Occasional papers on the prevention of some common diseases in childhood / by J. Sim Wallace.

THE PREVENTION OF COMMON DISEASES IN CHILDHOOD

OCCASIONAL PAPERS

ON THE

PREVENTION OF SOME COMMON DISEASES IN CHILDHOOD

BY

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PREFACE

The following papers appeared originally in various medical and dental journals, and thus the support which one should have given to another was no doubt lost. Nevertheless, the views have gained a certain currency; and with regard to the theory and practice of dietetics as advanced, it may be said that they are now not only widely accepted, but even belauded. Thus, in a recent article on "Diet in Childhood," it was stated that "in the last few years the diet of children has been entirely reconsidered. Much of the traditional feeding has been rejected, and in its place a carefully thought out dietary based on scientific principles has been established." It may be said, in general, that both medical and dental journals uphold, more or less vigorously, the teachings on diet referred to. It must be observed, however, as it evidently is by the editorial staff of medical journals, that many medical men—even, indeed, the majority of those who have recently been writing books on children's diseases—are quite unconscious of the new views. Since the subject was brought forward more especially in dental journals and books, this is not very surprising. It is with the hope that such writers and others may at least be induced to recon-

sider the evidence on which many of their dictates are based that I venture to republish these few papers. It is most important from the point of view of the honour of the medical profession as well as for the welfare of humanity that if the views brought forward are correct, the writers and teachers in the profession should not be last to advocate them. There seems already to be evidence of impatience with those who have not yet taken up the new views. In a recent review it was contended that the future of the nation's health depended on a recognition of the principles advocated, and therein it was said: "For some time to come the main barrier to reform will be the medical schools and textbooks. . . . If the medical profession refuses to initate reform, the public must take the matter into its own hands."

Inasmuch as it may certainly be estimated that 20 per cent. of the diseases of children would easily be prevented—indeed, it is quite frequently asserted that over 50 per cent. of such diseases would be avoided by preventing so-called "oral sepsis" alone—the subject would appear to be of more than ordinary importance, and worthy of the attention of all who are responsible for the health and welfare of children.

J. SIM WALLACE.

150, Harley Street, W.,
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"Dr. Sim Wallace has been engaged for some years past in a highly important work, by drawing attention to the means of dealing with caries of the teeth of children, and the crusade against the disease on which he has embarked will, no doubt, be productive of the happiest results, if only it helps to wake up the authorities in this country, as it has already done to some extent, to a thorough appreciation of the fact that, at least to a very great degree, caries is a preventable disease" ("A Review of the History of Dental Caries," by J. H. Mummery, Annual Report of the Royal Dental Hospital, 1911, p. 94).

CHAPTER I

DIET IN INFANCY AND CHILDHOOD*

It is but a few years since the diseases of the teeth were supposed to result from hereditary and constitutional causes. Dietetic considerations were hardly thought of, except in so far as they might be presumed in some vague way to cause structural deficiencies or perverted functions. Thus Mr. Tomes says: "There can be no question that the tendency to caries, whether induced by structural deficiencies or perverted functions, is strongly inherited; so strongly, indeed, that sometimes as the several children of the parent successively arrive at a certain age, the corresponding teeth will become decayed."

"This inherited tendency would appear to come often from one side only; thus, I am acquainted with two families in which the children by a first marriage have conspicuously good teeth, whilst those by a second have equally conspicuously bad ones. In both instances the mothers of the second families had lost all their teeth at a comparatively early age."

You will observe from this quotation that Mr. Tomes does not even take into consideration the fact that the

* Read before the Annual General Meeting of the British Dental Association in Belfast, June 6, 1908.

mothers of the second families may have brought up their families differently as far as diet was concerned. But we cannot blame him for this, as the dietetic factor was overlooked by all writers on the subject, except, as I have said, in so far as diet was supposed to have a constitutional influence on the teeth and oral secretions. It was well known that the fermentation of carbohydrates or mixed foods gave rise to decay, but why in one case the teeth remained healthy and in another case they were riddled with dental caries was an unsolved mystery. Moreover, the dental profession scarcely ventured to suspect a system of dietary which had been introduced by the medical profession. We, in awe and reverence for the physicians, accepted their edicts and scarcely dreamed that the system of diet which they advocated with such confidence and authority might indeed be by far the most important factor in bringing about the wholesale and lamentable destruction of children's teeth. We might, indeed, have continued to believe in the wisdom of their system, and have thought that the evil results followed through ignoring their commands, if we had found any marked superiority in the teeth of medical men's children; but alas, the opposite has seemed to be the case. I am not sure but that it was probably a recognition of these facts which led the Executive of the British Dental Association to invite me to read a paper on "Diet in Infancy and Childhood"; for the fact that diet has an important and direct effect on the teeth is beginning to be recognized by dentists in this country at least, and it is being impressed upon us more and more that we, too, have something to say on

diet, not only because of dental caries, but also from the point of view of other diet diseases which are so much in evidence and react so markedly upon the development, the arrangement, and the general well-being of the teeth. Mr. F. J. Colyer, a few months ago, referring to this subject, outlined a scheme of diet in accord with the principles to be referred to, and said that if such were adopted he believed that from 75 to 80 per cent. of dental diseases would be prevented. I believe his estimate is essentially correct, although considering the perfect results which have been obtained in those cases where the system has already been tried, we might reasonably put the percentage still higher.

Now let us approach our subject more closely. We have first to discuss the diet of infancy, but on this I shall be brief, because we are all unanimous on the subject. The diet of the toothless infant should be mother's milk, and until we degenerate to the level of reptiles or amphibians it will remain so. The substitution of other kinds of milk and all means to secure a perfect substitute is a hopeless pursuit of the unattainable. Although apparently good results may be obtained in a multitude of cases when care and science guide our efforts, yet, compared with results from mother's milk, they are failures on the whole, and an inexorable law is operative which leads to a proportionally greater extermination of the bottle-fed, and thus concomitantly to the extermination of prospective mothers born from those who have not fulfilled their maternal functions. It is but tinkering with the subject to establish the most perfect cow's-milk supply possible.

It is expensive, and will always remain inadequate. It is misdirecting attention which should be given to investigating the causes which eventuated in the decreased supply of mother's milk. It is not my intention at present to enter into the question of how the environment of mothers and prospective mothers could be ameliorated, so that in reference to the performance of the most important physiological functions, the civilized woman might equal, if not excel, the performance of these same functions by the ignorant savage. One thing I will say, however, until the crack of doom—the most humble mother would under reasonable circumstances be able to perform her maternal functions more perfectly than the most enlightened municipality which ever did or ever will control the milk-supply. We as dentists, however, need not be unduly concerned that environment and social customs cannot be changed all at once, even if we knew how best to do so ; for as regards the children's temporary teeth at least, they are so fully formed before birth that infant malfeeding has little serious effect, and when these teeth erupt they are but rarely seen to be defective.

The next stage to which we must direct our attention is one of transition—transition on the one hand from the toothless infant to the child with a complete set of temporary teeth, and on the other from the milk diet to the solid and varied diet for which the child's teeth and alimentary canal are so admirably adapted. This period of transition is most important. It will be remembered that " while the child starts life edentulous, and gradually acquires teeth, other parts of the alimentary tract in the

healthy subject undergo concordant changes."* Now, for the first six or nine months of a child's life it has been accustomed to extracting liquid from the mother's breast, and through all the ages of man's evolution nothing was mixed with this milk. When, with increasing age and concomitant changes, the first article of food was presented to the child, it was given at a different time from the sucking of the milk. I think it must be obvious that in a state of Nature it was utterly impossible to soak food in milk in order to effect the transition from mother's milk to the ordinary foods of children and adults. Moreover, there is no precedent which could in any way be interpreted as justifying the method of transition from milk to solid food which has been so universally adopted by the medical profession. I shall exemplify how the transition from milk to solid food is recommended by a few extracts from a recent authoritative textbook published "to aid the young practitioner" of medicine. As far as this is concerned, the author, it will be granted, is strictly orthodox. After nine months, he says, "Dilution of the milk is not necessary. . . . Some solid food may be added in the shape of boiled bread, or porridge, or pudding. These additions must be small in quantity at first." Then when the child is twelve months old, he says, "The porridge may be made thicker and of coarser oatmeal. A little potato and gravy or half an egg may be given once a day. Soft bread and butter or dripping may be taken." Pap

* Tomes, "Dental Surgery," fourth edition, who says, further: "Dr. West, in his valuable work, 'Diseases of Infancy and Childhood,' has brought together many facts which bear upon this subject."

feeding, such as is exemplified in the above, never existed in the evolution of man or animal. I intend to limit your attention to bread soaked in milk, for it illustrates the pap-feeding principle as well as anything else, and it is the most generally recommended food for infants who are beginning to be allowed something solid in addition to milk. Now, what happens when an infant hitherto accustomed to milk is given bread well soaked in milk? The first noticeable effect is that the infant gulps down the milk-soaked bread-and-milk without any attempt at retaining it in the mouth or mixing it with saliva. The starchy matter in the bread is therefore washed into the stomach without any insalivation, without any conversion of the starch, and without any preparation for digestion in the stomach. The physiological effect which the retention and mastication or gnawing of food in the mouth produces is practically lost, and the flow of digestive juices in the stomach is correspondingly lessened. The palate is cheated, for large amounts of carbohydrates are washed rapidly past it, and instead of appreciating the amount of converted starch, or rather of unconverted starch, which the child has consumed, it craves for more of that very substance of which it has already consumed too much, in other words, it develops an abnormal craving for sugar. Further, by becoming habituated to swallowing solid food, it soon loses that automatic mechanism which arrests solid food in the mouth till it has become liquefied and prepared for deglutition. If the child coughs, chokes, and splutters, can we be surprised? If the mother, seeing this, still further is inclined to pulverize, mince, boil, and

soak every particle of food before giving it to the child, can we wonder? To pound, scrape, pulverize, and mince food is not forbidden by the medical profession; in fact, it is strongly advocated and encouraged.

