

New Light on the Cause of Tooth Decay in Man from Field Studies of Primitive Districts Providing Immunity

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It is a pleasure indeed to send greetings to my professional brothers on the other side of the globe. We have common problems and similar griefs and joys in our professional work. I hope the message that I am privileged to give you will increase the latter and diminish the former. It gives me special happiness to anticipate that this will be the case.

Primitive races of the past and their remnants of the present have been, and are, largely immune to dental caries, while modern civilisations have so largely lost their immunity that tooth decay is now generally considered not only the most prevalent of modern diseases but one of the most serious affections of mankind.

The approach to the study of the dental caries problem that has been used in these investigations is a consideration of these changes in the diets that have been associated with a loss of immunity when part of the people of a general district have changed their diets and coincidentally have lost their immunity while adjoining groups have retained the diets of their primitive ancestors, and with it have retained their high immunity to dental caries. This approach has been indicated by the results of the author's investigations on the variations in vitamin and other activator contents in the same foods produced in different places at the same time, and in the same foods produced at different times of the year in the same place, together with the fact that the administration of these activating substances to individuals suffering from rampant tooth decay has been capable of reducing the dental caries to 90 per cent. In certain cases the mineral content of the diet was also increased by the use of foods high in minerals in their natural forms as reported.

The recent advance in the chemistry of foods has made possible a more critical evaluation of the efficiency of food products. These procedures have been applied to these studies. It has also been desirable to check the procedures recently developed by the author for evaluating immunity and susceptibility levels in the individuals by a chemical analysis of the saliva which has been based upon the difference in the behaviour of inorganic phosphorus of the saliva in the presence of powdered bone in cases of immunity as compared with cases of susceptibility to dental caries.

For carrying out these investigations it has been necessary to locate typical groups of people living on the same diet as their ancestors who, because of their physical isolation, have been unable to obtain the nutrition provided by modern civilisation. If the immunity was based upon the utilisation of high mineral-carrying foods and high activator-carrying foods it should not depend upon particular items of food or specific dietaries, nor should it be dependent upon such physical factors as altitude and geographic location.

Since the fat-soluble activators of dairy products have been found to be specially high in certain elevated locations, particularly at the period of most rapid spring growth, Switzerland was selected as one of the places in which to search for such primitive groups with adjoining groups living on modern diets. Some groups have been found in isolated valleys where transportation facilities were still inadequate for providing modern dietaries, and with adjoining districts which had recently received modern foods due to the development of transportation facilities.

Field studies were also made at sea level in the islands of the Inner and Outer Hebrides, where the people were living on different diets from those of the people in the Alpine valleys. In the Alpine districts the primitive diet had been very largely limited to rye and dairy products with exceedingly little fruit or vegetables except some of the latter in the summer. In the Outer Hebrides the primitive diet was oat products, as oatmeal and oatcakes, and sea foods with very limited fruits and vegetables except some of the latter in the summer. Parts of these islands had already been penetrated by roads which have permitted modern transportation to bring modern foods, and so a splendid opportunity is provided for comparative studies in closely-adjointing districts apparently differing only in the introduction of new food factors.

A physical examination of the teeth of the children between seven and sixteen years of age in these districts in both these countries revealed that in 4,280 teeth studied in the mouths of individuals in the communities having the primitive foods only 145 had ever been attacked by dental caries, or 3.4 per cent. Studies were also made of the teeth of individuals living in the adjoining or similar districts where modern foods had recently become available, and revealed that out of 2,063 teeth 516 had been attacked by dental caries, or 25.5 per cent.

Samples of foods were obtained from these various primitive districts for chemical analysis for their mineral content and estimates were made of the vitamin content. Similarly estimates were made of the supplanting dietaries as found in the adjoining groups receiving the modern foods which displaced part of their primitive foods. In the Alpine districts on the basis of a daily intake of two thousand calories in which rye bread provided one thousand, milk eight hundred and cheese two hundred calories, it was found that the fat-soluble activators would be very high. The daily intake of calcium would be 1.88, phosphorus 1.96, and iron 0.0073, which was provided by 1,587 grams, or 3.47 pounds of food. When this diet was amplified to rye bread eight hundred, milk four hundred, cheese four hundred, butter one hundred (barley one hundred), vegetables one hundred, and meat one hundred calories, the fat-soluble vitamins were still high, the daily calcium intake 1.66, phosphorus 1.84, and iron 0.009, all of which was provided by 1,349 grams, or 2.97 pounds of food.

