

TEETH

I

Nutrition and Diet

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In the time at my disposal I am not going to talk about the minutiae of current laboratory investigations into the pathology of the dental diseases and their application at the coal face. This work is published or abstracted in the journals we all read. I am going to look at our food and eating habits, narrowly, as a dentist, and invite you, who are not confined by the boundaries of a narrow speciality, to look at them with me.

There are three factors in the aetiology of the two major dental diseases that must be considered. The factors are genetic, structural, and functional. I shall only have a little to say about the genetic factor: a little, not only because the subject of this short paper is alimentary, but because not even enough is known about the genetics of dental disease to appreciate its relative importance. The structural factor is closely associated with nutrition—nutrition as distinct from diet. The functional factor is closely associated with diet. A working definition of nutrition is—everything that passes from our alimentary canal into our blood stream. A working definition of diet is—everything we put into our mouths and swallow. I am aware that these definitions would not, today, satisfy biochemical nutritionists, but they will suffice for my purpose here.

The two major dental diseases are dental caries and gum disease. Dental caries is the progressive dissolution of the hard tissues of the teeth and is most active in the first decades of life. Gum disease is a disease of the soft supporting tissues of the teeth beginning with a simple gingivitis and progressing to what is vulgarly known as “pyorrhoea”, the essential element of which is a deep pocket between the hard tooth and the soft tissues. Irrespective of the degree of active or passive eruption of the tooth, the depth of this pocket should be zero throughout life. But it can be, and is, quite ordinarily, in adults, one or two millimetres in depth without any evidence of disease. Gum disease has hitherto been considered a disease of the later decades of life because it was then that treatment for it was usually sought and carried out. It is, however, now known to begin in the first decades and there is some evidence that its genesis is at the actual eruption of the tooth.

The three factors in the aetiology of these diseases—genetic, structural, and functional—are probably the aetiological factors in

all disease. I am going to deal briefly with each in turn as they affect dental disease in order to define their boundaries. It will be apparent that if we have changed our food and eating habits, even more our food and eating habits have changed us.

I have said that little is known about the genetic factors in dental disease. But the following facts are strongly suggestive. If I examine, say, 250 children at school, a random sample, I shall find about 12, not more and usually less, with no evidence of dental caries and they will not necessarily have the cleanest mouths or even very clean mouths. Some may even have grossly irregular teeth that are impossible to keep clean and sometimes they have structural defects that are detectable at the macroscopic, clinical level. They would appear to have inherited great resistance to dental caries. Many of these—the dirty ones—usually succumb to early gum disease, the beginning of which, in the form of chronic marginal gingivitis, is often already apparent. On the other hand, some children whose dental care is exemplary, both theirs and their dentists', lose teeth at an early age through inability to keep pace with rapid caries. Identical twin children who are sharing, as nearly as possible, an identical dental environment, have identical dental apparatus morphologically, and also identical dental disease or health. The dental condition of unidentical twin children bears no more relation than that of any two siblings of a year apart in age. Within the limits imposed, let us suppose, by genetic factors there would appear to be for each of us a predetermined liability to dental disease, or enjoyment of dental health, by which we shall be cursed or blessed, in an optimal dental environment. Of course we do not know that this variable resistance, about which at present nothing can be done, is genetic. In the present state of ignorance the genetic sink seems the obvious one to put these facts in.

It is relevant to mention that irregularities of teeth, to which, in us racial mongrels, genetic factors are an important contributing factor, make teeth difficult and even impossible, to keep clean naturally or even artificially, and therefore predispose to both dental diseases.

The second factor is structural. It is obvious common sense that a tool well made of good material will resist wear and tear better than one made badly of poor material. Biological tools such as the dental apparatus resist disease best when well made of good material. Many of the factors which contribute to sound structure of the teeth are known. With the exception of fluorine they are, on the whole, well taken care of in this country at the present time. Of course there may be factors of which we are at present ignorant. Since metabolism in tooth enamel is practically nil and in dentine, though it reacts to injury, is very little, nutrition, once the tooth is formed,

is of little account as far as these tissues are concerned. During growth and maturation of the tooth, nutrition becomes of decreasing importance in so far as the more tooth that is formed the less there is that it can readily affect for good or ill. Since the soft supporting tissues of the teeth and the pulps of the teeth are always directly affected by metabolic nutritional factors, these factors are relevant and important throughout life with regard to these tissues. An obvious example is scurvy. It is probable that the same general factors that affect the health and disease of epithelial and connective tissues generally, affect the supporting tissues of the teeth. But specifically how important in a general or in a particular way nutrition is with regard to soft dental tissues, is not known.