At a later stage, say about the thirteenth month, when the first temporary molars have taken their positions, what happens when the child is restricted to this soft diet? The previous troubles continue and the teeth get dirty and tender from want of use; later they become carious and the tenderness increases, while for the same reasons mastication is not performed, and so oral sepsis and other troubles resulting therefrom become more or less thoroughly established. The child is pronounced constitutionally or hereditarily delicate to soothe the feelings of the anxious mother, and to avert all trouble in investigating real and preventable causes.

But it may be asked, why, then, has the milk-soaked diet been brought into existence? Well, I have no doubt it is because milk was considered the most excellent food for children, but it was found that cow's milk, when it was given to children undiluted, formed large clots in the stomach, and thence consequently led to various intestinal troubles. This did not dissuade those in authoritative positions from holding to their guns and still advocating undiluted milk. No, they said, soak bread in the milk so that the clots will be broken up. And if there is choking and spluttering, see that it is thoroughly soft and well broken up before the child gets it. If the child does not thrive, blame the mother for not *teaching* the child to masticate its food. Imagine teaching a child to perform a complex

physiological function before it has seen a couple of summers! Imagine attempting to teach a child to masticate bread-crumbs or porridge boiled and well soaked in milk!

Now, why should we not take a hint from Nature? Mother's milk when the child reaches nine months or a year does not become more solid, rather the reverse. Suppose we give cow's milk, why should we make it less diluted than it was before, seeing that the time is beginning to approach when the child will and can eat solid food and drink liquid water? The child has been accustomed for all the months it has existed to have its mother's nipple in its mouth (or an artificial substitute), and from this it has been able to express or suck liquid food. When it is determined to give the child solid food, why not let it get a solid piece into its mouth? In other words, why not let it have half a slice of bread, or, better, perhaps, toasted bread and butter? No doubt the child feels that toast and butter is not its mother's breast, and it certainly subjects the toast to the influence of its teeth. It gnaws it and sucks it; the gnawing induces a flow of saliva, and the ptyalin converts the starch. The child continues to suck much as it sucked its mother's breast, and its palate appreciates that it is actually sucking liquid out of the solid toast. Gradually the toast disappears, practically in the form of liquid down the child's throat, thoroughly prepared for further digestion in the stomach. Before the fourteenth month, or at least before the first temporary molars erupt, true mastication, of course, is not performed. It is gnawing which is indulged in, and it certainly is in-

dulged in by all children. Should they not be given the chance to gnaw solid food, they will pick up the pieces of stuff they find on the floor and gnaw and suck them instead, unless they are supplied with a "comforter," which is perhaps nearly as bad and generally quite as dirty. After the child has had its toast to supplement its milk diet, say twice a day for a month or two, then other things may be added, such as rusks and milk puddings made sufficiently solid, and as there is not an excess of albumin in the milk (it having been diluted), boiled fish and chicken* may be given in small amounts.

I have had some little experience of this method of feeding infants, and I can say most unhesitatingly that coughing, choking, or spluttering, has been conspicuous only by its total absence. But this is not all, the desire for hard food remains. The teeth do not become tender nor the mouth dirty nor the teeth carious. The palate is not cheated, and the desire for excess of food or sweets does not exist. The alimentary canal performs its functions in a natural and healthy manner, and by the age of two and a half, when it has its full set of temporary teeth, the child can and may be allowed to eat practically any food which adults habitually swallow.

Before going further, I must ask you to forgive me passing over the subject so quickly. I am, of course, conscious of omitting a great deal.

With regard to the diet of children after they have

* It is not necessary to give the chicken with a bone from which the child may gnaw the flesh, although it may amuse the parent and the child to keep rather strictly to what may be regarded as a primitive method.

their twenty temporary teeth, I will say but little. The principles on which it is based, however, are the result of careful inquiry, experience, and a study of the evolution of man and his diet, together with a recognition of the needs of civilized life.

It should consist of three meals daily, and nothing between meals except water when desired.

It should contain a sufficiency of solid food of a consistency which will stimulate the pleasurable activity of efficient mastication so as to prevent the child acquiring the habit of bolting its food. Different ways of doing this will no doubt suggest themselves, but perhaps the simplest way is to have toast, baked bread, or crusty bread rolls, instead of plain bread or porridge.*

Lastly, the meal should be *arranged* physiologically. All that I will say on this point, however, is that the meal must not terminate with concentrated and easily fermentable carbohydrates which lodge or stick about the teeth. Thus, therefore, no meal should end with bread and marmalade or jam, nor should it end with sweet milk puddings or foods with a large amount of sugar. If these things are eaten they must be followed by fresh fruit, and

* A curious belief seems to be prevalent. It is supposed that toast is "reducing" and not nutritious. Probably this belief has resulted from the well-known Banting system of reducing fat. It should be recognized, however, that wholesome food, especially when it demands efficient mastication, tends to restore the constitution to the normal weight. It is probably on this account, to a certain extent at least, that thin children usually increase considerably in weight when put on toast and the hard-food system generally, provided, of course, that they have some few functional teeth left.

of all the fresh fruits which clean the mouth and teeth, the apple is the best.

You will see from the above that after the child has twenty teeth I advocate practically no restriction in diet. All that is required is a recognition of the best custom and instincts. And this is but little more than to observe the necessity of having method in the arrangement of the meal. For a healthy child any special restriction in quantity or relative proportion of proteid is as a rule useless, if not harmful. Suppose we were able to know the exact quantity which is best for any particular child, and suppose we weighed it. Suppose we did not let the child choose the relative amount of proteid, carbohydrate, fat, etc., but had it all scientifically measured beforehand. Would the child be any better or happier for the care bestowed upon it? I doubt it. I do not know the origin of the attractiveness of the unimportant; and notwithstanding its prominence in recent investigations, my belief is that the exact number of ounces which should be consumed is of quite second-rate importance to the recognition of those conditions which eventuate in a pathological craving for an excessive amount. And here let me again refer to sugar. I have tried to indicate how the pathological craving for excess of sugar results from restricting the diet to pap. It may be that in this particular case, however, there may be other good reasons for limiting the amount which children may be allowed. For except in quite exceptional cases sugar is not found in Nature concentrated or *en masse*, but appears almost always as a flavouring highly diluted and associated with

vegetable acids, cellulose, etc. That in such forms it is altogether desirable I have no doubt. But sweets, jams, marmalade, etc., are, as it were, new articles of diet, and if, as appears, their effect on the alimentary canal is as harmful as it is in the mouth, then surely there is justification for limiting the amount. It may be said that according to a similar argument over-eating must always have been controlled to a certain extent in a state of Nature by the difficulty in procuring food. This probably applies to adults, and when work is absent over-eating does no doubt step in; but in the case of children there is a difference, for their ceaseless activity is their work, and the supply of food to them has always been proportional to the exertions of the parents rather than to their own. The only work that has been demanded of children throughout the ages, which has been proportional to the amount of food consumed, has been the work of masticating it. The modern pap-fed child, however, most generally has his food masticated, as it were, for him, often predigested in part, pepsined, and pancreatized. Recognizing the advances of medicine and the value of animal secretions, recognizing also that undiluted starch plays an important rôle in the causation of dyspepsia, how long will it be before tough ptyalin "tabloids" will be introduced procured from the mouths of State-inspected pigs under strict medical supervision?

