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SOME PHASES OF PREVENTIVE DENTISTRY OF SPECIAL CONCERN TO CANADIAN DENTISTS

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IT is indeed a pleasure to extend felicitations to the dental profession of Canada on the achievement of a National Journal. The effect will not be simply additive; it will multiply manyfold the influence and power of your Association.

The role of nutrition as the dominant factor in immunity to dental caries seems now to be adequately established though probably not yet generally appreciated. That irregularities of the dental arches and malformations of the face can also be demonstrated to be the result of faulty nutrition during the early formative and growth periods probably will not be more readily accepted in the light of past and current teachings.

In the light of these new advances more efficient and practical preventive programs become possible. These will provide the members of the dental profession, whose guard-duty is at Nature's most important observation post, with greatly enlarged opportunities for service both in the care of individual patients and for assisting in directing the needed special nutritional programs of individuals and families. For the Canadian dentist this offers some very special problems as well as unusual opportunities for helpfulness.

Many observers are noting that dental caries and some other degenerative processes are increasing in severity in certain districts of the United States and Canada and this in spite of increased efficiency of health organizations and institutions. If this be true it will be important to study possible contributing influences. This will lead us at once to a consideration of the principal controlling factors which determine the efficiency of a dietary. In other words what conditions establish, whether in a given group of individuals, the available nutrition shall provide a high or a low immunity to dental caries. Fortunately, remnants of primitive races are able to teach us much from their accumulated wisdom in this important matter.

Review of Investigations.

In may help us if we review briefly the data that have developed from my investigations of primitive racial stocks in various parts of the world, and to note what factors are common to various

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groups whether with high immunity or low immunity to dental caries; similarly to note what factors are associated with high excellence of dental arch and facial development and what factors with irregularities. It is very important that we shall establish standards of excellence; in other words controls. When we undertake to find such a group of individuals in any modern environment we may have the best that that community can provide but this may be below the highest ideal to which nature has arrived and accordingly not such an environment as will readily disclose the fundamental controlling factors. It is, therefore, very desirable that our studies shall include many groups with exceptionally high immunity to dental caries and with highly perfect dental and facial development.

In my studies of the vitamin content of dairy products in different parts of the world to which I shall refer later, I have found not only wide variations for the same districts at different times of the year but also a wide range for different districts at the same time. Apparently all of this was related to the nutrition of the dairy animals chiefly cattle, which nutrition was related to the period of growth and to some specially high vitamin foods in special districts where there was a long period of rest and a short period of rapid growth such as occurs in the high mountain valleys of Brazil, America and in several European and Canadian districts. On this basis I undertook to study the possible relationship of such growth factors to the presence or absence of dental caries and facial and dental arch deformities, when the individuals were compelled to limit their nutrition, in considerable part, to such specially favourable dairy products and to plant foods grown in that environment.

Primitive Groups.

For this I have studied remnants of several primitive racial stocks where their physical isolation had sheltered them from the influences of our modern civilization, and by studying them and their foods and their methods of living, certain underlying factors were found to be common to all these primitive groups, even though they were living in different countries and on very different foods. This permits us to critically examine modern civilizations at their points of contact with the primitives, and by studying them and their problems with the standards of the immune primitives, note the factors which are contributing to dental caries and facial and dental arch deformities.

By studying the children in four high isolated valleys in Switzerland, Loetschental, Visperterminen, Grachen and Ayer in the Swiss Alps,[1] [2] I found the incidence of dental caries to be only 4.6 per cent. of the teeth studied. Here oral prophylaxis and modern equipment for practising it were largely unknown. At St. Moritz,[3] however, at approximately the same altitude, which is a highly modernized community with excellent training in oral prophylaxis, the incidence of caries was 29.8 per cent. of teeth studied. At Vissoie and Zigal,[2] which were partially modernized, 22 per cent. of the teeth examined had been attacked by dental caries. At Herisau,[3] in the plains country of Switzerland, also a highly modernized community with splendid instruction and equipment for mouth cleanliness, the incidence of caries was 24.7 per cent. of the teeth examined.

