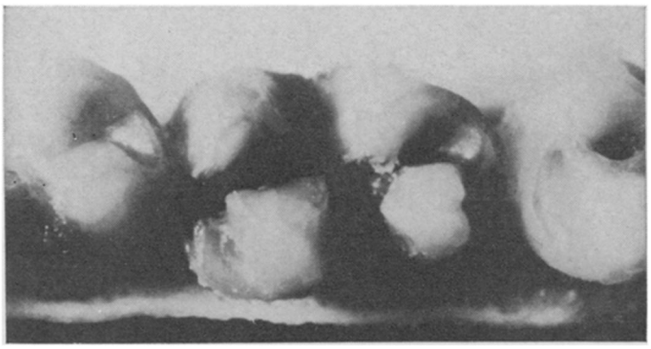
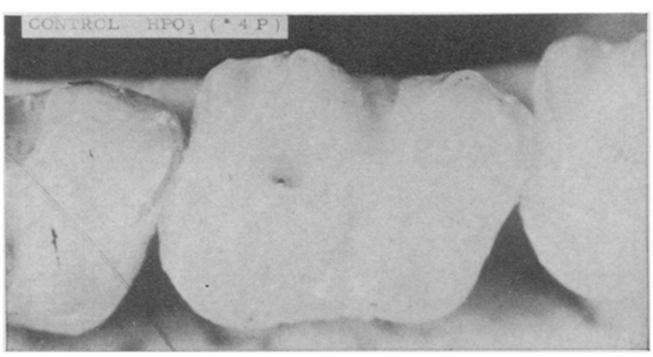
A chemical to fight tooth decay



Control diets for hamsters cause excessive cavities.



Harris/Nizel

Phosphate diets reduced cavities up to 95 percent.

Phosphates, together with fluorides, are still showing promise in the search for effective defense against dental caries

by Jeanne Bockel

Dental caries, or ordinary tooth decay, may be the commonest of all chronic diseases. Almost everyone in the world is affected by it; although it is more prevalent in civilized countries, even in parts of Africa and Asia 40 to 60 percent of the population is affected in some way.

But even with the high prevalence of the disease, and its resulting high cost to health services, both the cause and cure for it are unknown. Scientists generally agree that the cause is bacteria, but they cannot agree as to which microorganism induces the lesion. Treatment has run the gamut from simply cutting down on sugars to oral hygienic techniques. The most effective method turned up in the past 25 years has been the addition of fluorides to community drinking water. But unfortunately water fluoridation does not cure dental caries or even completely prevent it.

Water fluoridation is not the whole answer to dental health, says Dr. Robert Harris, chairman of the Department of Nutrition and Food Sciences at the Massachusetts Institute of Technology. As a nutritionist, Dr. Harris feels that sugar plays too great a role in tooth decay to be ignored and that another chemical is needed to add to the armamentarium against tooth decay.

The next chemical may be phosphates, which scientists have been investigating over the past 15 years (SN: 6/15/68, p. 572). Phosphates appear to counteract the effects of sugar when added to food, so that in conjunction with fluorides in the drinking water an additive effect could be achieved.

The case for phosphates is based on the belief that factors other than bacteria cause tooth decay. The fact that one can recover from one attack of tooth decay without becoming immune to another makes the cause difficult to pin down. Most researchers feel other factors are also required for caries to develop: a cariogenic diet—usually one high in carbohydrates—and a group of mysterious factors which combine to create a susceptible host.