It may be asked, what do physicians think about our system? Well, some take up a non-committal attitude.* Others, like Dr. H. Campbell and Dr. Stewart Tidy,

* Leading article, *Medical Press*, August, 1904.

advocate it strongly. Even those who were certainly not enthusiastic when they first wrote upon the subject have come to uphold it and to recommend it not only in the prevention of disease, but also in the treatment. Thus Dr. G. A. Sutherland, in his recent work on the "Treatment of Disease in Children," when dealing with the treatment of abdominal tuberculosis, says: "The natural tendency is to put such cases on a 'sloppy' diet, milk, bread-and-milk, and pudding. Experience has shown that this is the worst possible form of treatment." I must frankly admit, however, that most physicians have yet to learn how ludicrous and unscientific their graduated pap system really is. Moreover, the rank and file of the medical profession know nothing about the hard-food system of feeding children, and would perhaps be thunderstruck to hear that the "scientific pap system" which *they* were taught, could ever be questioned. But we must remember that it has been difficult to reach the ears of physicians, for although we scan what is written in medical journals, few physicians trouble to read a dental journal. In fact, I have never heard of a single medical man sufficiently interested in the teeth to subscribe to a dental magazine. Moreover, it is not our lot to be able to speak from positions of eminence and authority. Professorships do not exist for members of our profession, and influential positions are conspicuous by their absence. We must therefore rely solely on the marshalling of our facts, the force of our arguments, and the overwhelming importance of our cause.

Gentlemen, the main trend of modern dietetics has of

late years been sickly and artificial, and if we can form an opinion of its general effect by the results which we see on children's teeth, then indeed it has been disastrous; for from 95 to 100 per cent. of children at the age of five or six have diseased teeth, and the average number of decayed teeth in each child's mouth at that age is about nine. (And this, be it remarked, in spite of general hygienic improvement and the fact that among the better classes at least the tooth-brush has been much more frequently used than it formerly was.)

Now, we have a mission to perform; it may be difficult, it may be gigantic, but it must and shall be done. First, we have got to show the medical profession the wholesale ruin of the teeth with concomitant and resulting diseases. Whether they admit that it was their system which was the cause or not, we must at least get them to realize that they are *very largely responsible* for the state of the teeth as we find them to-day. If they can devise a system which will excel that which we have referred to, let them do so. If they see error in it, let them criticize. We have always been willing to listen to the medical profession; we honour it for its achievements in the past, and rely assuredly on the fact that its authority can and will effect the necessary changes for the prevention of almost unlimited and unnecessary suffering.

Then we shall have to work to undermine the power of those who, taking up the erroneous teaching of the past, are spending millions annually in foisting their products and their seductive literature on an unduly trusting public. Much more which will suggest itself has to be

done. One thing, however, is certain. Great things can be done by the dental profession. Sir William Osler has said that if he were asked to say whether more physical deterioration were produced by alcohol or defective teeth, he should unhesitatingly say defective teeth. This is, I believe, the opinion of those who have studied the question, and however difficult it may be to prevent alcoholism, fortunately, defective teeth may usually be easily prevented. But even if we are only able to reduce dental and correlated diseases among children by 50 per cent. during the next twenty years, more good may thus be done, and more suffering averted, than has resulted from the triumph of antiseptic surgery. For whereas the teeth are at present a trouble and sometimes a very real pain almost from the cradle to the grave, and while these troubles are common to almost all, and the more remote results both frequent and serious, the benefits of antiseptic surgery are fortunately limited to rare occasions in life. However this may be, there is a field in the prevention of the diseases of the teeth which promises a most fruitful harvest. We have all had a liberal education, and may be trusted not to wander into the realms of faddism. We have all got patients to see daily, and therefore will not be inclined to let our theories be uncontrolled by a recognition of facts. Indeed, all we have to do is to apply ourselves with persistent and unflinching determination, and some day the results of our work will inevitably follow.

CHAPTER II

OBSERVATIONS ON THE DIETARIES IN BOYS' AND GIRLS' SCHOOLS, WITH SPECIAL REFERENCE TO THE TEETH*

Of all branches of preventive medicine none seem to hold out better prospects for our activities than an investigation of those physiological principles which are concerned with the maintenance of the mouth in a healthy state. For the mouth is *par excellence* the entrance portal of disease. It is, moreover, the first part of the alimentary canal, which when deranged may so profoundly injure the various parts of the system.

Now, however well adapted the mouth may be to perform its functions when in a state of health, it does not follow that it can do so when mutilated or diseased. That the general condition of the mouth, and more especially of the teeth, is very unsatisfactory in this country, no one questions. We have now definite statistics, and it appears that at the age of six, when children enter upon school life, something closely approaching 100 per cent. are suffering from decayed teeth. When the temporary teeth are replaced by the second set, a new start is

* Paper read before the Buxton Congress of the Royal Institute of Public Health, 1908.

given, for the teeth always erupt free from caries. But even the "permanent" set rapidly commences to decay, so that at the age of fourteen the number of children who are free from dental caries is less than 15 per cent., and even this small percentage gradually decreases, so that not more than 5 per cent. of adults have a perfect set of teeth. And as dental caries is increasing, we can only shudder while contemplating what the teeth of the children of the present day may be like when they reach adult life, if the present conditions continue.

When we consider this state of affairs, we see that there is ample room for our energies in preventing dental disease. We may realize, indeed, that if the nation would only employ or even encourage those who have investigated this subject and are able to disseminate the knowledge requisite for the prevention of dental disease, hundreds of thousands of teeth would be saved annually, a vast amount of suffering arising from the diseased teeth themselves would be averted, an enormous amount of correlated and consequent diseases would be prevented, and millions of pounds would be saved which at present are spent on attempting to restore the teeth to a state of health. It may be asked, however, do we possess the requisite knowledge for this Utopian transformation? I say emphatically, we do; and it is my conviction that dental caries is one of those diseases that can be most surely and easily prevented.

Not many years ago it was supposed that dental caries was a constitutional disease and markedly hereditary. When these ideas were prevalent, it seemed practically

hopeless to attempt to prevent the disease, but now that it is known to be entirely, or almost entirely, the result of unphysiological dietaries we see that the possibility of preventing the disease is relatively a simple problem. About a dozen or more years ago various considerations led me to suspect that unphysiological diet was at the root of the widespread prevalence of dental caries, and consequently for years I paid careful attention to the nature of the diet when the teeth were perfect or nearly so, and I also paid careful attention to the nature of the diet when the teeth were attacked by dental caries in a marked degree. The result of this was to show that what I came to recognize as dietetic error, was, to all intents and purposes, the cause of the dental caries. Moreover, since discovering the nature of these dietetic errors, it has become my lot to apply the knowledge gained in preventing the disease, and in all cases where the principles, which I shall mention later, have been recognized in the dietaries of young children, not one single case of dental caries has been observed, even though in two cases at least neither tooth-brush nor antiseptics of any kind were used. I omitted the use of the tooth-brush and antiseptics in one case under my direct control partly because this method of preserving the teeth has proved to be hopelessly insufficient, partly because it is a difficult and troublesome method with children, and partly because I had absolute confidence from my previous investigations that the teeth would keep clean and free from disease without any artificial aid, when the necessary dietetic considerations were recognized.

Now, before alluding to actual dietaries, it will be well

to refer briefly to certain points in oral hygiene, for in this you will see, in part at least, the justification upon which our criticism of the dietaries of children rests. And however simple it may be to arrange the dietaries in such a way as to secure physiological cleanliness of the mouth, it is highly desirable to recognize the main features of the normal and natural processes by which physiological cleanliness is maintained, however complex these processes may be. For convenience in description we may consider the processes under different headings, although they are more or less intimately associated and dependent upon each other.

Firstly, we have the *mechanical* process. This depends, to a great extent, on the physical consistency of the food. When the food is of a firm and somewhat fibrillar consistency, it stimulates the pleasurable activity of efficient mastication. The teeth and gums are rubbed and scoured, particles of food are dislodged from the teeth, expressed from the bolus of food, sucked or pressed back towards the pharynx, and swallowed. In other words, food of such a consistency has a detergent effect. Highly refined or "short" and soft food has, on the contrary, a different effect when taken into the mouth; it is simply crushed or squashed into the crevices of the teeth, and if it is at all of a sticky nature it remains impacted there. Bread and jam and cake may be taken as examples of such foods which tend to lodge about the teeth.

Secondly, we have the *chemico-physiological* process. Food, when taken into the mouth, stimulates a flow of saliva, and carbohydrate food, especially if slightly acid

and firm in consistency, stimulates the secretion of saliva rich in ptyalin. The mastication helps to incorporate the ptyalin in the food, and the solid starch becomes converted into soluble sugar, which is ultimately swallowed in a liquid, or nearly liquid, form. This is, of course, the natural method of treating carbohydrate food, and, in passing, it may be said, the physiological method of leaving the mouth free from carbohydrates at the end of a meal. It should be remembered, however, that much sugar hampers the action of the ptyalin.

