followed by depression. The stimulation increases the amplitude. The effect is transient, however, and often lasts only 10 minutes although, in some cases, it persists as long as 20 or 30 minutes. The maximum increase occurs with a 0.25% solution. The rate may also be slightly increased but it is the amplitude that shows the greatest effect of stimulation. On the other hand, the secondary depression appears as a decreased rate. In the lower concentrations (up to 0.2%) this is not evident in the first 10 minutes but in higher concentrations, may set in sooner. The depressive effect increases with the concentration of sulfanilamide. A 0.5% solution of sulfanilamide causes a 50% to 100% decrease in rate within 10 minutes after it is introduced into the heart. While some hearts stopped within the first 10 minutes, others maintained a very slow rate with some irregularity for 40-60 minutes.

10892 P

Reduction in Experimental Rat Caries by Fluorine.

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Dental research in the field of caries prevention received new impetus when Hoppert, Webber and Canniff[1] experimentally produced dental caries in 90 to 100% of their rats by feeding them a diet, which although adequate nutritionally, consisted mainly of coarse corn particles. Their hypothesis was that the corn particles became impacted in the teeth and produced decay. Lilly[2] obtained a 90% reduction in the incidence of dental decay by substituting commercial casein for the powdered whole milk (20% of the Hoppert, Webber and Canniff diet). The same year, Hodge, Luce-Clausen and Brown[3] found that the commercial casein used by them was contaminated with fluorine (0.2%). It occurred to us that fluorine might be the factor producing the caries reduction in Lilly's experiments. Two major findings in the literature support this contention: (1) clinical observations by Dean and others[4] give evidence of a reduction of caries in areas of endemic fluorisis (mottled enam-

1 Hoppert, C. A., Webber, P. A., and Canniff, T. L., *Science*, 1931, **74**, 77.

2 Lilly, C. A., PROC. SOC. EXP. BIOL. AND MED., 1938, **38**, 398.

3 Hodge, H. C., Luce-Clausen, E. M., and Brown, E. F., *J. Nutrition*, 1939, **17**, 35.

4 Dean, H. T., *Public Health Rep.*, 1938, **53**, 1443.

el); (2) analyses made by Armstrong and Brekhus[5] have shown that sound enamel contains a higher percentage (.0111%) of fluorine than carious enamel (.0069%). Our experiment was, therefore, undertaken to compare the incidence of caries on the Hoppert, Webber and Canniff diet with (a) that on a diet in which "fluorine-free" casein is substituted for the powdered whole milk, and (b) that on the latter diet to which fluorine is added. While this experiment was in progress, Miller[6] reported that adding fluorine or iodoacetic acid to a modified Hoppert, Webber and Canniff diet markedly reduced the incidence of caries.

One hundred and thirty-five stock rats at weaning age were divided into 3 groups, separating littermates and segregating the sexes. The first group of 45 rats received the Hoppert, Webber and Canniff diet consisting of 60% coarse corn meal, 30% powdered whole milk, 6% linseed meal, 3% alfalfa meal and 1% NaCl (with added vitamins). The second group received essentially the same diet with casein substituted for the powdered whole milk. The third group received the latter diet plus the daily oral administration of a drop of an aqueous solution of KF containing 3 mg of fluorine. Each of the 3 groups of rats was divided into 3 sub-groups. The first received corn particles considerably larger than 20 mesh, the second was given particles between 10 and 20 mesh, and the third unsifted or run of the mill cracked corn. The different corn sizes were employed to establish whether caries incidence increased with particle size or whether approximately 20 mesh corn size was optimum. The food and distilled water were given *ad lib.* The rats were weighed every 4 days and the teeth observed periodically, using Hunt's technic (personal communication). After 200 days on the diets, the animals were sacrificed and the separated jaws examined under binoculars (15 ×). Missing cusps and macroscopic caries were recorded. In several cases it was difficult to distinguish between true fractures and severe attrition.

As may be seen from Table I, the rats receiving powdered milk or casein had about equal incidence of caries and an equal number of cusps involved. The rats receiving fluorine showed a 60 to 70% decrease in both cavities and cusps involved, as compared to the other 2 groups. Thirteen of the 42 rats receiving fluorine had perfect teeth; in contrast, all of the rats in the other 2 groups had caries. In all the rats, upper teeth were more involved than lower, thus, the upper teeth had 171 cavities with 620 cusps involved, while the

[5] Armstrong, W. D., and Brekhus, P. J., *J. Dent. Res.*, 1938, **17**, 393.

[6] Miller, B. F., PROC. SOC. EXP. BIOL. AND MED., 1938, **39**, 389.

TABLE I.
Effect of Fluorine on Caries Incidence.

Diet constituent varied	No. rats	No. cavities per rat, av. ± s.d.	No. cusps involved per rat, av. ± s.d.	No. caries-free rats
Powdered milk	40	3.5 ± 1.2	10.6 ± 4.5	0
Casein	42	3.0 ± 1.1	9.0 ± 3.3	0
Casein and fluorine	42	1.1 ± 1.0	3.1 ± 3.6	13

lower teeth had 145 cavities with 360 cusps involved. The variation of corn particle size was found to be unimportant; this was to be expected since all the diets contained particles larger than 20 mesh.

There is little doubt that fluorine not casein is responsible for the diminished incidence of fractured and carious teeth. Therefore, the caries reduction reported by Lilly can probably be attributed to fluorine contamination of the casein which he fed.

10893

Acceleration of Hemolysis in Relation to Chemical Structure. II. The Straight-Chain Alcohols.

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One of us (Ponder[1]) has already discussed the relation between the chemical structure of the benzene derivatives and the extent to which they accelerate hemolysis by the simple lysins, and has formulated a single expression to indicate the accelerating power of any substance in any concentration.* This note considers acceleration by the straight chain alcohols, from propyl to nonyl.

Method. The method used was that described by Ponder.[1] By a comparison of 2 time-dilution curves the acceleration for a given concentration of alcohol was determined. From this R value and the concentration of alcohol in mM/l, a value for (1-R)/c was obtained.†

As with the benzene derivatives, the solubility of the higher alco-

[1] Ponder, E., *J. Exp. Biol.*, 1939, **16**, 38.

* Published in *J. Exp. Biol.*, 1939, **16**, 38.

† Previously we have used (R-1)/c as a measure of acceleration or inhibition. Here we use (1-R)/c as a measure of acceleration in order to avoid obtaining logarithms of negative values. This is merely a mathematical transformation.