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Similar studies were made in the Outer Hebrides,[4] off the west coast of Scotland and revealed that in the isolated districts of the Isles of Lewis and Harris only 1.2 per cent. of the teeth examined had been attacked by dental caries. Oral prophylaxis was almost unknown. In the ports and modernized sections the incidence of dental caries was found to be 30 per cent. of the teeth examined.

The natural foods available for these two primitive groups were very different in origin but similar in chemical content, as will be shown presently.

Eskimos and Indians.

Similarly, studies were made of remnants of the primitive Eskimos and Indians of Alaska and northern Canada and of those individuals of these groups who are at the point of contact with modern civilization. The Eskimos of western and northern Alaska were reached by aeroplane and for several groups who had been but little influenced by modern civilization, hence living entirely on native foods, the per cent. of teeth found to have been attacked by dental caries was 0.09, that is, only two teeth out of 2,138 in seventy-two individuals.[5] No effort apparently had even been made at oral prophylaxis in these groups.

At the point of contact with modern civilization, where a government supply boat comes once a year to provision a government station, the incidence of

caries among the local Eskimos[5] increased to 13 per cent. of the teeth, or 394 teeth out of 2,254 in eighty-one individuals. At this point oral prophylaxis was being taught and practised and, in spite of it, the increase in dental caries was 144 fold. The controlling factors in producing these changes will be shown presently to be nutritional.

The natural food of the primitive Eskimo was almost entirely the animal life of the sea.

Similarly, quite primitive Indians were sought for and found in northern Canada who were living practically entirely on wild animals. Their physical isolation from the influence of modern civilization was very complete.

Three groups were found, consisting of seventy-six individuals with 2,144 teeth and without a single tooth having been attacked by dental caries. In a total of 2,464 teeth examined for eighty-seven individuals in four groups, only four teeth had ever been attacked by dental caries, or 0.16 per cent.[6] These people knew nothing of oral prophylaxis as understood by modern civilizations.

For the groups of these Indians at the point of contact with modern civilization, 21.5 per cent. of 1,878 teeth in seventy individuals, or a total of 405 teeth, had been attacked by dental caries,[6 7 8] This is an increase of 134 fold. These individuals had been taught oral prophylaxis.

Knowledge of and equipment for oral prophylaxis are in direct proportion in these groups with the incidence of dental caries and dental caries is in direct proportion to the displacement of native foods with modern foods.

South Sea Islanders.

All of the above groups are in the northern hemisphere and temperate zone. While they represent a wide range in type and in kind of nutrition, climate and racial stock, they do not provide for a comparison, a consideration of people in tropical and sub-tropical countries. This strongly emphasized the need that there should be included in this investigation a critical examination of groups of individuals in the South Sea Islands. To accomplish this, extended field studies were made in 1934 in eight archipelagos of the Pacific Ocean, including large groups of each Melanesian and Polynesian racial stocks. Owing to the vast extent of the Pacific waters and the limited number of transportation lines it became very difficult to arrange a convenient itinerary. This, however, was accomplished satisfactorily by going south through the more easterly archipelagos, namely, the Marquesas Islands, Society Islands and Cook Islands and then westward to the Tongan Islands in the southern central Pacific near New Zealand and then westward to New Caledonia near Australia. From this group we went northward to the Fiji Islands, also in the western Pacific, and thence to the Samoan Islands in the Central Pacific south of the Equator and to the Hawaiian Islands north of the Equator. These island groups were all populated by different racial stocks speaking different languages. The movements from archipelago to archipelago were made on the larger ships and between the islands of the group in small crafts, except in the Hawaiian Islands where an aeroplane was used.