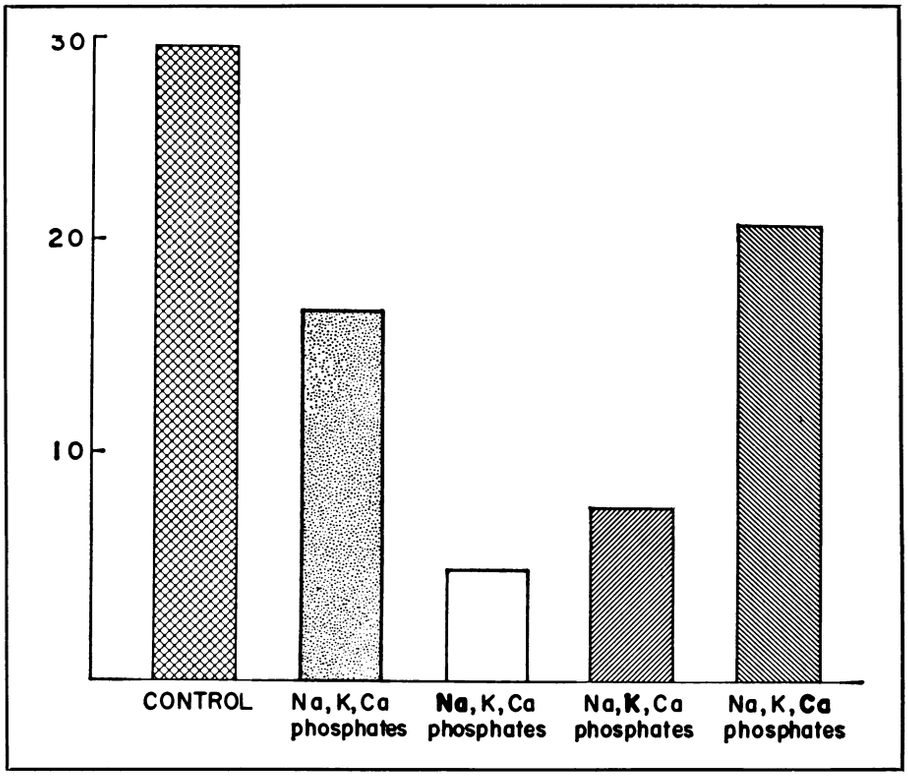
Dr. Harris stumbled onto the discovery that phosphates effectively prevent dental caries in 1950 when he and Dr. Abraham E. Nizel, also of the Department of Nutrition and Food Science at MIT, observed that diets containing corn and milk produced in Texas caused 40 percent as many caries when fed to hamsters as identical diets containing corn and milk produced in New England. They found that the Texas foods caused less trouble, not because they contained some cariostatic or decay-reducing factor, but because the New England food contained cariogenic or decay-causing factors. Experimenting further, they prepared salt mixtures omitting each of the elements successively. No effect was observed until phosphorus was omitted. When the phosphorus content of the New England diet was subsequently doubled, the cariogenic factor was destroyed and the diet became cariostatic.

Since that time Drs. Harris and Nizel have completed hundreds of studies with phosphates in rodents and have found that in some instances caries have been reduced by as much as 95 percent. Interestingly, excellent results are obtained when rodent diets are augmented by two percent phosphates—an amount similar to that removed from natural foods during the refining process.

The effectiveness of phosphates depends on the phosphate anion and cation with which it is combined, and foodstuffs with which they are fed. Studies comparing the cariostatic activities of a number of anion and cation combinations in rats show that sodium trimetaphosphate is the most effective, reducing caries by as much as 78 percent.

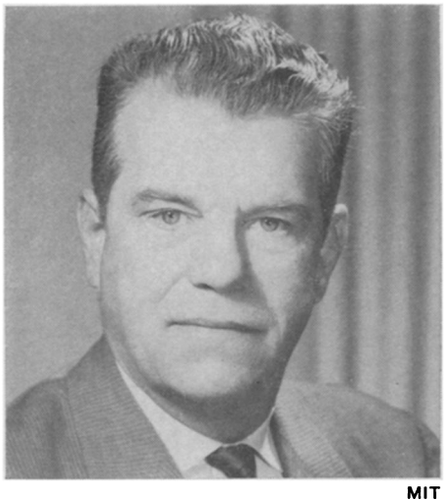
To date, only four or five studies have been conducted with human beings; as yet the sodium trimetaphosphate has not been used. Dr. Samuel Dreizen, a University of Texas dental scientist who has experimented with phosphates in children, says studies are still equivocal, but that phosphates offer promise for an effective antidecay agent in the future.

