ULTRA-VIOLET LIGHT AND THE OXIDATION OF COD LIVER OIL

IN these columns a year ago appeared a note,[1] stating that ultra-violet light is emitted when cod liver oil is oxidized. Careful experiments in this laboratory have failed to confirm these findings.[2] With an absolutely gas-tight camera, no darkening of a photographic film could be discerned after bubbling oxygen through cod liver oil in a quartz cell for ten days.

In other experiments the cod liver oil was heated to 100° C. while oxygen was passed through for three days, but no trace of a photographic effect was registered. The oxidation was sufficient to change the character of the oil as shown by a change in its iodine number.

The oxidation of para brom-phenyl magnesium bromide under identical conditions gave a distinct shadow of the cross wires behind the quartz lens, with an exposure of only two minutes. This reaction is known to be luminescent[3] and the positive effect proved that the apparatus was working properly. Feeding experiments in the laboratory of Professor H. Steenbock proved that the cod liver oil used was effective in curing rickets.

The reported evolution of oxygen by the action of ultra-violet light on oxidized cod liver oil was not found, when precautions were taken to drive out the dissolved air.

In connection with recent comments on this subject[4, 5] it should be emphasized that ordinary chemical fog ("Russell effect"[4]) is readily produced if reducing or other chemically active gases are allowed to come in contact with the photographic film.[6] In all our experiments the utmost care was taken to eliminate ordinary chemical fog as a factor, because in our early experiments we found that a fine mist of cod liver oil and vapors from asphaltum paint or beeswax acted chemically on the film to give a darkening on development and that these false images simulated the apertures through which the vapors had diffused.

It does not seem likely that black body radiation could have affected the photographic plates, as suggested,[5] unless they were especially sensitized to the infra red. No effect of this kind was observed in our experiments, although the cod liver oil and its container were heated to 100°, at which temperature the black body radiation should have been much greater.

It is unfortunate that the erroneous conclusions of the original article,[1] in spite of their correction,[4] should have led to such widespread speculation concerning the mechanism of the cure of rickets.

FARRINGTON DANIELS
RUSSELL J. FOSBINDER
LABORATORY OF PHYSICAL CHEMISTRY
UNIVERSITY OF WISCONSIN

1 Kugelmass and McQuarrie, SCIENCE, 60, 272, 1924.
2 Details are given in B. S. Thesis, 1925, Univ. Wis.
3 Evans and Dufford, *J. Am. Chem. Soc.*, 45, 278, 1923.
4 Kugelmass and McQuarrie, SCIENCE, 52, 87, 1925.
5 West and Bishop, SCIENCE, 52, 86, 1925.
6 Mathews and Dewey, *J. Phys. Chem.*, 17, 230, 1913.

THE THIRD STAGE OF DIGESTION IN PARAMECIA

APPARENTLY the earliest attempts to demonstrate the acidity or alkalinity of the protozoan food vacuole were made by allowing the organism to ingest small grains of litmus powder and noting the color change which the ingested fluid induced in the individual granules. Later, when the use of aniline dyes became common in the field of microchemistry, solutions of neutral red replaced both litmus and the somewhat capricious and unreliable indicator alizarin-sodium-sulphonic acid for the detection of acid and base in microscopic preparations. The studies which have been made of the reaction of the food vacuole of protozoa and the bolus of food within with the above-mentioned micro-indicators have resulted in the dictum now generally taught and accepted that in paramecium, at least, there are two stages of digestion—an initial one during which the prey is supposed to be killed in an acid fluid and a second or digestive-absorptive stage in which the food vacuole is alkaline.

In paramecia (either caudatum or aurelia) grown in hay infusion or in malted milk, acid solutions of phenolsulphonaphthalein can be seen flowing down the gullet in a yellow stream to distend the nascent food vacuole. As the stream passes through the narrow end of the gullet, just before entering the vacuole, evidences are visible of the beginning of a distinct alkaline reaction in part of the fluid. The borders of the stream next to the wall of the gullet become faintly but distinctly pink. The ingested bacteria which are colored yellow by the dye are carried into the newly formed food vacuole which is filled with an *alkaline* fluid. As the vacuole is freed from the gullet and moves off into the cytoplasm, it becomes slightly smaller and at the same time the alkalinity of the contained fluid becomes more pronounced, perhaps from concentration resulting from the passage of water from it into the cytoplasm, an increased alkalinity which is indicated by a deepening of the color in the dye-containing fluid. The alkaline reaction in the food vacuole persists until the vacuole turns to begin its journey to the anterior end of the organism when the pink color, which has become paler, is changed to the yellow tint which de-