

Technical Papers

Importance of Atmospheric Oxygen for Maintenance of the Optical Properties of the Human Cornea¹

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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 CO₂ 15%, (3) N₂, (4) N₂ 85% and CO₂ 15%, all saturated with water vapor, and (5) relatively dry N₂. 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-CO₂ 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-CO₂ mixtures produced halos similar in brightness to those obtained with N₂ 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 N₂ 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

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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.

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The deposit is significant to geologists and archaeologists because it may provide a datum in correlating late glacial and postglacial deposits in an area along the probable migration route of ancient man into the interior of the continent.

References

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Attraction of Flies by Iso-Valeraldehyde

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Sporadic reports occur in the literature of compounds which act as specific attractants for various species of insects, but the physiological and behavioral bases of these actions are clearly understood in a few isolated cases only (1). The attractant reported here is of interest not merely because it adds another compound to the list but principally because it focuses attention upon a homologous series some members of which have recently been shown to possess qualities of attractiveness for insects. Furthermore, this series (the aliphatic aldehydes) already shows promise of serving as a useful tool for investigating the mechanism of action of attraction in much the same manner as the aliphatic alcohols have extended our knowledge of the mechanism of repellency (2,3).

In the course of testing several hundred natural products and the extracts thereof as attractants for the flies *Musca domestica*, *Ophyra aenescens*, *Phormia regina*, and *Sarcophaga bullata*, it was found that of all materials tried a 10% aqueous solution of malt extract was the most attractive for the housefly and decayed casein the most attractive for *S. bullata*. The resemblance of the odor of certain fractions of these to that of iso-valeraldehyde suggested the desirability of testing that compound. Preliminary screening was accomplished by the use of Petri dish techniques (4). These consisted essentially of counting the numbers of caged flies attracted to various aqueous solutions of the aldehyde placed beneath the floor of the cage. Data from these experiments indicated that a 0.013M solution of iso-valeraldehyde was superior in its attraction of *Musca* and *Ophyra* to all other chemically defined materials heretofore tested.

This concentration is nearly equal to that which is repellent when acting as a stimulus to tarsal contact chemoreceptors. Stimulation of the tarsal receptors of the blowfly *P. regina*, for example, by a 0.028M solution of iso-valeraldehyde, even with the addition of 0.1M sucrose, causes rejection (5). Thus, although the present experiments indicate that the solution is an olfactory attractant, it would not be expected in

the field to detain flies which had oriented to it unless an additional factor acceptable to tarsal and oral chemical senses was also present.

In order to determine the actual effective concentration in the gas phase, extensive tests were conducted by means of an olfactometric technique (Fig. 1) (3). Results to date show that the vapor concentra-

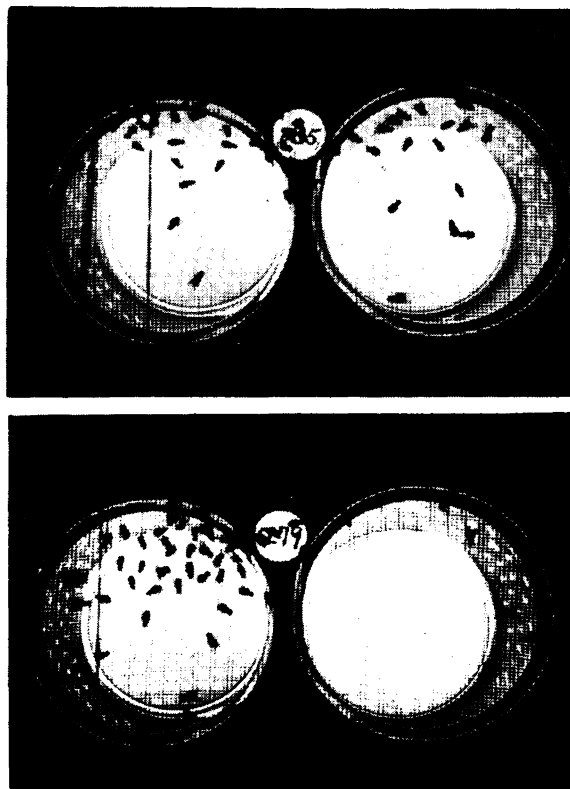


FIG. 1. Record of response of *Musca domestica* in an olfactometer to the odor of iso-valeraldehyde. Top, control: filtered air passing through both ports; bottom, experimental: iso-valeraldehyde vapor passing through left port.

tion producing maximum attraction is approximately $1.2 \times 10^{-5}M$. Over the range $2.0 \times 10^{-5}M$ to $2.8 \times 10^{-5}M$ the aldehyde is partly attractive and partly repellent. This crossing-over phenomenon has been emphasized in the literature (1). Beyond $6.0 \times 10^{-5}M$ maximum repellency is obtained. Studies are continuing in order to determine the complete active concentration curve and to investigate the effectiveness of other homologs.

As indicated above, other aldehydes have been reported as insect attractants. Those with short chains (up to 5 carbon atoms) attract codling moths and the Natal fruit fly, *Pterandrus rosa* (Ksh.) (6,7). Palmitaldehyde is an effective attractant for cabbage looper moths, *Autographa* spp. (8). Recently it has been shown that acetaldehyde as a natural constituent of potato leaves directs the Colorado potato beetle in its selection of food (9). Whereas this case is apparently concerned with action on the gustatory sense, other aldehydes undoubtedly act through the agency of the olfactory sense.