Thirdly, we have the *hydrodynamical* process. With each act of mastication, the saliva is mixed with the food, forced in certain directions between and about the teeth, between the food shreds, and ultimately it, together with dissolved and suspended particles, is swallowed. We may note here, again, that if the food is soft or pappy, this hydrodynamical process is practically lost, as such foods do not stimulate efficient mastication.

Lastly, we have a *saprophytic* or *bacterial* process. In the whole history of man or animal, the mouth has never been an aseptic cavity, and the bacterial flora of the mouth seems to play an important part in its hygiene. There is no pepsin or other ferment in the mouth which can digest or liquefy the various albuminous shreds which are apt to lodge between the teeth. But there are many of the mouth bacteria which have this power. In fact, these bacteria digest and liquefy the albuminous shreds which lodge about the teeth, and so allow of their dissolution. They give rise to a continual disintegration and removal of food particles, and tend to keep the teeth clean at those

very situations which are not kept clean by the natural friction of the food, tongue, and lips. I do not say that all the bacteria which may be in the mouth are beneficial, for even some of those which have the power of liquefying albuminous matter have also the power of producing acid when the lodging food particles are of a starchy or sugary nature. The strictly liquefying mouth bacteria, however, seem to be quite innocuous to the teeth, and if the dietary is arranged physiologically, these beneficial mouth bacteria are favoured; while, on the other hand, the harmful—the acid-forming—bacteria are, in my opinion at least, prevented from proliferating. It appears that, when acid forming bacteria produce a certain amount of acid, this acid itself arrests their further growth. Thus, therefore, weak acids in foods may be presumed to have a like effect on the acid-forming bacteria.

These being the most important factors in oral hygiene, we may now refer to the dietaries of school children. It must be evident that, on the whole, the dietary should be of a consistency demanding or stimulating efficient mastication. In other words, porridge and milk, milk-puddings, soft white bread, and things of this sort, should not form a great part of the meal. As bread forms a considerable part of school-children's meals, the easiest way to insure a reasonable amount of hardness is to substitute crisp toast, or baked bread, or crusty bread rolls, for the plain white bread. It is, however, of little consequence *how* the meal is made sufficiently hard to stimulate mastication so long as it is done. I need not say more on the necessity of insisting upon this point; for whether oral hygiene,

digestion in the mouth, or digestion in the stomach is considered, the necessity for food which demands efficient mastication is obvious.

The next point to which I would refer is the necessity to have the meal *arranged*. It is not a matter of indifference whether we eat in the orthodox arrangement or in the reverse order. There are good physiological reasons for the arrangement of the meal, as custom so generally prescribes. I do not intend, however, to go into this in detail. I only wish to mention that in a well-organized repast, dessert always follows sweets. This is done, not because physiologists say it is right, but I think it is because sweets leave a sticky or clammy feeling about the mouth, while fresh fruit leaves a clean and refreshing flavour. Over and above this, fresh fruit not only makes the mouth feel clean, it actually does clean the mouth, as will be seen if you refer to the essential requirements of oral hygiene.

Now, I wish you to bear in mind these two points: The necessity for food which demands efficient mastication; and, secondly, the necessity for finishing the meal in such a way that the mouth will be left physiologically clean. Then I wish you to consider actual dietaries such as are usually found in boys' and girls' schools at the present day. You will, I think, see that they frequently violate one or more of the physiological requirements we have referred to. For example, at boys' and girls' schools the following is quite a common breakfast: Porridge and milk, an egg, bread and marmalade, and milk, tea or coffee. On the whole, this meal is distinctly too soft, and

on that account would rather discourage efficient mastication and simply stimulate swallowing the food. On this account the detergent effect which should accompany the mastication of food is lost, the food is not properly insalivated and prepared for passage into the stomach. Moreover, it may be presumed also that the stomach is not properly prepared for the reception of the food, for the mastication of the food has a physiological effect on the secretion of the gastric juice. Secondly, the meal being finished with bread and marmalade, the action of the saliva is hampered by the presence of concentrated sugar, and the sticky or lodgable nature of the food tends to establish all the requisite conditions for the destruction of the teeth. It may be asked what would we advise rather than the breakfast which we have criticized. Well, a typical, somewhat similar and yet satisfactory breakfast would be: Bacon or bacon and egg, baked or toasted bread, fresh fruit—*e.g.*, a slice of melon, a pear, or an apple —followed by coffee. This might by some be regarded as too much. It is quite easy to reduce it by omitting the bacon or egg, or both. And if for any reason the fresh fruit is not desired, it may possibly be omitted also without harm resulting, provided the tea or coffee is taken *after* the meal and is not excessively sweet.

With regard to the next meal, the luncheon or dinner, I need not say much. The errors are similar to those already referred to in the breakfast, but generally not so pronounced, as it usually includes a piece of meat of some kind, and this, as a rule, stimulates at least a little mastication. Moreover, it is becoming fashionable to provide

toast or baked bread at this meal, and although this probably originates from the fact that people may always be presumed to be suffering more or less from indigestion, still, from whatever motives, we may welcome the change. The midday meal, however, at schools, generally terminates with sweet puddings of some kind or another, and although they may not be so bad as bread and marmalade or jam for leaving the mouth dirty, they certainly are not cleansing, and ought, therefore, to be followed by fresh fruit. With regard to what school children should be given to drink with, or rather after, this meal, I am strongly of opinion that it should be water and not milk. But the reasons for this are numerous, and I have not time to refer to them just now.*

With regard to the last meal of the day; it generally resembles either the breakfast or the lunch, and we need not say much about it. Sometimes it is, however, what we might call a purely vegetarian meal, consisting chiefly of milk or tea, bread-and-butter, jam, scones, and cakes. Now, a meal such as this is particularly objectionable, as you will observe from what we have already said; but being the last meal of the day the harmfulness is augmented by the fact that the mouth has not the chance of being thoroughly cleansed physiologically from the remains of such a meal until the next morning. It has been observed by many dentists that the teeth of vegetarians appear to be subject to rapid decay, and this has been my experience. It is not always so, and it is by no

* This subject is discussed by the author in "The Rôle of Modern Dietetics in the Causation of Disease."

means necessarily so, for a vegetarian meal can be arranged physiologically just as a mixed meal can. If the meal is composed of baked bread and cheese, toast or ship's biscuits and butter, followed by an apple, there will, I assure you, be no reason to expect the slightest harm to result. As a matter of fact, however, the vegetarian meal is most frequently arranged on the bread-and-jam type, and the deplorable results in these cases tend only to bring vegetarianism into disrepute. What has made this most pathetic is that it has been adopted, to my knowledge, by at least one school for physical culture—and perhaps it has been adopted by every school for physical culture for all I know. I do not say that they have no justification for adopting this régime. Elaborate experiments have been made by Professor Chittenden to show that the amount of food, and more especially of proteids consumed, is, as a rule, excessive, and that the dietary standards for those who would be fittest for physical endurance should be rather vegetable than animal. Well, suppose that this is so, would it not have been better to attempt to discover what was the origin of over-eating? For, even supposing that by an effort of will we can reduce the amount of food consumed, would it ultimately be of much use if at the same time the teeth were ruined and the alimentary canal deranged? But surely the root of all the troubles is that the soft food usually consumed does not supply physiological necessities, does not leave the teeth clean, does not stimulate efficient and sufficient mastication, but deranges the physiological reflexes which are the only practical guides to the quality and quantity of food which might

be required by any particular person at any particular time.

As to what may be done between meals I have little to say. Little meals such as biscuits and milk frequently provided, especially in the better-class schools, should not be permitted. If the child's appetite is bad, there is no use in making it worse in this way. Surely Nature's tonic is hunger.

Now, it may be said that these are rather hard and fast rules, and they will be most assuredly broken by boys and girls. To this my reply is, first, that I have repeatedly advocated the system, and have found that children welcome it eagerly, except when the teeth are tender from disease or from prolonged restriction to soft and bland or alkaline foods. In these latter cases, of course, the teeth required first to be put right, and then a graduated change in the system of dietary instituted. Then, secondly, I have to say that the breaking of the rules occasionally, or perhaps even frequently, will do little or no harm so long as the rules remain, and so long as the breaking of the rules does not become a regular and a persistent habit.