Before I come to the third factor, the functional and by far the most important factor, I am going to glance at nutrition and diet. Since many of us used to die, and elsewhere still do, as a result of specific nutritional deficiencies in our diet we can, perhaps, be excused for our traditional nutritional bias of interest in our food. After all, if I were dying of scurvy I hope I should not be asked whether I preferred to have ascorbic acid injected into me, to swallow pills of the stuff, or to eat a crate of oranges. Ill with kwashiorkor I shouldn't have the energy to masticate a steak even if it were prescribed, or even steamed fish. I would settle for progressively strengthened solutions of dried skimmed milk which I could suck like an infant mammal or swallow like a toothless elasmobranch. I should survive the non-use of my dental apparatus. Even if the remains of my dental apparatus were removed an artificial denture would be 20 per cent efficient—probably more efficient than the majority of natural dentitions in my species, and certainly more efficient than, for example, an artificial eye, with which I could not see at all. In any event my denture would look all right and I could manage most of the food that was placed before me and certainly everything my physician prescribed.

In their pursuit of the grave nutritional factors in health and disease, and in their biochemical elucidation, medical scientists have come to regard us, I feel, as a mere laboratory in which chemical energy—air and food—is changed into mechanical and heat energy to move the laboratory about and keep it warm and as raw material to effect running repairs to it. The function of the laboratory, its use and uses, have been forgotten. The bias of interest in food has become narrowly nutritional and chemical. It is time this interest was leavened with an equal interest in the dietetic and physical aspects of our food—which indeed until recently, say, 200 years ago, were the only interests in food we could have. We haven't yards of alimentary canal, beginning with a dental apparatus and ending with a barrow load of guts in our abdomen in order to suck

or swallow food in the pure form of analytic reagents, B.P. We dentists fall out with our medical colleagues over their almost total disregard of, and lack of interest in, the physical character of our food, that is, our diet as distinct from our nutrition. To dentists it is very important whether we, healthy functional mammals, get our ascorbic acid, for example, by chewing raw oranges, by drinking orange juice, or by swallowing a pill. We have the impression that physicians, and particularly nutritionists, don't mind much how we get it. We are distressed by their ready, and apparently uncritical, acceptance of our dietetic and eating habits. The mechanics of eating are important. With the greatest respect I presume to say to physicians that it should also be equally important to them that we exercise our dental apparatus. The golden rule is cleanliness and exercise and the first can still be achieved on our internal, if not on our external surfaces, by taking the second.

I come to the functional factor and to what we mean by cleanliness. Before we are born our digestion is done for us by our mother. After we are born our chewing is done for us. As soon as we have teeth we should chew for our nourishment. The two sets of teeth, each complete in itself, the progressive eruption and shedding of the first set and the superimposed eruption of the second are a compensation for the fact that teeth, once formed, do not grow in size but that our jaws do, and quite considerably. Our alimentary canal is intended to digest raw food and our dental apparatus is intended to chew raw food. The only time some of us eat an entirely raw diet is when we suckle our mothers. I am not suggesting that we should eat raw food. You will know better than I the great damage that could be done to an individual whose alimentary canal has been conditioned to a so-called civilized diet if he wantonly adopted a raw diet. It is important, however, to remind ourselves of the threshold from which to measure the degree of our departure from the function implied by the structure of our dental apparatus. A superficial scrutiny of our dental structure informs us that we should eat a raw omnivorous diet. We should feed like pigs—another omnivore. If we did we should have negligible dental disease—as have other wild animals. Our gums would be continuously keratinized by friction and this invagination of teeth into an internal surface would offer no openings in the interface between our internal and external environments for irregular interchange between them. Moreover, such a diet would be self-cleansing.

