Technical Papers

Importance of Atmospheric Oxygen for Maintenance of the Optical Properties of the Human Cornea[1]

George K. Smelser and V. Ozanics

Department of Ophthalmology, Columbia University, New York

It is well known that ordinary contact lenses interfere with the optical qualities of the cornea. This is evidenced by increasing haze in the vision and by diffraction phenomena (halos) about light sources. The changes are reversible and slowly disappear when the lenses are removed. In a study of the mechanism of these changes the fact that contact lenses prevent the access of the cornea to atmospheric oxygen was obvious.

To determine whether the cornea remains optically normal under relatively anaerobic conditions, four subjects were fitted with diving goggles in which the eyes could be exposed to various gas mixtures. The goggles were equipped with tubes through which the desired gas could be passed continuously and under slight pressure, so that all air in the goggle was quickly displaced and did not leak back in. The outlet tube from the goggle discharged under water.

The eyes were exposed for 4 hr to each of the following gases: (1) air, (2) air 85% and CO_2 15%, (3) N_2, (4) N_2 85% and CO_2 15%, all saturated with water vapor, and (5) relatively dry N_2. At intervals the subjects looked at a bright light source in a darkened room to discover whether halos, similar to those caused by contact lenses, had developed. All subjects had worn contact lenses previously and were familiar with such halos.

No halos were produced by exposing the cornea to moist air, or air-CO_2 mixtures for 4 hr, but bright halos developed in less than 2–3 hr in all four subjects when nitrogen was used. The subjects reported that, in addition to the appearance of the halos, their vision was "hazy" for a short time after the goggles were removed. Nitrogen-CO_2 mixtures produced halos similar in brightness to those obtained with N_2 alone. The halos produced with dry nitrogen, however, were not as bright as those obtained when water-saturated nitrogen was used. The halos observed in the experiments were similar in appearance, comparable in brightness, and of the same angular diameter as those caused by contact lenses.

If, as these data suggest, contact lens halos are caused by oxygen deficiency under the lens, they could be prevented by the addition of oxygen bubbles to the contact lens fluid. Contact lenses equipped with stoppered openings and fitted to the four subjects were found to cause definite halos in 1½ hr. Addition of N_2 bubbles to the contact lens fluid did not affect halo development, but the introduction of oxygen bubbles under the lens prevented the appearance of halos in experiments lasting 7 hr. During an experiment the bubbles became reduced in size, indicating that the cornea utilized the oxygen.

It is believed that the corneal haze and halos noted when contact lenses are worn are caused by hydration of the cornea, and that contact lenses interfere with the mechanism which maintains the cornea in its normal state of deturgescence. This mechanism may in part depend on the osmotic relations between the cornea and tears, but it is suggested that metabolic processes also are involved in the removal of water from the cornea.

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Quaternary Volcanic Ash in Southern Alberta, Canada

Leland Horberg

University of Chicago, Chicago, Illinois

A 6-in. layer of volcanic ash occurs 6 ft below the surface in a 26-ft section of postglacial alluvial silts exposed along the east bluff of the Oldman River, 5 miles southeast of Monarch, Alberta (NW ¼, sec 26, T 9 N, R 23 W). The alluvial silts rest unconformably on proglacial lake deposits of glacial Lake Macleod (*1*), which existed as the ice retreated eastward during the Wisconsin Tazewell or Cary substage. The age of the ash thus appears to be Mankato or early postglacial.

The deposit is purplish-white in color and is composed largely of volcanic glass shards having an index of refraction of 1.507 ± 0.002. Below 1/16 mm the material is almost 100% volcanic glass, but above 1/16 mm there are abundant quartz, feldspar, and heavy mineral grains. Most of the grains are angular, but grains with well-developed crystal outlines also are present. The heavy minerals include brown hornblende—most abundant; common hornblende—abundant; hypersthene-enstatite—common; blue-green hornblende, zircon, apatite, and diopside—present; and basaltic hornblende, titanite, garnet, epidote, spodumene (?), and staurolite—rare. The variety of heavy minerals suggests that some contamination occurred during deposition. Mechanical analyses of the deposit fall within the range of loess analyses and confirm eolian deposition.

The indices indicate that the ash was derived from volcanics having an acid composition (*2*). Quaternary effusives to the west in southern British Columbia are a possible source.