On bringing my remarks to a conclusion I should, perhaps, anticipate a criticism which might readily be made. I can well imagine it being said that there has been too much consideration given to the teeth and too little to other things concerned with boys' and girls' dietaries. My reply to this is simply that in a communication such as the present, a great deal must be omitted. I can imagine it being said, also, that I have based my whole argument on the teeth, and on my own solution of

the problem why they decay so rapidly at the present day. No doubt this is the origin of the ideas which I have just presented to you, but an idea must originally arise somehow, and if it did arise from the study of the teeth, that is rather favourable than otherwise. For the diseases of the teeth are definite and visible. There is no mistaking them. The result of disease on the tooth is always recognizable. The amount and nature of dental diseases in past epochs and under different dietetic conditions are, as a rule, relatively easily and certainly ascertained. There is no imagination or Christian Science about dental caries. There is no necessity for considering errors in diagnosis, etc., such as exists in other more or less invisible diseases. In fact, the teeth offer us some of the most definitely ascertainable facts with regard to the pathology of digestion and the science of dietetics. If, therefore, we have taken our clue from the teeth, we are not taking a hint from chimerical suppositions. But over and above this we find that those physicians* and stomatologists† who have recently interested themselves in the subject have strongly endorsed the ideas in their own special spheres, and this much in proportion to their eminence in their own departments. There is, therefore, the greatest hope that the ideas which I have briefly recapitulated may soon be generally recognized, and there is every reason

* H. Campbell, *Treatment*, 1907 ; G. A. Sutherland, "Treatment of Disease in Children," 1907 ; S. Tidney, *Lancet*, December, 1904.

† J. F. Colyer, Dean of the Royal Dental Hospital, Transactions of the Royal Society of Medicine, 1908 ; the late Professor W. D. Miller, *Dental Cosmos*, 1903, 1904 ; E. A. Bogue, M.D., D.D.S., Presidential Address, American Medical Association, June, 1908.

to assume that the results of their application may be as excellent, in general, as they have recently been with regard to the teeth in those few cases where the system has already been adopted. In fact, much more may even be expected, for not only would the diseases of the alimentary canal be greatly reduced, but the predisposition to disease, which is the result of a weak, deranged, and diseased alimentary canal, would be avoided, while the general amelioration resulting from unimpaired nutrition holds out prospects of health, strength, and fitness, which, but a few years ago, would have seemed utterly visionary.

CHAPTER III

MAIN LINES OF REFORM IN FEEDING AT PUBLIC, SECONDARY, AND PRIVATE SCHOOLS*

URGENCY OF THE QUESTION.—It is safe to say that reform in the methods of feeding both at public and private schools in general is an urgent necessity. In his recent annual report the chief medical officer of the Board of Education, Sir George Newman, writes: "There are few questions of greater moment calling for the attention of the health and education authorities of this country than this one of diet, both in relation to teeth and to the general nutrition of the child. The problem concerns both the most suitable forms of food and the best methods of feeding at the different periods of life. A suitable and sufficient diet is one of the most pressing requirements in relation to the national life." And again in the same report he says: "Speaking generally, not more than a few children out of every hundred will be found who fail to bear evidence of present or past dental disease. What, however, is of even greater moment is the fact that probably the majority of school-children suffer more or less serious disability in some form or other, sooner or

* Paper read at the Guildhall Conference on School-Children's Diet, May 13, 1912.

later, from dental decay. Indeed, it is probably true to say that there is no single ailment of school children which is responsible, directly or indirectly, for a larger proportion of the delicacy and disease (including constitutional disease) which is found at every turn to handicap efficiency, both physical and mental." As the truth of these quotations is practically incontrovertible, it is evident that we have to do with a most serious and important question.

Existing Methods.—It is not my intention to dwell on the existing methods of feeding. From several points of view, moreover, there does not seem to be any sufficient reason for advocating change. A general survey of existing methods seems to indicate that the nutritive quality of the food is not at fault in public, secondary, and private schools, except, perhaps, from its being too highly nutritious. Nor can it be said that the digestibility and absorbability of the food leaves much or any room for improvement. These points have been carefully inquired into by medical men and physiologists, and investigations along these lines show us that on these points public, secondary, and private school children are not to be pitied.

A New Principle.—There is a new principle, however, overlooked in the past by physiologists and medical men generally, which is still neglected by most of those in authority at public and private schools. I refer to that most important principle in dietetics which teaches us that the meals should be of such a nature or so arranged that the diets which are recommended shall be such as will

leave the different parts of the alimentary canal in a hygienic state. It is of primary importance that the meals shall be so arranged that the mouth will be in a hygienic state on finishing meals, for if the mouth is left in an unhygienic state at the end of meals the stomach is most liable to be brought into a similar state by the constant swallowing of septic products and by the contamination of foods. Now, this principle has been recognized by many dentists for several years, and more recently the medical profession and especially school medical officers, have endorsed it most enthusiastically.

Classification of Foods.—This principle leads us to divide foods into two classes—namely, those which tend to cling about the teeth and give rise to oral malhygiene, and those which, on the other hand, are cleansing in their nature, thus giving rise to a hygienic state of the mouth and teeth. As, with regard to school-children, it is the foods which stick about the teeth and give rise to decay which are most important, I shall give you a short list of foods which are not cleansing and liable to induce dental caries.

Non-Cleansing Foods.—Farinaceous and sugary foods in general without fibrous element. Examples: Sweet biscuits and cake; bread and marmalade; bread and jam; bread and honey; new bread without crust; bread soaked in milk; milk-puddings; porridge and milk; preserved fruit; chocolates and sweets of all kinds.

Liquids: Cocoa and chocolate.

Now, according to our principle that the meals must be of such a nature that they will leave the mouth in a

hygienic state, it therefore follows that these foods should not be eaten except when followed by food of a cleansing kind.

Cleansing Foods. — The following list indicates the kinds of foods which are cleansing or otherwise antagonistic to the occurrence of decay in teeth :

Fibrous foods generally. Examples : Fish, meat, bacon, poultry, uncooked vegetables, lettuce, cress, radish, celery. Cooked vegetables are as a rule cleansing, but in a less degree than uncooked vegetables.

Stale bread with crust ; toasted bread of all kinds ; twice-baked bread ; pulled bread and cheese.

Savouries : Fresh fruits, especially those requiring mastication (*e.g.*, apples) ; fatty foods (*e.g.*, butter and margarine).

Liquids : Tea, coffee, water, also soups and beef tea.

General Rules.—Certain rules naturally follow a recognition of the fact that some foods tend to leave the mouth dirty, while others tend to clean the mouth and teeth. The following are the more important, at least with regard to children of school age.

1. *Children should always have a considerable amount of the farinaceous food in a form which will stimulate a pleasurable amount of efficient mastication*, and thus promote the normal growth of the jaws and a regular arrangement of the teeth. The albuminous part of their diet should also be presented in a form which will encourage mastication—*e.g.*, boiled fish, meat, and bacon. Milk or milk substitutes should only be allowed in small amounts.

2. The meals should be *arranged* in such a way that if soft, starchy, or sugary food, has been eaten, the mouth and teeth will be cleansed by food of a detergent nature taken immediately after. Thus, therefore, when sweets of any kind—*e.g.*, milk-puddings, jam rolls, cake, sweet biscuits, bread and marmalade or jam—are eaten, *fresh fruit should be eaten afterwards.*

3. *Three meals daily are to be preferred to any greater number*, as the longer the interval the more hygienic is the state of the mouth and stomach, and more perfectly prepared for the reception of a further meal. *Sweets, chocolate, or biscuit and milk should never be eaten between meals or before going to bed.*

When these rules for the prevention of decay in teeth cannot be observed, some attempt should be made, with a small tooth-brush, to clean the crevices of and between the teeth after every unhygienic meal; but as this is *extremely difficult to do effectually* without injuring the teeth or gums, it is advisable to have children, who are brought up in this way, taken regularly to the dentist from the age of three onwards every six months, till the teeth become crowded and irregular; thereafter the visits may require at times to be more frequent until all the natural teeth have been replaced by artificial substitutes.

From certain physiological considerations it is obvious that some foods of a cleansing nature are not suitable for the termination of a meal. We are practically limited to savouries, to pulled bread with cheese and celery, followed by water or some more refreshing drink, preferably slightly acid and aromatic, or to fresh fruit.

Value of Fruit.—Notwithstanding these alternative terminations, it will be found in practice with numbers of children that the best and most suitable termination, and the termination which children most relish, is fresh fruit. Nothing is more conducive to the hygiene of the mouth except, perhaps, raw vegetable foods, so that fresh fruit should practically always form part of the routine dietary of healthy children, and after fresh fruit has terminated the last meal of the day (which should not be taken just before going to bed) nothing should be allowed except water.

Its Part in Dental Hygiene.—Here, perhaps, a word may be said with regard to how fruit is conducive to the hygiene of the mouth. For our purpose we may say that fruit is made up of a fibrous part holding in its meshwork the sweet aromatic and acid juices which are so agreeable to the palate. When fruit is masticated, the more or less liquid part contained in the fibrous meshwork is expressed and swallowed, while the fibrous part is again and again subjected to crushing and disintegration between the teeth. At the end of the process the disintegrated fibrillar mass is practically tasteless. The sweet juices have been swallowed first, while the more fibrillar part has been stimulating mastication, insalivation, and the dislodgment of food particles. The fibrillar part of the fruit may be likened to a mop which, through the influence of the acid and aromatic juices, is able to call forth a copious flow of alkaline saliva, which is forced in all directions about and between the teeth so as to cleanse them thoroughly. Furthermore, when the fibrous remains

are swallowed an afterflow of alkaline saliva completes the further flushing out of the mouth.