We all talk of cleanliness but rarely do we think about what it means in a biological context. In organisms the functions of all structures—or structures of all functions, it doesn't matter which way round—are self-cleansing. They have to be or disease will

ensue. If the function or structure changes without a corresponding change in the structure or function, self-cleanliness ceases and disease ensues, a disharmony between function and structure beyond the limit within which survival is possible. In general terms, for universal application, if a is the function and b the structure of x , x being anything to which a name is given, then $\frac{a}{b}$ or $\frac{b}{a}$ is always greater or less than one or unity. If this were one or unity, x would be static. There is a limit above or below one or unity which this disharmony must not exceed in organisms. A snake keeps its integument as clean as it needs to be in moving about, and keeps its dental apparatus clean in using it. It has no need of bathrooms or toothbrushes.

The structures of wild animals keep as clean as they need to be in functioning, at the cellular, component, whole animal, and species level. Our species is changing rapidly, not genetically, but parent-tuitively. Our functions, at all levels, are obviously achieving self-cleanliness enough for our survival but not sufficient to avoid a high incidence of disease and disorder at every level. Never have there been so many of so large an animal—there are over 2,000 million of us. One price we pay for our increase is disease that does not kill us, that is repairable or whose results can be dodged. Personally I would prefer more disease prevented and quality rather than quantity.

As soon as we domesticate animals and interfere with their diet the disharmony of dental function and structure goes beyond the permissible limits and dental disease begins. The first animal we domesticated was ourselves. As soon as erect posture was established in our quadruped ancestors they had a pair of limbs free of locomotor function to be used otherwise or disused. Out of erect posture the kangaroo got a heavy tail to balance it and a pair of limbs that seem to be supernumerary. We lost our tail, acquired hands that can play the violin and our rather alarming cerebral development—the term to which would seem to be the size of the female pelvis. Our tentatively erect ancestors picked up a stone and a stick and used them as weapons. In doing this their limbs usurped a function of their teeth. Vicariously they lengthened their canine teeth to the length of their arms, as we may now call them. From these, through spears, javelins, and arrows, they came to firearms and their canine teeth are now a mile long. Their teeth ceased to be their weapons and their arms usurped this dental function. Early in this concomitant manual/cerebral development that has resulted, thus far, in you and me, the cooking of food was discovered. Immediately the comminutive function of teeth declined. Our chewing is now done for us by cooks, in factories, who even do some of our digestion for us too, sometimes.

As soon as we began to cook food the necessity for the artificial achievement of personal cleanliness arose. When we began to hunt in packs and our social development began, based upon the family, the necessity for social cleanliness arose in addition to personal cleanliness. Regarded as individuals our functions were no longer self-cleansing. Our social function—that of surviving in the inter-species competition for food—probably never has been self-cleansing as is that, for example, of razor-bills on a cliff. What we now call public health became necessary for survival in addition to bathrooms in the cave. And when in our social development intra-species competition—in its most acute form we call it war—super-vened upon the inter-species competition, social cleanliness became urgent. What began with communal scavenging, sewage disposal and water supplies, has become extended to public scrutiny of our personal habits—as in smoking, of the air we breathe and of the food we eat. Just as personal cleanliness is not now the simple matter it was when we wore no clothes and ate raw food, public cleanliness has become more than the provision of water that does not poison us and the disposal of our waste products—with an eye on our parasites, contagious and infectious diseases. What we eat and how we eat has become of social importance—if only because our Welfare State my dental health is helping to pay for the cost of your dental disease.

Now if we want sugar we open a factory packet and suck a lump of it—flavoured and coloured one way or another we call it a sweet. We haven't the time to chew through a foot of sugar cane to get it, which incidentally would keep our mouth clean and exercised. We feed out of cans, tins, packets, and bottles—we are forgetting what real food looks like and tastes like. We are continually eating, sucking, munching, or merely swallowing highly refined foods that do not exercise our jaws or keratinize our gums and only mess up our mouths. Artificial exercise and cleaning is resorted to. Socially the only acceptable raw foods are fruit, nuts and salad but we usually end our meals now with a dentally dangerous mess called dessert. This status symbol, this conspicuous piece of consumption, began quite recently when sugar was only within the reach of the wealthy. Now everyone has a sweet sticky mess at the end of their meal in imitation of those who once were our social betters, and our children's habit of compulsive eating is based upon this love of sugar to which they are now conditioned in infancy. There is room in our libraries for a history of meals and eating habits—none to my knowledge exists. I commend the writing of it to anyone with access to the University Library. It would occupy their retirement, keep them quiet, be interesting to do and to read.

