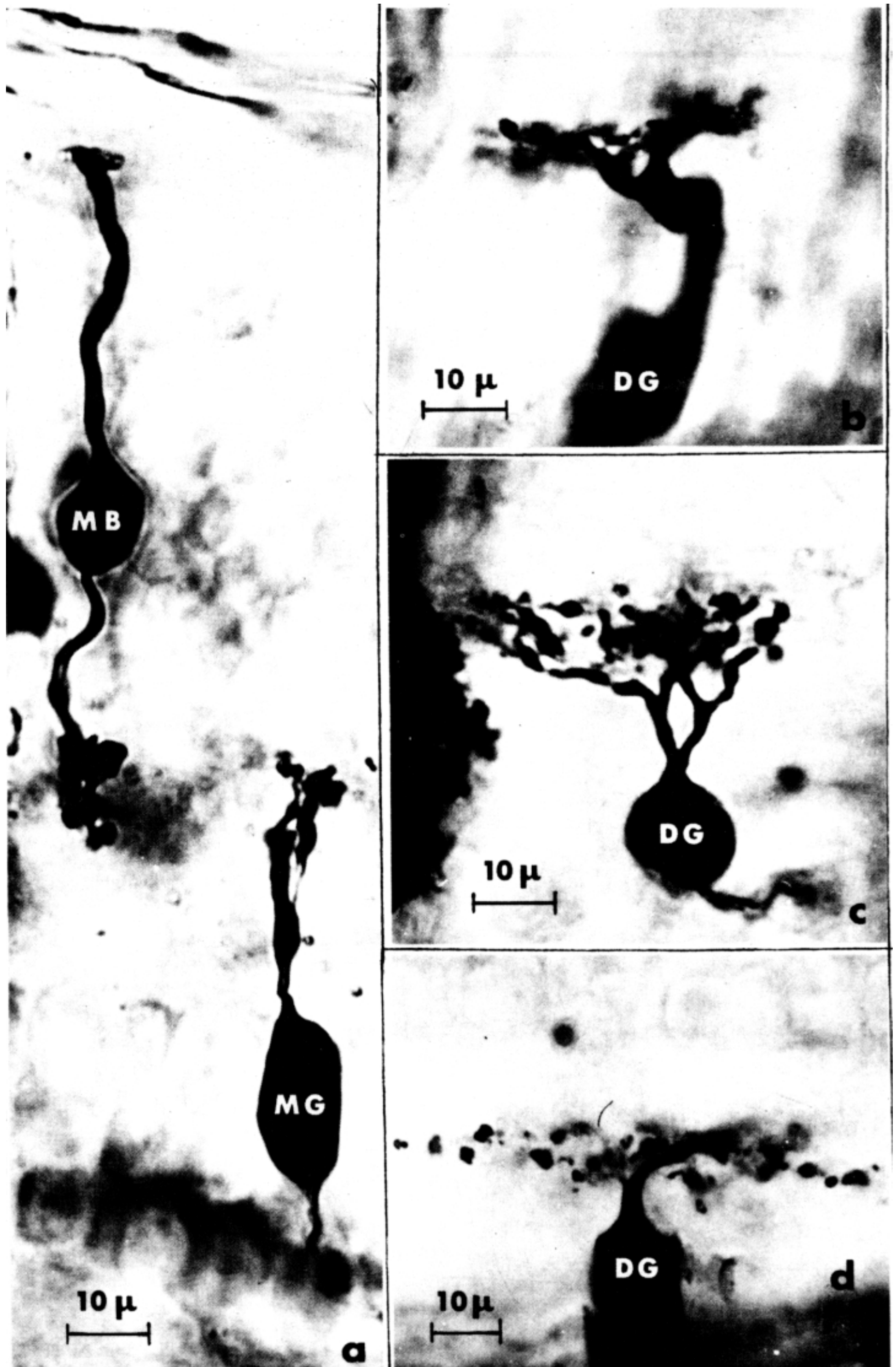

Figure 2-4: Typical diffuse and midget ganglion cells from the parafoveal region of the monkey retina. From Dowling and Boycott [15]. Abbreviations: (MB) midget bipolar; (MG) midget ganglion; (DG) diffuse ganglion.