Result of Régime.—I am not, of course, advocating an untried régime. It is a régime which has often been followed in the past, perhaps more by good luck than by good guidance, but more probably because those who followed it felt how much cleaner and more pleasant the mouth felt when the meal terminated with dessert than with sweets. Moreover, during the last ten years or more the régime has been followed as a set plan, and the beneficent results as regards preventing decay in teeth and oral malhygiene have been described as "almost wonderful, nay, miraculous to the uninitiated."

A subsidiary effect which has been noticed and thought remarkable is the fact that children brought up under this régime do not show any great craving for sweets. Frequently they refuse them when they are offered, and wasting money at tuck shops is an almost unknown occurrence.

Opinions of Authorities.—Moreover, not only have these rules been followed out in actual practice, but they are recommended with little or no variation by those who lead thought and opinion in the dental and medical professions. They are being taught in a routine way to dental students, for they are expounded in such standard textbooks as Mr. J. F. Colyer's "Dental Surgery and Pathology." Furthermore, he calls attention to an important consideration which is so frequently overlooked, namely, that "we must always keep clearly in mind the necessity of rendering the mouth functional. Unless this

is done, no amount of tooth-brushing work will keep it clean." And generally we may say that the greater the authority the more are these rules appreciated. Thus, Mr. J. H. Mummery says the diet which I advocate "does not depart to any great extent from that adopted by most sensible parents, and should be strictly adhered to."

Tuck Shop.—Now, it is obviously the duty of public and private schools to provide what is right. School meals should be in general above criticism. The school meals should provide for the child's wants and needs, or at least they should provide all that is necessary and desirable. If children go to the tuck shop, either the healthy appetite of the child has not been satisfied by the meals provided, or an unhealthy appetite exists. If the healthy appetite of the child were satisfied, the tuck shop would go out of existence for want of customers. If, however, it be assumed that an unhealthy appetite exists for "tuck," then it is the duty of the school authorities to make sure that the school-children are not allowed to go into a tuck shop—at least with money in their pockets. Possibly you may think that I have given too much consideration to diet in relation to the teeth. If what I have said were in conflict with correct dietetic principles concerned with the general welfare of the child, this might be so.

But the principles which I have been advocating are important, not only because they prevent toothache, oral malhygiene, and the various serious disorders frequently resulting therefrom, but also because it is desirable to follow the rules or principles advocated from quite other considerations.

During the last year or two some school medical officers have made a beginning in promulgating these principles and advocating the food which is requisite by instructing the elementary school teachers in their county and otherwise; but, nevertheless, the urgent and immediate need of the reform at the present time makes this conference of special value. And although the wisdom of teaching school-children about physiology and their digestions is doubtful, it is at least at the present time of the utmost importance that those who are responsible for the arrangement of the school meals should have some considerable knowledge with regard to hygienic food and feeding.

CHAPTER IV

THE "ADDENDUM PRANDII" AND PROFESSIONAL EDUCATION*

Most of us must often have wondered why it is that so many members of the medical profession seem to take so little interest in the hygiene of the mouth. For the mouth is admittedly the great entrance-portal of disease. The natural self-cleansing processes of the mouth are as a rule unknown to them, and instead of aiding these self-cleansing processes, they very frequently advocate procedures which would really appear to have been deliberately invented to ruin the physiological perfection of the mouth at the earliest possible age. We, of course, as dentists see what actually takes place, and are painfully aware of the havoc wrought in children's mouths and teeth at, or even before, the age of six. It has been shown that in some towns in England, where accurate statistics have been taken, that each child has, on the average, about nine carious teeth at this age. It is not possible to say that this results from disobeying the dictates of the medical profession, for it is common knowledge that children

* Read before the Annual General Meeting of the British Dental Association at Birmingham, June 1, 1909.

brought up most carefully according to the régime advocated by the highest authorities in the medical profession, have their teeth equally carious, as a rule, at an even earlier age than those children who have but little care bestowed upon them, and who are allowed to do and eat pretty much what they like. It is not enough to recognize that the system currently advocated will eventuate in the destruction of the teeth and then blame fate or the depravity of the human constitution. Nor is it sufficient to advocate that children should be taken to the dentist every six months. This latter is obviously necessary, and will always remain a wise precaution however much things are improved, but it should be distinctly realized that teeth do not decay except when the dietetic régime has brought the mouth into an unhygienic state, and it should also be recognized that this unhygienic régime should be rectified immediately the dental surgeon has rendered the teeth functional and the mouth potentially self-cleansing, for an unhygienic régime is not only a menace to the teeth but to the child's health in general.

There has of late been an enormous amount of investigation on the subject of the nutritive value of foods. This is, of course, an important subject, at least to those who are on the verge of starvation, but to those who have enough to eat the more important question is, is the food hygienic, is it such as is conducive to health? The nutritive value of a pound of putrid meat may be about as much as the nutritive value of a pound of fresh meat, but from the hygienic point of view it may have a totally different value. So, too, the value of food which lodges and ferments in

the mouth is quite different from food which is digested in the stomach. It is with regard to the hygienic value of certain articles of diet that I intend to speak, because the nutritive value of the food has practically nothing to do with caries of the teeth, even hypoplasia, which occasionally predisposes to caries, results from more or less prolonged and severe constitutional disease, and not from deficiency of the nutritive constituents in the food.

Now, it is obvious that the hygienic state of the mouth, in so far as it depends upon foods, depends more especially on what is taken towards the end of the meal, for it is the food that remains or lodges in the mouth after the meal is over which ferments and causes the disastrous results to the teeth. It is not a matter of indifference, therefore, whether a meal be finished with food which leaves the mouth clean or leaves it dirty. And overlooked though it may have been, some foods do leave the mouth clean and some leave the mouth dirty, or rather do not leave it at all until they have undergone fermentation or putrefaction in the mouth. This is a simple, obvious and important point, and has helped to give rise to a characteristically civilized custom—the custom of having arrangement in the meal. Recent investigations in the physiology of digestion have shown the wisdom of arrangement of the meal as far as digestion is concerned, and it is my intention to show how the further arrangement of the meal which custom prescribes, but which is not yet countenanced by physiologists, is eminently the result of the hygienic requirements of the mouth. We may here refer to the present state of knowledge in the medical profession.

In a recent article on "Post-prandial Habits" in the *Lancet*,* the following observations were made: "As a rule, post-prandial habits do not receive the approval of physiological teaching. Theoretically they are calculated to interfere, and often in practice their indulgence does interfere, with the healthy disposal of the meal. From a purely physiological point of view at all events, the post-prandial habits are superfluous. . . . Post-prandial habits, in short, have their origin in the fact that they are a source of enjoyment, and enjoyment is the chief excuse for their indulgence. . . . To the man who thus, as it is said, 'does himself well,' these things are regarded as the crowning attraction of a good dinner. They are, of course, nothing more than easily acquired habits which, though associated with the meal, have really nothing to do with it regarded as a nutritious mass."

Professor Pawlow, after showing how the ordinary arrangement of the meal is justified physiologically, says: "The usual termination of the repast is also from a physiological standpoint easy to understand. The chief meal is generally ended with something sweet, and everybody knows that sweets are pleasant." †

These extracts indicate the views of medical men and physiologists at the present day; and it will be observed the hygiene of the mouth is completely overlooked. It is quite true that sweets are pleasant, but it is not true that in a well-regulated repast the chief meal ends with sweets. Dessert or fresh fruit always does, or should, follow

* *Lancet*, November 7, 1908.

† Pawlow, "The Work of the Digestive Glands," p. 140.

sweets, because sweets leave the mouth sticky with fermentable carbohydrates, and, moreover, give the mouth a clammy feeling which anyone who is accustomed to having the mouth physiologically clean has a difficulty in tolerating. There are two customs which have arisen no doubt on account of the dirty feeling which results from refined, civilized, and more especially sweet foods. They have both originated independently of scientific teaching. One is the brushing of the teeth after meals. This is frequently done by some savage tribes, and sometimes done by the civilized. The other custom which has arisen among the more highly civilized is what we may call the *addendum prandii*, or the eating and drinking of foods which clean the mouth at the end of the meal.