These studies involved a physical examination of the mouth of each individual to determine the extent of dental caries. Detailed data were recorded regarding the state of eruption of the teeth,

the shape of the dental arches, individual physical characteristics and age, together with information regarding the nutrition both at present and in the past. We were assisted in this matter in each group by special guides and interpreters that were usually obtained through government officials and arrangements for whom had been largely made through correspondence in advance. The inhabitants of New Caledonia and Fiji Islands were of Melanesian stock. The Tongans were probably originally a mixture of the Melanesians and Polynesians. The balance of the above island groups were inhabited by Polynesians.

The incidence of dental caries among those Melanesians who are still so isolated as to be compelled to depend upon their efficient native foods, was 0.38 per cent. of the teeth studied. For those individuals living on the trade or imported foods of modern civilization 29.0 per cent. of teeth studied had been attacked by dental caries. For the isolated Polynesians living quite exclusively on their native foods the incidence of dental caries was 0.32 per cent. of the total teeth examined. For the Polynesians living on trade or imported foods of modern civilization 21.9 per cent. of the teeth had been attacked by dental caries. The similarity of the figures was directly related to the similarity of the native foods and uniformity of the displacing imported foods.

While dental caries is recognized as the most universal affliction which accompanies civilization and is, as we have shown, a direct expression and effect of nutritional stress, it can now be shown to constitute or represent only one of many injurious effects or expressions of faulty nutrition. Rickets of childhood has long been recognized as one of these. Several affections or so-called diseases of modern civilization are progressively on the increase. Others are particularly destructive for certain groups. Others chiefly maim and produce deformities in various parts of the body, such as the face and dental arches.

Facial Irregularities.

Facial and dental irregularities have been chiefly ascribed to thumb and finger sucking and to mixed racial physical characteristics. In my investigations of primitive racial stocks and of the effects produced by their displacing of part of their natural foods with foods of modern civilization, it has been disclosed that the rigid conformity to physical type characteristic of these races has been lost in a single generation as an effect of nutrition on development processes during prenatal and postnatal life.

For the face this may express itself as retarded growth of either the middle third or lower third or both. This directly affects the arrangement of the teeth in the dental arches as well as the interrelation of the dental arches. It occurred in as high a percentage of full bloods in the first generation after adopting the nutrition of modern civilization as in the mixed bloods. This deficiency was also found to have an expression in many other structures of the body.

As I have shown in my reports, the dental arches of the children and adults of the high Alpine valleys[9] were universally regular in contour and proportion. In St. Moritz at the same altitude, but where the children had been reared on modern foods, irregularities of the dental arches were common and when we came down to the plains country the assortment of

deformities and of irregularities of facial development became very frequent and included many mouth breathers and badly proportioned features. The pure Swiss of the latter group had lost the physical characteristics which constituted the racial pattern in the isolated valleys. These physical changes accompanied the loss of immunity to dental caries. The nutrition of the isolated groups was largely limited to the native foods, rye and dairy products. At the point of contact with civilization and in all the modernized groups the white flour, sugar products, canned fruits, as marmalades, pastries, etc., displaced the natural foods.

Similarly in the Outer Hebrides in all the groups whose isolation provided as their nutrition oat products and sea foods, excellent facial and dental arch development were constant characteristics. In the first generation, however, after these native foods had been supplanted by the imported white flour and sweet goods, mouth breathers were common and marked deformities of the dental arches developed. I have shown, for example,[10] a group of four children in one family all of whom were mouth breathers and all had dental caries. All were using imported foods.

Among the primitive Eskimos of Alaska who were living entirely on their native foods, chiefly of the large animal life of the sea, not a single case of irregularities of the dental arches nor a single mouth breather was found. In the present generation, however, where the mother had used the trade foods, white flour and sugar, largely for her nutrition during the gestation and lactation periods and those foods were used also by the growing children, irregularities of the dental arches and face were a frequent occurrence and often in very severe form.

