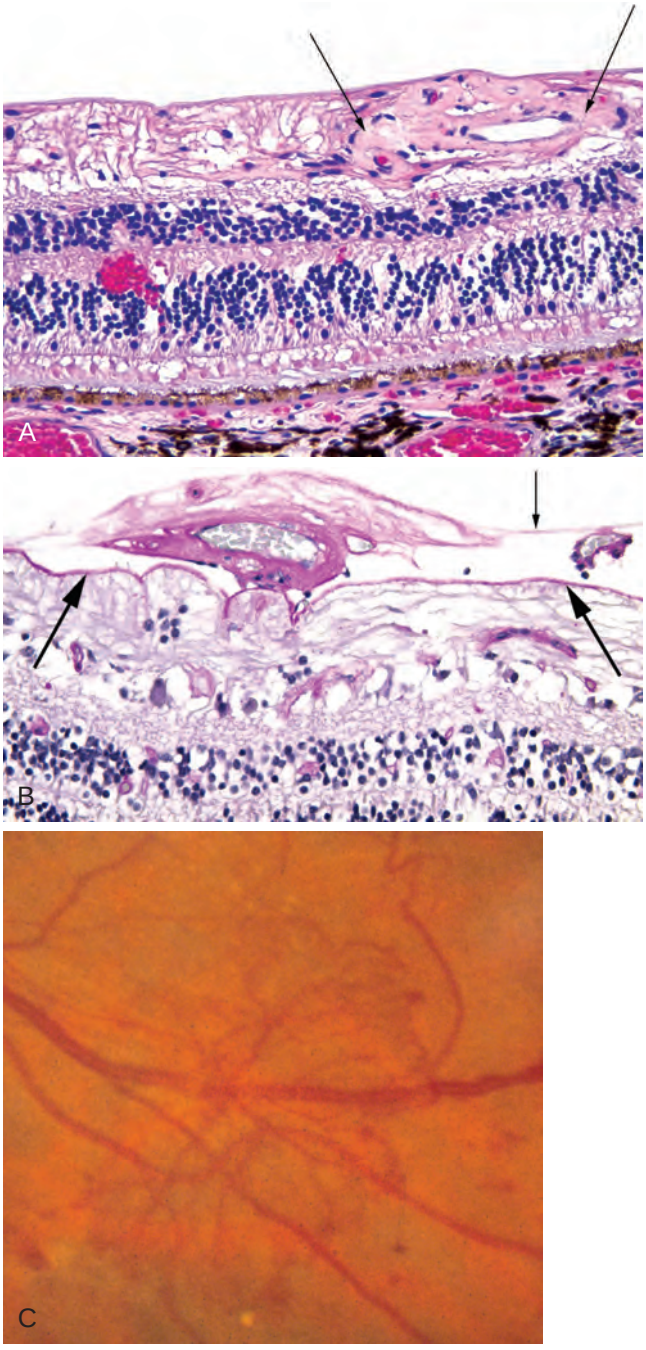

Figure 29-21 The retina in diabetes mellitus (see Fig. 29-16 for a schematic of retinal structure). **A,** A tangle of abnormal vessels lies just beneath the internal limiting membrane of the retina on the right half of the photomicrograph *(between arrows)*. This is an example of intraretinal angiogenesis known as intraretinal microangiopathy (IRMA). Note the retinal hemorrhage in the outer plexiform layer in the *left half*. The ganglion cell layer and the nerve fiber layer—the axons of the ganglion cells—are absent. The rarefied space beneath internal limiting membrane to the *left* of the focus of IRMA consists largely of elements of retinal glial (Müller) cells. Absence of the ganglion cell and nerve fiber layers is a hallmark of glaucoma. The chronic diabetes mellitus in this individual was complicated by iris neovascularization and secondary angle-closure glaucoma (neovascular glaucoma). **B,** In this section stained by periodic acid–Schiff, the internal limiting membrane is indicated by the *thick arrows* and the posterior hyaloid of the vitreous by the *thin arrow*. In the potential space between these two landmarks, the vessels to the left of the *thin arrow* are invested with a fibrous-glial stroma and would appear ophthalmoscopically as a white neovascular membrane. The thin-walled vessel to the right of the *thin arrow* is not invested with connective tissue. A posterior vitreous detachment in an eye such as this might exert traction on these new vessels and precipitate a massive vitreous hemorrhage. **C,** Ophthalmoscopic view of retinal neovascularization (known clinically as neovascularization "elsewhere" in contrast with neovascularization of the optic disc) creating a neovascular membrane.

areas of florid neovascularization in the periphery of the retina, described clinically as "sea-fans."

Neovascularization also occurs in a variety of other clinical settings such as peripheral retinal vasculitis, and in irradiation used to treat intraocular tumors. The feature common to these conditions is damage to retinal vessels, producing zones of retinal ischemia that trigger retinal angiogenesis and its complications, hemorrhage and traction which in turn may cause detachment..

Retinal Artery and Vein Occlusions

The central retinal artery or its branches can be occluded by disorders that affect the vessels in general. For example, the lumen of the central retinal artery can be narrowed significantly by atherosclerosis, thus predisposing to thrombosis. Emboli to the central retinal artery can originate from thrombi in the heart or from ulcerated atheromatous plaques in the carotid arteries. Fragments of atherosclerotic plaques can lodge within the retinal circulation *(Hollenhorst plaques)*. Total occlusion of a branch of retinal artery can produce a segmental infarct of the retina. With sudden cessation of blood supply, the retina (an embryologic derivative of brain tissue) swells acutely and becomes optically opaque. By ophthalmoscopy the fundus in the affected area appears white instead of red or orange, because the retinal opacity blocks the view of the richly vascular choroid.

Total occlusion of the central retinal artery can produce a *diffuse infarct* of the retina. Following an acute occlusion, the retina appears relatively opaque by ophthalmoscopy. The fovea and foveola are physiologically thin; therefore, the normal orange-red of the choroid is not only visible but also highlighted by the surrounding opaque retina—the origin of the *cherry-red spot* of the central retinal artery occlusion. Cherry-red spots can also be seen in rare storage diseases such as *Tay-Sachs* and *Niemann-Pick* diseases because of the structural organization of the retina. The storage material accumulates in retinal ganglion cells: the ganglion cell layer of the macula surrounding the fovea is thick, but there are no ganglion cells in the center of the macula, the fovea. Thus, the fovea is relatively transparent to the underlying choroidal vasculature but is rimmed by relatively opaque retina, the result of storage material accumulating in the perifoveal macular ganglion cells (Fig. 29-22).

Retinal vein occlusion may occur with or without ischemia. In ischemic retinal vein occlusion, VEGF and other proangiogenic factors are up-regulated in the retina, leading to neovascularization of the retina and surface of the optic nerve head as well as neovascularization of the iris and subsequent angle-closure glaucoma. It follows that