When, as a dentist, I regard our society's eating habits I do not know where to begin a critical survey of them. As far as caries are concerned the damage is done in a few minutes after eating carbohydrate, and a half biscuit or a single toffee as effectively crosses the danger threshold as a loaf or bread or a seven course dinner. As a matter of fact in the Vipeholm caries investigation it was found you could consume twice the daily Swedish average of sugar consumption with main meals without doing any additional damage to your teeth. I must emphasise that it has been amply shown that it is the frequency of eating relatively small amounts of carbohydrate in between the main meals that is damaging. In a dental context some adults and many children are eating thirty to forty dentally dangerous meals a day.

The calorie requirement of our dense industrial population is based on the economics of the production, distribution, and consumption of cheap carbohydrate foods that are easy to eat quickly without doing us immediately apparent damage—that is, highly refined carbohydrate that requires no chewing. It is a matter of mere regular refuelling—like filling an automobile fuel tank. Unfortunately these foods lend themselves to piecemeal refuelling and we are increasingly apt not to fill the tank when it is empty and have done, but to dribble in gills at frequent intervals. Unrefined carbohydrate foods would take too long to chew—time we could use to manufacture more similar carbohydrate foods in order to give us leisure to do what? To consume more carbohydrate foods.

The time of our ancestors and of other wild animals contemporary with us, is entirely consumed in the instinctive pursuits—of feeding and mating—and in sleeping. In our ancestors, when the interspecies competition for food became less acute as a result of their non-dental weapons, they immediately had time on their hands. No other species ever had so much time free from the instinctive pursuits that relentlessly drive other animals and fill their day. By degrees they began to symbolize their instincts in what we now call the arts, using the manual, cerebral skills to do so which were acquired in making non-dental weapons. What had been their food in the narrow physiological sense became their food in the broad sense of all their needs. Men ceased to live by bread alone. Today we can grow or make all our food, our needs in the broadest sense, in an ever shorter time. The problem of what to do with the remainder of our time, our so-called leisure, is becoming acute. Many of us use it eating food we do not need or want. I suggest that we should spend more of our time eating the necessary meals, giving them more time and thought. The culinary art need not be incompatible with our physicians' nutritional requirements or our dentists' dietetic requirements.

Today we largely eat what manufacturers condition us to want—and what they make to sell to us is not always what we should be having. The whole of our popular press—newspaper and periodical—is kept going on advertisements, a very large proportion of which are of foodstuffs. The women's magazine industry especially should be noted since it is our women who feed us. The emphasis is often on saving time—for what? To eat another meal very often, of pre-cooked, pre-chewed, pre-digested rubbish out of a packet or tin that we have been persuaded to want, have been told is good for us, but which we do not need and will only help to rot our teeth and make us fat and give us more weight to carry about. In our welfare state many have much money and leisure, with neither of which they know what to do. They are increasingly guided in their leisure activities by the women's magazine industry. Out of boredom many eat to fill in their time and use their money. Many older children go to work out of school hours and have too much money in their pockets. In their leisure they are exploited by big business as efficiently as they were a hundred and fifty years ago at work. They cannot be made to begin rotting their lungs until they are 16 or drowning their sorrows in beer until they are 18 but they can be and are made compulsive eaters before they graduate from napkins. Our economy could not endure without married women at work—who sweat their guts out at work to buy labour-saving devices for their homes. The family now eats separately, on the run, far too many times a day. It feeds on tasteless but nutritious bits and pieces from factories, in tins and packets from refrigerators, containing the Lord alone knows what nutritious rubbish beside that divulged on the wrapper.