When we study the characteristic diet of the people living in protected, primitive districts in the Outer Hebrides, it was found on the basis of a daily intake of two thousand calories distributed as oatmeal five hundred, oatcake five hundred, barley one hundred; fish eight hundred including fish livers, and eggs one hundred calories to provide very high fat-soluble activators or vitamins and a daily

intake of calcium of 1.75, phosphorus 3.04 and iron 0.07 grams supplied by 718 grams or 1.59 pounds of food.

A similar analysis of the substituting diet which displaced the apparently protecting diets revealed that for two thousand calories per day in which white bread furnished one thousand, sweets as jams, honey, sugar and syrup four hundred, chocolate and coffee one hundred, milk one hundred, meat one hundred, canned vegetables one hundred, vegetable fats one hundred, and dairy butter one hundred calories, the fat-soluble activators were low and the daily intake of calcium 0.42, phosphorus 0.85, and iron 0.02. The weight of this diet was 954 grams or 2.08 pounds of food.

Samples of saliva were obtained from one hundred and seventy-one individuals of these various groups and were sent or carried back to my laboratories for analysing. These showed in general the same characteristics in the behaviour of the inorganic phosphorus of the saliva in the presence of powdered bone as reported previously for clinical groups, namely, there was a lowering of the level of the inorganic phosphorus of the saliva in the presence of powdered bone in salivas obtained from these individuals who had a very high immunity to dental caries and who are on the diet containing a high level of fat-soluble activators and high minerals, whereas in the group with high susceptibility to dental caries and receiving modern foods there was a rise in the level of inorganic phosphorus of the saliva in the presence of powdered bone.

These studies included making records of facial development both clinically and photographically, and revealed that in those individuals with high immunity to dental caries receiving the primitive diets irregularity of the arches was very rare as was also irregular development of facial bones. In the group who had lost their immunity to dental caries and who had modern foods during the period of facial growth there was a marked evidence of delayed development of the middle or lower third of the face, or both, with an inadequate development of the air passages and with much tooth irregularity. The more complete report is illustrated with typical cases.

These field studies have been going forward for the past two years and similar studies have been in progress by correspondence with individuals (chiefly dentists) in several hundred places distributed throughout the world. These negotiations have included the sending of samples of saliva preserved with formalin, accompanied by detailed case histories and a record of the diet. These have revealed that in every instance where the people had a high immunity to dental caries they were living on primitive diets characterised by high levels of fat-soluble activators and liberal carriers of minerals, particularly phosphorus. Those individuals with a high susceptibility were almost invariably living on characteristic modern foods as provided by modern commerce. A critical analysis of the differences in the foods of the immunes and susceptibles has been found to be that those with immunity are receiving foods liberal in fat-soluble activators and high in minerals in natural proportions as provided in natural foods in association with energy-carrying factors, which latter were not in concentrated form or high in calories; whereas those individuals with high susceptibility to dental caries were receiving foods very high in energy-carrying factors and relatively lower in their content of

minerals and fat-soluble activators than the foods of the immune group.

A circumstance of much importance has developed in all these groups with high immunity, namely, that they had practically no knowledge of oral hygiene methods or showed evidence of oral prophylaxis. Their immunity to tooth decay was clearly in spite of the fact that they did not have the helpfulness of an efficient oral hygiene procedure.

These studies have also shown that the characteristics of the foods found adequate to produce immunity to dental caries have not been limited to any one formula nor to hardness or softness of foods. For example, cereals were an important part of the diet in the Alps and Outer Hebrides and Porto Santa, rye in the former and oats in the latter two, but no cereals are available in Tristan da Cunha. Dairy products were available in the Alps but almost absent in the Outer Hebrides. Fish products were available and used liberally in the Outer Hebrides and Tristan da Cunha, but not available in the Alps. These are only a few of the illustrations of the wide divergence of foods found to be adequate for producing immunity to dental caries which are presented in detail in the text.