Similarly, my studies of the Indians of the far north of Canada revealed dental arches of very remarkable perfection so long as the individuals had, during their developmental and growth periods, lived entirely on the native foods, consisting of the animal life of the land with a constant use of the organs. Again at the point of contact with modern civilization's foods, the first generation showed very marked divergence from the normal racial type, in that dental arches were irregular, nostrils were narrow and gross facial deformities often occurred. The activity of the dental caries process in this group was very marked, though the extent of the facial irregularity did not have a constant relationship with the loss of immunity to dental caries. These two factors were clearly related to two different growth periods.

My studies during the summer of 1934 among the primitive people of the South Sea Islands have again revealed information of a most striking character in this matter of the development of facial deformities with a change from the native to the trade foods. It is exceedingly significant that not one single case was found of deformed dental arches among the isolated groups on the eight archipelagos studied. In one case a supernumerary was found which produced crowding but the arch was of normal size. In each archipelago, however, where the children had developed on the trade foods, many cases of gross irregularity of the dental arches were apparent.

Many score of these cases have been photographed and several reported for these various racial stocks.

If the physical injury arising from faulty nutrition in the formative and

growth periods was limited to the oral and facial deformity, or even these and the serious obstruction of the air passages due to their lack of normal development, this would indeed be a very severe affliction; but another very important discovery has been made in these special field studies.

Immunity to Degenerative Processes

In all the racial groups where a comparison could be made of the individuals still using the native foods and those living on the imported foods of modern civilization, the opportunity has been presented for a study, at the same time, of the level of immunity to several other degenerative processes, including arthritis and tuberculosis. It is commonly considered that tuberculosis is essentially an infective process, and much emphasis has been put upon the absence of exposure to the infection and the need for freedom from contact. It is of great importance that we shall keep in mind that practically all of these racial groups break down rapidly when they come in contact with our modern civilization and its foods. Among these destructive diseases, tuberculosis plays a very important role. The rapid breakdown of these primitive races with tuberculosis has been largely ascribed to the fact that there had not been an inherited immunity due to both a previous racial exposure and successful combat.

I have been deeply interested in studying the individuals who are making a poor fight against tuberculosis among these primitive racial stocks such as have been carried into institutions for care and nursing. At Juneau, Alaska, there is an excellent government hospital maintained for this purpose. Every one of the Eskimo and Indian boys and girls who were in that institution suffering from pulmonary tuberculosis had very marked deformity of the dental arches with irregularity of the teeth. Similarly, in the tuberculosis hospitals of Hilo and Honolulu in the Hawaiian Islands only one individual between ten and thirty was found who did not have this marked evidence of nutritional deficiency in the development and early growth period. That individual was suffering from tuberculosis of the cervical glands.

Interpretation.

My interpretation of the significance of this finding is that the defensive mechanisms of the body did not develop normally as a result of the same deficiencies which produced the disturbance in physical growth.

A recent survey of the Eskimos of Alaska by Dr. V. E. Levine and Professor C. W. Bauer of Creighton University (Nebraska) has been reported as follows:

> "Cordova, Alaska, Oct. 26, 1934.—Due to susceptibility to tuberculosis and other diseases the average life span of the Eskimo of Alaska is only 20 years and their race is doomed to extinction within a few generations unless modern medical science comes to their aid."

What is happening to the Eskimos is happening to the Indians at practically all points of contact with our modern civilization and its foods. It is also very significant that in my field studies among the Indians in northwest Canada that while I did not see a single arthritic cripple in the isolated groups in the far north, I found ten bedridden cripples, mostly arthritics in Telegraph Creek and vicinity at the point of contact with modern foods.

Since these degenerative processes are so definitely on the increase at the point of contact of these several primitive racial stocks with modern civilizations often where no other change has taken place except the displacement of part of the native foods with imported foods, it becomes very important to study critically the chemical characteristics of both the native dietaries and those foods which have displaced them.

Large numbers of samples of foods have been collected in my various expeditions and transported to my laboratory for chemical analysis.