The question naturally arises, how far this latter custom, which has arisen more or less instinctively, is in accord with the hygienic requirements of the mouth. We know that there are three important processes which in a natural way keep the mouth in a hygienic state. These may be referred to as (1) the mechanical, (2) the chemico-physiological, and (3) the parasitic or saprophytic processes. We know that the mouth is left in an exceedingly unhygienic state after a meal, or rather after a "nutritious mass," ending with sweets, has been consumed. We must now ask if the usual additions to the nutritious mass are useful in washing away such carbohydrates or sweets as are left in the crevices and inaccessible interspaces of the teeth, which even a tooth-brush cannot be made to clean out properly. I have already said that a well-regulated or hygienic repast does not end with sweets,

but that the sweets are properly followed by something of a detergent nature. Firstly, let us direct attention to fresh fruit, which customarily follows sweets. We need not refer to any nutrition which may be found in fruit. This is little in amount and unimportant from the point of view of cleanliness. Fruits, however, invariably contain cellulose in its natural state—that is to say, it is of a somewhat fibrous consistency which, when taken into the mouth, stimulates a pleasurable amount of mastication. This is, of course, an important stimulus to the mechanical self-cleansing of the mouth. Then the fibrous meshwork of the fruit contains the vegetable acids, the sweet juices and the aromatic essences which render the fruits so palatable. Now, when by the act of mastication these various delectable liquids are expressed from the fibrillar mass, the gustatory nerves are stimulated, the mouth is flushed with saliva; in other words, the chemico-physiological self-cleansing processes are stimulated. This, coming at the end of the meal, when the appetite has ceased to be keen and the relish for a nutritious mass is at an end, is highly important. But this is not all, the sweet and aromatic flavours remain in the mouth even after the diluted sugars have been expressed and swallowed, and thus prolong the chemico-physiological self-cleansing processes. The fibrillar part of the fruit which is swallowed last is meanwhile mopping up the particles which have been left about the crevices of the teeth, to be expressed and swallowed after further mastication. Fortunately, too, the aromatic flavours, the vegetable acids, and essential oils in the fruits, leave a taste in the

mouth, giving it a clean and fresh feeling which is but moderately imitated by some of our best mouth-washes, so that after the mastication of fibrous foods, which so dexterously clean the crevices of the teeth, there is a flow of saliva which, as a further precaution, seems to perform the finishing touches of the dental toilet. So much for the mechanical and physiological processes. We must just note again, quite briefly, the effect of fruit on the bacterial or saprophytic process. All fruits are acid, and, as Dr. Miller has shown, "acids and alkalies, especially the former, even in very dilute solution, retard the development of bacteria."* Furthermore, "the growth and ferment activity of bacteria are always more or less influenced by their own waste products."† "The bacteria themselves are often destroyed by the action of the acid which they have produced"; it therefore follows that the acid-forming bacteria more especially are retarded in their growth or destroyed by the acids in fruits, while the alkali-forming bacteria are not correspondingly affected.‡

Now, let us briefly refer to the liquids which sometimes form the whole or, more generally, part of the *addendum prandii*. The liquid most generally consumed after a meal is coffee. This is generally recognized as a pleasant way

* "Micro-organisms of the Human Mouth," p. 12.

† *Ibid.*, p. 14.

‡ When we recognize the nature of the self-cleansing processes of the mouth, it is obvious that some fruits may not stimulate these processes so well as others. It is possible, too, that there may be an exception or exceptions to the rule. Grapes, for example, contain a large amount of fermentable sugar and—presuming, of course, that the skin is not eaten—very little cellulose, such as would stimulate mastication.

of terminating the meal. A cup of coffee after a meal is generally slowly consumed, each mouthful washes away some of the food particles which may be lodging about the teeth, and the aromatic flavour stimulates the salivary secretions which help to clean the mouth. If the meal has not been of a particularly sticky character, and if the teeth are normally arranged, a cup of coffee may be sufficient to make the mouth physiologically clean.

It may be said that *post-prandial* liquids such as I have referred to have certain disadvantages. We may be told that a cup of coffee impedes digestion. Perhaps it may. But what of that? Does it necessarily follow that those who swallow their food quickest digest it best. Does it *necessarily* follow that within limits there is any disadvantage in prolonged digestion in the stomach? Should we always eschew roast beef and potatoes because they take longer to digest than boiled mutton and boiled rice? I scarcely think we should, and like other men we will have our cup of coffee after dinner or after any other meal at which we fancy it. Perhaps we shall have more; we may also have a fairly good hygienic reason for having it. We may take up another line of argument and claim that though coffee does retard the digestion of proteids in the stomach, that it promotes the digestion of the carbohydrates by allowing alkaline digestion of the carbohydrates to be prolonged, for inasmuch as coffee is taken last and stimulates the secretion of saliva, and in so far as it mixes with the carbohydrates taken at the end of the meal, it rather aids their digestion; while the proteid digestion at the pyloric end of the stomach is unimpeded.

I presume you are all aware that the supposed churning motions of the stomach are now regarded as somewhat mythical, and that for an hour or two after a meal the stomach tends to keep the food in the position in which it was introduced, although it has the power of expelling water.

We do not need to pursue this subject further at present. Enough has been said to indicate either that we know nothing about the hygiene of the mouth, or that the medical profession knows nothing or cares nothing about it. Simple methods of dental hygiene, such as the tooth-brush and mouth-washes, seem now to be quite inadequate to prevent the ruinous results of a dietetic system such as is being forced upon the children of the present generation with the most dogmatic assurance. Hardly has a child cut its temporary teeth before it is *restricted* to soft fermentable foods which stultify the natural self-cleansing processes of the mouth. Young children are almost entirely limited to milk, bread soaked in milk, milk-puddings and porridge—all fermentable foods which are non-detergent in their effects—and by the time these children have their temporary dentition complete, the teeth are so tender from lack of use, they naturally refuse to nibble even a crust. What can we do? We are dentists, and as it is supposed that the dietetic régime should be left to the medical profession, it does not seem likely that we shall be able to do much without the co-operation of medical men. And when we have the great authorities paying all their attention to the nutritive value of the food, it is difficult to persuade anyone that lack of oral

hygiene accounts for far more trouble among children than lack of nourishment. Children are supplied with ample nourishment except when depravity has destroyed all parental instincts. The difficulties which parents sometimes find in getting their children to take enough food results, in most cases, from the insanitary condition of the mouth and alimentary canal, and it cannot astonish us that children refuse the nourishment which has brought about this insanitary state. Then, what can be done? We seem all to be completely dammed by the imaginary boundaries of our specialities. But little percolates, and that very slowly from one speciality to another. In the case of dentistry, fortunately the student has the benefit of an acquaintance with the general principles of medicine, surgery, and pathology; but unfortunately the medical student is generally devoid of elementary knowledge with regard to the teeth, oral hygiene, or preventive dentistry. A medical student never learns anything about the diseases of the teeth because he knows that medical students are never examined in these subjects at their examinations. Why should this be? A man should not be a general practitioner if he is grossly ignorant of any important part of the body, much less should he be regarded as duly qualified if he knows nothing about the hygiene of the entrance-portal of disease. A State which recognizes any such man as qualified to practise medicine does not recognize the value of preventive medicine, much less of preventive dentistry. Universities which turn out such men are doing a serious injury to themselves and the public. I know a physician who has

devoted a considerable amount of study to the teeth and mouth, and he now believes that the ordinary physician who has not done so, and who devotes his time and practice to children's diseases, does more harm by the diseases he unconsciously causes than he does good by the diseases which he cures. The Chief Medical Officer to the Educational Department of the London County Council, when commenting on such an elementary matter as the inspection of children's teeth, said: "I doubt if it is quite realized how ignorant doctors are about dental affairs. . . . It comes out very strongly now with our medical inspectors when some of them volunteer for the inspection of teeth. The results of their inspection I have simply suppressed. As far as statistics or any scientific knowledge of the teeth is concerned, I regard the doctors' reports as of no value at all."*

Surely it is obvious that the medical student ought to be taught elementary odontology, or, at the very least, that at all universities there ought to be teachers and classes in the subject which he might attend if he desired. The very absence at medical schools of teachers in this branch tends to make the medical student think the subject is useless or unimportant. But, indeed, there is no more generally useful branch of learning for a young physician in a country practice or even in a fashionable town.