If, as these data indicate, the factors which control immunity to dental caries are an adequate level of fat-soluble activators and minerals in available form then the reinforcement of modern dietaries with these factors should accomplish a control or prevention of susceptibility to dental caries. This has already been accomplished in several groups as previously reported.

A particularly instructive investigation has been in progress during the past two years in which children with exceedingly rampant tooth decay have been fed one reinforced meal a day for six days a week in order to determine the possibility that this reinforcement could change susceptibility to immunity. These studies are also accompanied by a detailed chemical analysis of the saliva of the individuals, before, during and after treatment, and also roentgenograms.

In a group of forty children receiving the special meal from February to June, 1932, fed by the staff of the Broadway Methodist Episcopal Mission under the guidance of Reverend Edwin A. Brown, and receiving the additional activators as provided by the author, there was apparently complete control of tooth decay with no evidence of new cavities as determined by the clinical examination and roentgenograms made before, during and after treatment. Besides this there was evidence of a marked mineralisation of decalcified dentin where teeth were not filled and the building in of new pulpal walls where the dentin had been decalcified to the pulp chamber. An illustration of this is provided with this text. Associated with the change from susceptibility to immunity there has been a change in the chemical characteristics of the saliva in the matter of the behaviour of inorganic phosphorus in the presence of powdered bone. This has indicated the establishment of a high factor of safety through the means of six specially reinforced meals a week.

These studies have added important evidence indicating that the saliva determines the environment of the tooth, and thereby provides those factors which control immunity and susceptibility to tooth

decay. The level of these factors in the saliva is determined by the blood stream, which is controlled primarily by nutrition.

This review of these investigations is of necessity very brief, and it is, of course, impossible to include technical details which relate to the interpretation of chemical procedures. These are included in an extended text book which is nearly ready for the publishers.

A review of a number of my field studies is appearing in six successive issues of the "Dental Digest" (published by M. B. Massol, 1117 Wolfendale Street, Pittsburgh, Pa.), beginning with the March number and extending through August. These will probably also be reprinted in booklet form at a very small expense.

While your convention is in progress the writer will be studying Eskimos and Indians in various stages of modernisation and civilisation in Alaska and north-west Canada. These with studies already in hand of the American Indians in various places of North America will be added to the data in the text book to which I have referred.

Unfortunately, it has not been feasible to accompany this communication with illustrations because of the need for brevity. I am, however, including one illustration showing four stages of the same tooth demonstrating the building in of a protective wall of dentin over a nearly exposed pulp as a result of a reinforced nutritional program. I am also sending a slide of this illustration so that when the paper is presented the audience may see the example of practical progress in preventive dentistry. The temporary filling was placed for protection of the pulp. The caries is controlled whether the cavities are filled or not, provided the saliva has free access. This preventive service largely removes much of the grief of dental practice and greatly enhances the joys both for the practising dentist and the families whom he is serving.

It now seems clear why so many of the primitive races had high immunity to dental caries since as nature has originally provided most of the foods the levels of the minerals including phosphorus is amply high to supply the bodies' needs even under the additional demands of growth, gestation and lactation, often with no foods available in which calories or energy-producing factors are proportionately very high, as in refined flours and high-sweetened fruits. Besides this, dwellers by the sea have been richly supplied with both minerals and fat-soluble activators through the sea foods, while dwellers in pasturage areas depending on dairy products for a large part of their nutrition received minerals and fat-soluble activators from the dairy products.

All countries in which dental caries is rampant will need to be studied from these two standpoints and such reinforcements made in minerals and fat-soluble activators, and sometimes in water-soluble activators as may be necessary to provide an adequate factor of safety for the stress periods of life. Whether this service will be rendered by the dental branch of the healing art will depend upon the relative ability of the dentist to qualify for leadership. The public will use the service of those who are most competent to render that service. Since the members of the dental profession are responsible for the dental health of the people the highest expression of that service will be found in the prevention of dental disease. Fortunately, there is no service that the public so highly appreciates and is so ready to pay for as the prevention of disease.

I congratulate you, therefore, upon your opportunity not only for a larger usefulness to your communities but upon being in a position to be recipients of a compensation which can only come from doing for people what no one else can do for them and for which they cannot adequately compensate you; which is a worthy reward for the highest type of professionalism.

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