The requirements of the normal human for two of the several requisite minerals, namely, calcium and phosphorus, have been shown by Sherman[11] to be approximately two grams of each in suitable chemical form in the daily diet, in order that the body may obtain at least one gram to 1.3 grams of each per day, which can only be accomplished when there is present an adequate quantity of the various vitamins, particularly the fat-soluble vitamins. The minerals can never be entirely removed. The following minerals were routinely determined, calcium, phosphorus, iron, magnesium, copper and iodine.

The quantity of Ca and P found from a study of the diets of both the immunes and susceptibles in Switzerland,[9] shows a marked reduction in several minerals as provided in the normal daily diet, consisting chiefly of entire rye and dairy products in comparison with the displacing diets obtained from modern civilization. This decrease was from 1.6 to 0.4 grams for calcium, from 1.8 to 0.8 for phosphorus and from + + + for fat- soluble activators to + on a basis of 2,000 calories. This amounts to a reduction of 75.4 per cent. for calcium, 55.1 per cent. for phosphorus and 67 per cent. reduction for the fat-soluble activators.

For the Outer Hebrides when their native foods, which consisted chiefly of oats and sea foods, were displaced with the diet used by modern civilization, there was a reduction[9] from 1.7 to 0.8 grams for calcium, from 3.04 to 1.3 grams for phosphorus and from + + + to + for fat-soluble activators, a reduction of 52.3 per cent. for calcium, 57.2 per cent. for phosphorus and 67 per cent. for fat-soluble activators on a basis of 2,000 calories daily.

When the native diets of the Eskimos are changed from the animal life of the sea to those used by modern civilization, there is a reduction from 2.14 to 0.39 grams for calcium, from 5.70 to 1.14 grams for phosphorus, from 0.100 to 0.067 grams for iron, from 1.27 to 0.16 grams for magnesium, from 0.0312 to 0.0167 grams for copper, from 0.000131 grams for iodine to 0.00000276 grams and from + + + to + for fat-soluble vitamins or a reduction of 81.8 per cent. for calcium, 80 per cent. for phosphorus, 30 per cent. for iron, 86.6 per cent. for magnesium, 46.6 per cent. for copper, 97.8 per cent. for iodine and approximately 67 per cent. for fat-soluble activators on the basis of 3,000 calories for their severe climate.[12]

For the Indians of northern Canada the loss of immunity when their normal diet, consisting chiefly of wild animal life of the land, was displaced with diets as used by modern civilization, the reduction was from[12] 2.3 to 0.39 for calcium, from 6.61 to 1.14 for phosphorus, from 0.186 to 0.067 for iron, from 0.68 to 0.16 grams for magnesium, from 0.0254 to 0.0167 grams for copper, from 0.0000240

to 0.00000276 grams for iodine and from + + + to + for fat-soluble activators on a basis of 3,000 calories. This is a reduction of 83 per cent. for calcium, 82.7 per cent. for phosphorus, 63.9 per cent. for iron, 76.4 per cent. for magnesium, 34.0 per cent. for copper, 88.5 per cent. for iodine and approximately 67 per cent. for fat-soluble activators.

When the foods constituting the diet of the South Sea Islands have been analyzed and the data expressed quantitatively for the various minerals it is disclosed that the diets of the isolated primitives provided them 1.9 grams of calcium per day and the modernized diets provided 0.97 grams, which is a reduction of 53 per cent. When the native foods were displaced by modern foods there was a reduction in the phosphorus from 3.10 grams to 1.36, or a reduction of 56 per cent. There was a marked reduction in the fat-soluble activators in the modernized foods, being + + + in the native foods and + in the modernized foods, a reduction approximately of 67 per cent. The primitive foods in the South Sea Islands consisted of various plants as taro, yams, maniota, sweet potatoes, bread fruit, chiefly taro; the young tops of the taro, many fruits including bananas, oranges, coconuts and papaya. With these were used animal life of the sea as shellfish, soft and hard such as crayfish, octopus, lobsters, oysters, and clams, also fish of many kinds both large and small, and turtles.

