brates, whether visibly colored or not, possess ultraviolet-absorbing compounds that make them excellent "cutoff" filters in the spectral region from 390 to 410 nm. The adaptive significance of this feature is almost certainly related to the reduction of chromatic aberration; the wavelength restriction is imposed not at the point where ultraviolet light becomes abiotic, but rather at the point where it begins to impose serious refractive errors. In this context, Zigman's arguments are rather perplexing. He states: "The lens appears to utilize a most ingenious and efficient mechanism for eliminating near-ultraviolet light before it reaches the retina by converting it to fluorescence at a higher wavelength." Were the conversion in fact efficient, it would merely create stray visible light that would constitute noise in the visual image.

The protein-bound complexes produced in Zigman's photooxidation experiments on dogfish lenses contribute relatively little absorption at 365 nm; lenses that are good ultraviolet cutoff filters show much higher absorbance at this wavelength. It is thus unlikely that this class of compounds, even if present in the lenses of diurnal terrestrial vertebrates or surface-living fishes, plays a significant role in their absorption of near-ultraviolet light. Indeed, it is unlikely that dogfish, at their usual depths in coastal marine waters, ever receive significant amounts of ultraviolet light at 340 to 380 nm, the wavelengths employed in Zigman's irradiation experiments.

Thus, although the reaction described by Zigman may occur, its contribution to the ultraviolet-absorbing properties of vertebrate lenses is not great. That such lenses are superb ultraviolet cutoff filters is due to an entirely different class of compounds having low molecular weight and wide distribution.

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The comments of Kennedy and Milkman (*1*) confirm the fact that certain partially characterized, fluorescent, aromatic substances of low molecular weight are present in the lens, and that they strongly influence its light transmission properties. Such comments add further emphasis to the idea, stated in my report (*2*), that other aromatic compounds as well as the amino acids in the lenses of diurnal animals could also be photooxidized by near-ultraviolet light to colored or ultraviolet-absorbing compounds. The evidence that pteridines are present in the lens, as suggested by Kennedy and Milkman (*3*) and later by Cremer-Bartels (*4*), is still incomplete. In addition, Cooper and Robson (*5*) have found that the amounts of unbound fluorescent substances extractable from colorless young human lenses tend to decrease at an age when intensification of lens coloration begins. This coloration of human lenses becomes progressively greater with aging, a process that sometimes results in brunescent cataracts.

Although the elimination of chromatic aberration has long been known to be an advantage of colored lenses, an additional emphasis is placed (*2*) on a possible role of the lens as a protective shield for the retina against near-ultraviolet light. Near-ultraviolet light causes certain harmful effects on the retina (*6*) and on other cells, tissues, and organs (*7*).

In my work I used dogfish lenses as model lenses *because* they infrequently encounter ultraviolet light and are not colored. However, lake trout, maintained in shallow water exposed to bright sunlight, were found by McCandless *et al.* to have a high incidence of cataracts (*8*). In my report (*2*) I showed that the absorption of 365-nm light by the isolated dogfish lens increases with coloration from 41 to 70 percent, an amount which I believe is appreciable. Discrepancies between the lens absorption values reported by Kennedy and Milkman (*3*) and Cooper and Robson (*5*) and my measurements can be explained on the basis of differences in instrumentation. In their work a spectrophotometer with a narrow beam of light through the central and densest portion of the lens was used; I used a more energetic and diffuse near-ultraviolet light which passes through the peripheral portions as well.

In my discussion of the efficiency of converting ultraviolet light to fluorescence, as referred to in (*2*), I meant the conversion of a potentially hazardous type of energy into a harmless type. The magnitude of the fluorescence was not discussed. The lens compounds referred to by Kennedy and Milkman (*1*) would also convert ultraviolet energy into visible fluorescence.

In summary, the colored and fluorescent compounds of lenses will need to be isolated and characterized, and further experimental documentation of the relative importance of these compounds will be required before any final conclusions can be formulated.

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Adaptation of an Intertidal Fish Is Not Unique

Recently, Graham and Rosenblatt (*1*) have shown that an intertidal clinid fish (*Mnierpes macrocephalus*) has two flattened surfaces in each cornea so that vision may be possible in both media. The authors' claim that the remarkable eye structure is unique among fish cannot be upheld, since it had been found earlier in another amphibious clinid (*Dialommus fuscus*) (*2*). Moreover, this structure was suggested to be an ecological adaptation because of a striking correlation between the ontogeny of the eye and the amphibious life habit.

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