In this country last year £272 million was spent on sweets and chocolate. Nearly £10 million was spent on advertising it on television alone. Only £35 million was spent on apples and £12,000 spent on advertising their virtues. In the decade before 1958 we consumed 25 lbs of apples per capita per annum. We now consume 35 lbs each. But the average for Europe is over 50 lbs and for Switzerland over 120 lbs. We consume much less fruit in this country than any in Europe for which figures are available. Confectionery was untaxed until this year. Only 25 million toothbrushes are sold in each year but toothbrushes and toothpaste have been taxed for 20 years. At our maintained schools confectionery—a principal means of making children fat and rotting their teeth—is quite ordinarily sold to make money for such worthy objects as building swimming baths to make the children healthier. I have even been invited to the showing of dental health films projected on a machine bought out of school tuck-shop profits.

Our society is an inchoate and incoherent mess, no less diseased than our teeth, and needs attention. Until it gets it, and while commercial pressures greater than those we can bring to bear are the paramount conditioners of our personal habits, you can tell your patients to limit their meals to three or four a day and to end them with a self-cleansing food. If they cannot end their meal with a self-cleansing food—such as an apple, a carrot, or a stick of celery—then they should brush their teeth. If for social reasons they cannot, then they can rinse their mouths as vigorously as good manners permit with the wine or water at the end of the meal and swallow it. An apple will clean your mouth as efficiently as a toothbrush. Unfortunately half the population—the denture wearers and those with untreated dental disease—cannot eat an apple with comfort let alone pleasure. The virtue of apples is that they are clean and easy to carry about, they do not need any tools to eat them and do not mess up your hands or face. They should be on the menu of every public or commercial eating place.

The appalling toleration of dental disease is an interesting study. Socially, skin disease which could not have been prevented by its victims is not tolerated. Those with obvious skin disease hide it or themselves. Dental disease, however, more than half of which we could easily prevent by fluoriding our water and exercising a little daily discipline, is socially tolerated even when it is obvious—and in all strata of society. Even dentists themselves call the filling of teeth preventive dentistry!

With the possible exception of the common cold, dental disease is our most expensive disease. More than £50 million was paid to the N.H.S. general dental practitioners last year for its repair. To that figure must be added the cost of the local government and hospital dental services. The value of the time lost seeking and enduring dental treatment we can only guess at. The average age of the 13,000 dentists in active practice is nearly 60 and we have places in our dental schools sufficient only just to replace the wastage due to death or retirement. The population is increasing. Dental caries among children has doubled in the last ten years. Dental disease is out of control and cannot now be brought under control by letting it come and treating it. Unless we soon take its prevention seriously in hand and achieve control of it we shall only be able to eat those foods that cause our dental disease in the first place.

Unless some artful dodge is discovered whereby a link in the pathological chain of dental caries can be broken, I see no possible way of reducing its morbidity except by a substantial change in our eating habits and in our food. An antibiotic which selectively attacks the organisms responsible for the initial proteolytic breach in the

organic enamel matrix would enable us to retain our present eating habits and our useless teeth, which would then become merely organs of sexual selection “ a miss is as good as her smile ” sort of thing. This would be in the tradition of medical science which has always been, it seems to me, less concerned with the achievement of positive health than of repairing or dodging the result of disease.

How we can change our eating habits while great commercial interests are at work, I do not know. We should remember that we are all first citizens and only secondly physicians and dentists. We are not always in our consulting rooms—or shouldn't be. Fluoridation, by making the structure of our teeth more resistant to the ill result of our misuse of them may become a licence to eat what, how, and when we like without merely being worse off dentally. At all events there is a basic contradiction in our accepted methods of dealing with dental disease. We endeavour with our expensive bag of tools and our technical skills to restore our teeth to the structure necessary to eat raw food—just as though we were going to eat it. In fact the structure of our dental apparatus needs only ability to deal with stewed fruit, mashed potatoes and minced meat—food that melts in your mouth! The gum pads of the toothless infant are sufficient for that kind of food. Why bother to repair our teeth to enable them to eat raw beef? The fact that we lose our teeth and survive means that we can do without them. Ultimately we have to make up our minds whether we want to keep teeth or not. If we want to keep them, if only for aesthetic reasons, the only way is to use them.

II

Fluorides in Diet

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In the subject of fluorides and nutrition, the main fact to be borne in mind is the wide distribution and ubiquity of the element over the earth's surface. It is constantly present as fluoride in soil and plants and water, but scattered and not uniform in amount. Now recognized as a minor trace element, the universal occurrence of fluorine in

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