In general the usual contact with the outside world was through the calling of a small trade ship which gathered up the collected shells and dried coconut or copra. In nearly every instance the collected materials were paid for in goods which consisted of approximately 90 per cent. white flour and sugar and 10 per cent. clothing. These trade ships usually call about twice or three times a year, and due to the coral reefs surrounding nearly all of the Pacific Islands, their only point of contact with the inhabitants would be at the few openings through the reefs. There is usually one principal port for each of the various archipelagos at which the larger merchant and passenger ships can call. At this port local trade stores are established which maintain the supply of trade goods for the continued use of the purchasers. Many groups were studied who had no contact with even trade ships.

Other remnants of primitive racial stocks have been and are being studied. The data for these are not yet consolidated.

It is very important to note that the building blocks from which our bodies are constructed, including all those forms of animal life having skeletons, are precisely those which we found to be present in liberal amounts in the native dietaries of those individuals in all the various groups with a high immunity to dental caries, but not present in adequate amounts in the nutritions of all of those with a low immunity to dental caries. If it be true that it is the absence of these minerals and activating substances which constitute the controlling factors for excellent physical development and the maintenance of high immunity to dental caries, then the providing of an adequate reinforcement to deficient dietaries should result in the effective control of the active caries process, and provide for normal physical development including the mechanisms of defense against infection.

Fortunately, we have a large fund of data dealing with these points. In all

the isolated racial groups studied, individuals were found who had left the isolated districts for a period of time and had gone to more modernized communities and then returned to their former environment. When this contact with modern civilization and its foods lasted from six months to a year, dental caries became active and injured or destroyed several teeth. If these teeth became abscessed or seriously painful while in the modernized community they were extracted. On return to their original living conditions the caries ceased to be active and remained so. The surfaces of the cavities became hard and glistening, indicating a high degree of remineralization of the decalcified dentine and a high immunity to dental caries. These cases were frequently encountered in the Alps in Switzerland and the Outer Hebrides and among the Indians in northern and central Canada.

Another type of condition was particularly instructive which was found in several places in the South Sea Islands. When the price of dried coconut or copra was high the trade ships were active and made frequent calls gathering up this material for European and American markets. Since the material was paid for almost entirely with white flour and sugar products, these low mineral and high calories foods became available for displacing the native foods. This was the condition for a few years following the War. For several years just past, however, the price of copra has been so low that the trade ships have not called and in many places the people have been for several years without the imported foods. The effect was clearly demonstrated in the condition of the teeth. When examined practically all mouths were free from active caries. Large numbers of them had cavities with glistening hard surfaces where the tooth decay had become entirely arrested and these cavities were reported to have developed entirely during the periods that were covered by the exchange of the copra for the trade foods.

Still another type of condition was very instructive. There have been a few very severe hurricanes within recent years that have caused great damage in some of the Pacific Islands. When these occur practically all vegetation is stripped of its leaves, and fruits and plant foods are destroyed for an extended period. Relief is provided by the Red Cross in the form of modern trade foods. In several districts periods of active tooth decay could be identified as coincident with the period in which the Red Cross foods were available.

If it be true that the level of immunity to tooth decay is directly a problem of the level of the intake of body building materials, especially the minerals and fat-soluble activators, an adequate reinforcement of any deficient diet with those substances in suitable form for becoming available should provide the requisites for establishing and maintaining immunity almost regardless of the basic diet. The accumulating evidence strongly emphasizes the view that it is not what has been eaten that has done the harm, but rather the absence of what was not eaten, and that poor foods high in calories therefore satisfying hunger and energy demands, but low in body building material, had displaced or supplanted foods providing both. A logical procedure, therefore, is to obtain data on the results produced by reinforcing an inadequate dietary. It is at this point that the available evidence becomes very convincing.

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