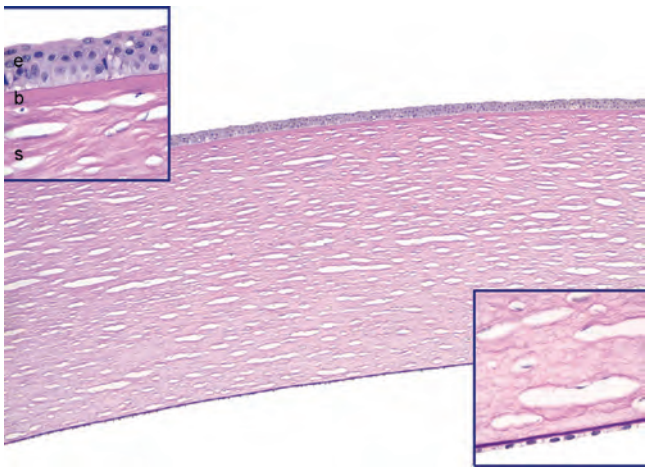

Figure 29-7 Normal corneal microarchitecture. The corneal tissue is stained by periodic acid–Schiff (PAS) to highlight basement membranes. The inset at the upper left is a high magnification of the anterior layers of the cornea: the epithelium *(e)*, Bowman layer *(b)*, and the stroma *(s)*. A very thin PAS-positive basement membrane separates the epithelium from the Bowman layer. Note that the Bowman layer is acellular. The *inset* at the *lower right* is a high magnification of the PAS-positive Descemet membrane and the corneal endothelium. The "holes" in the stroma are artifactitious spaces between parallel collagenous stromal lamellae.

attests to the importance of corneal shape in contributing to the refractive power of the eye.

Anteriorly, the cornea is covered by *epithelium* that rests on a basement membrane. The *Bowman layer*, situated just beneath the epithelial basement membrane, is acellular and forms an efficient barrier against the penetration of malignant cells from the epithelium into the underlying stroma.

The *corneal stroma* lacks blood vessels and lymphatics, a feature that contributes not only to the transparency of the cornea, but also to high rate of success of corneal transplantation. Indeed, nonimmunologic graft failure (associated with loss of endothelial cells and subsequent corneal edema) is seen more commonly than is immunologic graft rejection. The risk of corneal graft rejection increases with stromal vascularization and inflammation. A precise alignment of collagen in the corneal stroma also contributes to transparency.

Corneal vascularization may accompany chronic corneal edema, inflammation, and scarring. The application of topical VEGF antagonists affords a promising approach to preventing corneal vascularization. Scarring and edema both disrupt the spatial alignment of stromal collagen and contribute to corneal opacification. Scars may result from trauma or inflammation. Normally, the corneal stroma is in a state of relative deturgescence (dehydration), maintained in large part by active pumping of fluid from the stroma back into the anterior chamber by the corneal endothelium.

The corneal *endothelium* is derived from neural crest and is not related to vascular endothelium. It rests on its basement membrane, Descemet membrane. A decrease in endothelial cells or a malfunction of endothelium results in stromal edema, which may be complicated by bullous separation of the epithelium *(bullous keratopathy)*. *Descemet membrane* increases in thickness with age. It is the site of copper deposition in the Kayser-Fleischer ring of Wilson disease (Chapter 18).

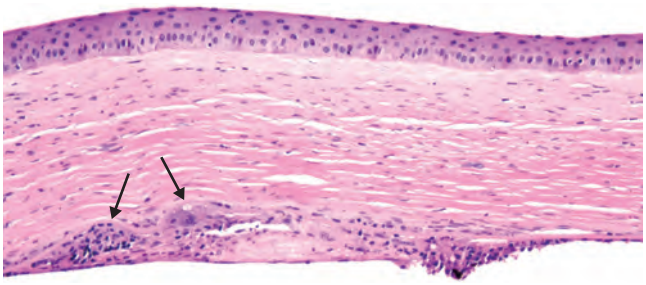

Figure 29-8 Chronic herpes simplex keratitis. The cornea is thin and scarred (note the increased number of fibroblast nuclei). Granulomatous reaction in the Descemet membrane, illustrated in this photomicrograph *(arrows)*, is a histologic hallmark of chronic herpes simplex keratitis.

Keratitis and Ulcers

Various pathogens—bacterial, fungal, viral (especially herpes simplex and herpes zoster), and protozoal (*Acanthamoeba*)—can cause corneal ulceration. In all forms of keratitis, dissolution of the corneal stroma may be accelerated by activation of collagenases within corneal epithelium and stromal fibroblasts (also known as keratocytes). Exudate and cells leaking from iris and ciliary body vessels into the anterior chamber may be visible by slit-lamp examination and may accumulate in sufficient quantity to become visible even by a penlight examination *(hypopyon)*. Although the corneal ulcer may be infectious, the hypopyon seldom contains organisms and is an example par excellence of the vascular response to acute inflammation. The specific forms of keratitis may have certain distinctive features. For example, chronic herpes simplex keratitis may be associated with a granulomatous reaction involving the Descemet membrane (Fig. 29-8).

Corneal Degenerations and Dystrophies

Ophthalmologists have traditionally divided many corneal disorders into degenerations and dystrophies. Corneal degenerations may be either unilateral or bilateral and are typically nonfamilial. By contrast, corneal dystrophies are typically bilateral and are hereditary. Corneal dystrophies may affect selective corneal layers (e.g., *Reis-Bückler dystrophy* affects Bowman layer, and *posterior polymorphous dystrophy* affects the endothelium), or the changes may be distributed throughout multiple layers.

Band Keratopathies

Two types of band keratopathy serve as examples of corneal degenerations. *Calcific band keratopathy* is characterized by deposition of calcium in the Bowman layer. This condition may complicate chronic uveitis, especially in individuals with chronic juvenile rheumatoid arthritis. *Actinic band keratopathy* develops in individuals who are exposed chronically to high levels of ultraviolet light. In this condition, extensive solar elastosis develops in the superficial layers of corneal collagen in the sun-exposed interpalpebral fissure, hence the horizontally distributed band of pathology. Similar to pinguecula, the sun-damaged collagen of the cornea may take on a yellow hue to the point that this condition is sometimes erroneously called "oil-droplet keratopathy."