Dr. Dreizen compared presweetened breakfast cereal, with and without fortification, using one percent sodium dihydrogen phosphate in the diets of 500 school children, and found the incidence of dental caries reduced by 30 percent in those given the fortified cereal. In another study with 1,400 Australian



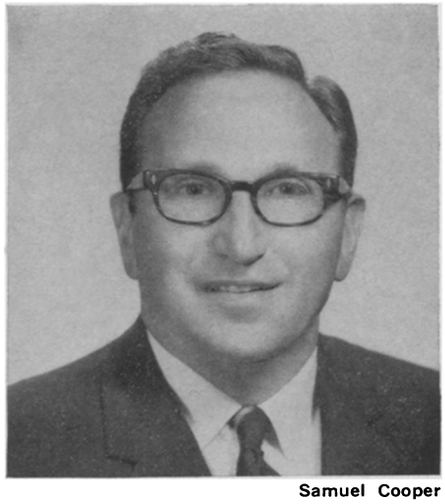
Dental Research

Various phosphate diets are fed to rats in a search for the most effective.



MIT

Harris: More than fluorides alone.



Samuel Cooper

Nizel: Phosphates are cariostatic.

children, calcium sucrose phosphate in the range of 0.2 to 1.0 percent added to high-carbohydrate food also reduced decay by 30 percent.

Scientists at the Indiana University Medical Center in Indianapolis have achieved even better results. Drs. George K. Stookey and Joseph C. Muhler found reductions approaching 50 percent when fortified cereal was eaten on a regular basis. They conducted more controlled studies with 474 children in an institution for the mentally retarded where attendants were responsible for serving the cereal, which was fortified with sodium dihydrogen phosphate. Decay was reduced by 48 to 55 percent, whereas previous studies in which no control was exercised over consumption only reduced decay by 20 to 40 percent.

Stronger interest in phosphates stems from the complementary effect it has with fluorides. Dr. Nizel found a greater cariostatic action when both minerals were fed simultaneously to rats than when either fluorides or phosphates were given alone.

Although it is not yet fully understood how fluorides act on the teeth, most researchers agree their effect is both topical and systemic. Dr. James P. Carlos, chief of the Biometry and Field Investigation Branch of the National Institute of Dental Health in Bethesda, Md., explains that in children the mode is systemic: Fluorides help make the enamel more resistant to acid. But in adults the systemic route is lost; the fluorides act topically through a remineralizing effect on the tooth in which the fluoride replaces the calcium hydroxide crystal.

Although both fluorides and phosphates improve the quality of the enamel, Dr. Harris contends phosphates have a definite local action on the teeth either as the food passes through the mouth or as it returns to the mouth in the form of saliva. The systemic effects of phosphates have not been studied adequately, but preliminary studies by Dr. Harris show that in rats, at least, phosphates exert some systemic reaction. Phosphates fed to rats during pregnancy strengthened the teeth that evenually erupted in the pups, reports Dr. Harris.

Another theory advanced is one called the common-ion effect. This theory proposes that since phosphorus is liberated during tooth decay, additional phosphorus acts to overwhelm the reaction.

Dr. Harris showed that adhesiveness too may play an important role. He compared the action of phosphates imbedded in fats with phosphates and fat mixed in a caries-producing diet fed to rats. Results showed the unimbedded phosphates reduced caries by 60 percent, while the imbedded phosphates caused a 90 percent reduction, a significantly greater effect. The only explanation for this appears to be that the imbedded phosphates are retained in the pits and fissures of the teeth and set up areas of cariostasis, in the same way that certain adhering foods, like sugar, set up areas increasing the rate of caries development.

Presently, however, the local cariostatic effect appears to be by a remineralizing process, perhaps the same as fluorides, but by a different mode of action.

Where research stands today, says Dr. Dreizen, is that phosphates negate the effect of sugar when added to foods. Comparing phosphate research with fluorides, he says that results have been much less dramatic over the same period of time.

Until more is known, researchers can only speculate on the value of phosphates. One use may be in presweetened cereals for children who don't get adequate dental care. Phosphates would also be valuable in areas where fluoridation is not practicable, such as in Switzerland, where the population lives in villages or isolated farmsteads with no community water supply. Nevertheless, the research so far indicates a combination of the two offers the best potential in combatting tooth decay. □