It may be said that we are not as yet competent to teach this branch of medicine. It may be said that we do

* Report, School Dentists' Society, *British Journal of Dental Science*, January 10, 1909.

not really know the cause of caries, that we are not all agreed that caries, pyorrhœa, etc., do result from unhygienic diet, that it may be rather hereditary and constitutional, etc.; but even if this were so, it would only show that in addition to what knowledge we already possess there is need for scientific investigation. The teacher should also be an investigator. Further, because of the complexity and importance of the subject, and the necessarily high scientific attainments of competent teachers in this branch of medicine, he ought to rank with the other teachers in the faculty of medicine. He ought, indeed, to be, and to be recognized as a professor in his subject. He ought, moreover, to be enabled to devote the whole or the greater part of his time to the elucidation of this important subject. This could be done at all universities as it has been done with such excellent results at Berlin and other Continental universities, and as also it has been done more recently at the University of New Zealand. Teaching and investigation always go together. The enthusiastic investigator is a stimulus as well as a guide to his students. But enthusiasm in scientific research is apt to be chilled if, at the same time, there is necessarily an enthusiasm for the fruits of private practice. Moreover, when we are too fully engaged in practice, there is greater temptation to exclusive devotion to perfect ourselves in the art of rectifying the evil results for which our services are sought for and paid, than to keep to the highest ideals and to devote attention to that which would render our art unnecessary. Indeed, if professors in dental science are to be worthy of our profession at all, they must not be merely distinguished

local dentists whose sole aim and ambition is to get some advantage over their fellow-practitioners in private practice. At all events, it is urgently necessary that the rising generation of medical students should have a good opportunity of studying oral hygiene and odontology. Recent events indicate that this is beginning to be recognized in this country. The first dental professorship in any university in England was established last year, and this, be it noted, in a university which grants medical and not dental degrees. The universities which do grant dental degrees are extremely anomalous in that they have no professorships in dental subjects. I wonder what the medical profession would say should a university be started granting medical degrees, but without professorships in medical subjects. Surely the prestige of such a university would be at a discount.

Without further elaboration I think we have now said amply sufficient to indicate how the medical and dental professions might be kept in touch with each other. How those in the dental profession who by their work have attained to eminent positions could be recognized and looked to by the medical profession for guidance, just as we look to those of the medical profession who are in eminent and recognized positions for authoritative knowledge on subjects related to our own speciality ! And instead of appearing in the eyes of the public to be grossly antagonistic in our elementary recommendations, it would be seen that we are both working in co-operation for the benefit of our patients, and still more for the benefit of those who by following our advice would never require to have our services at all.

CHAPTER V

OPEN WINDOWS AND ADENOIDS*

The simplest, most definite, and most important truth which preventive medicine has been teaching during the last few decades has been the value of fresh air. This fact has justified many a monograph dealing with the general amelioration in health which has resulted. Curiously enough, the historical or evolutionary justification of the doctrine has not received the attention that such an important principle demands. I do not intend to attempt to supply this want. At the same time I must allude to it, for it was, paradoxical as it may seem, the consideration of this subject which led me to believe that we are not justified under all circumstances in advocating fresh air without any reserve. Moreover, a consideration of the evolutionary justification gives also a rough guide to the limitations, or rather safeguards, which have to be observed under special circumstances. If we look back at the evolution of man, we see that he is undoubtedly and essentially a fresh air animal. Our relations, the monkeys and the anthropoid apes, are animals which specially indicate an urgent need for fresh air if they are to be kept in perfect health. Their

* Published in the *Medical Press,* April 1, 1908.

arboreal habitat has from all time fitted them for fresh air, and when brought into confinement, as in zoological gardens, the absolute necessity for thorough ventilation in their houses is now recognized. Moreover, like ourselves, the monkey tribe is specially susceptible to succumb to certain diseases which are almost innocuous to such animals as rats and house mice, which may be taken as types of animals not requiring perfect ventilation to keep them in good health. There appears to be one thing, however, in which we differ from our anthropoid relations in respect to habitat. Man is not solely a tropical or subtropical animal. To him almost all regions of the globe are habitable, while anthropoid apes, at least, seem quite incapable of living for any time, even in temperate regions, except when most carefully protected from the inclemency of the weather. So, too, perhaps, it was with man before he became more highly differentiated from these animals, until, indeed, his intelligence, his clothing and housing, such as it originally was, allowed him gradually to live in countries less and less tropical. And although at the present day man is adapted to live in northern climates, yet the essential similarity to our anthropoid ancestors is still to be seen in a heavy mortality from the very disease to which monkeys are susceptible when they are brought to live in these climates. It does not need any argument, indeed, to show that man without house and clothing is not fully adapted for all the climates in which he lives. This applies even more strongly in the case of infants and children, who are unable to stand exposure so well as adults. We are certainly justified in saying that ever since man commenced to depart from his

tropical habitat he must always have had some protection, especially for his children, against the less congenial climates. In other words, a house and clothing became necessities of life. At present I intend to refer only to the house. It was until recently a primitive protection, perhaps, but it had this merit—it was always, with the help of the other primitive comforts obtainable, enough to allow for the continuity of the race. It may have had its faults, it may have been insanitary, it may have been ill-ventilated, especially among cave-dwellers, but, on the whole, its utility justified its existence. Probably many millions have perished on account of the faults of hygiene referred to, and perhaps during the same period man may have become better adapted to his climatic surroundings, although infants and children, which were necessarily kept more strictly under the protection of the house, may not have become so fully adapted.

What is of special importance to note, however, is that the house existed as a protection against certain extremes or kinds of climatic conditions which are inimical to the well-being of the human body. It may here be said that these kinds of climatic conditions to which I refer do not exist in tropical or subtropical regions, so that we as animals had not in our primitive state become adapted to these climatic conditions. It would appear that cold and damp are in general never associated in the tropics. In many tropical localities where the atmosphere is clear, dry, and still at night, radiation is rapid, and very considerable cold may be experienced; but during rainy and damp weather the temperature does not fall to anything like the

same extent. When we consider cold and damp, however, such as, let us say, are exemplified in our fogs from November till March, we begin to see something differing from tropical climatic variations, and are justified in doubting if man is altogether adapted for them.

Now, let us consider what habit and instinct appear to show. It is hardly necessary to refer to the fact that fires are universally used in cold weather, and this in spite of the fact that it is a more expensive method of maintaining heat than by shutting out the air and heaping on clothes. The fire has three attributes to which I would refer. First, it provides warmth; secondly, it ventilates; thirdly, it reduces the humidity of the air. Thus fires are beneficial from all these three points of view. It has not required the advances of science to induce people to put on fires. They instinctively do so. The advances of science have, however, been necessary to induce people to appreciate as thoroughly as they should the benefits of fresh air. But the fresh air doctrine has during the last thirty years been taught with effect, and among the educated classes there are few who do not appreciate it. In fact, it seems to have become a sort of cult, and, notwithstanding the fact that there is an instinctive tendency to shut windows on cold and damp nights, the doctrine of fresh air, winter and summer, has now become part of the educated man's faith. But here is where a protest must be made, not because of the insistence on fresh air, winter and summer, and night and day, but because of the method most commonly employed to secure it. The neglect to prevent the cold and damp from accompanying the fresh air must be regarded

as a serious error. In other words, it is not right to attempt to ventilate a room simply by keeping the windows open if the weather is cold and damp. There are several diseases which the medical profession recognizes to be in some way associated with cold and damp, such as catarrhs and rheumatism, but I only wish to refer to one at present —namely, "adenoids." This disease has apparently increased in frequency with prodigious rapidity in recent years, and, what is certainly very suggestive, its increase seems to have been concomitant with the cult of open windows night and day, summer and winter. Moreover, my observations would appear to indicate that the proportion of children affected with adenoids is distinctly greater among the more educated classes, who are most scrupulously insistent on keeping their windows open at night throughout the year. Children brought up with open windows appear, indeed, to be about fifteen times more likely to contract adenoids than those who sleep with the windows shut on cold and damp nights, or at least than those who sleep with closed windows throughout the greater part of the year. The few figures which I have so far been able to obtain are as follows: Of sixty-nine who slept with closed windows, two cases of adenoids were found, while of forty-nine who slept with open windows at night, winter and summer, twenty-two cases of adenoids were found. *It will be seen from the above that adenoids appear to be confined almost entirely to those children who sleep with open windows;* but, notwithstanding this, it must not be thought that there are no other contributory causes, or that I abandon altogether the other factors connected with clothing, per-

spiration, digestion, and the development of the palatal arch which I have previously referred to elsewhere. It would probably be more satisfactory, therefore, if in the collection of further statistics the relative frequency of adenoids were considered class for class and not one class against another, where the other conditions, such as housing, fires, clothing, etc., may be essentially different.

When we consider the question from the point of view of physiology and pathology, and what is already known with regard to the etiology of adenoids, we find that the same conclusion must be arrived at. The first point we have to note is that cold air, especially when damp, causes a certain amount of congestion and catarrh of the mucous membrane of the nose and naso-pharynx, and although it may be foggy, and on that account specially objectionable to breathe the air directly into the lungs, we tend more than usually to breathe through the mouth. If the stream of cold air is made greater—as, for example, during considerable muscular exertion, then the congestion and simple catarrh is augmented. Those who skate need hardly be reminded of this. Now, if it is conceded that cold and damp air induce congestion and catarrh, then, if continued sufficiently long, it will tend to produce thickening or hypertrophy also. But, in addition to this, it seems undeniable that the specific catarrhal inflammations are more readily contracted when the mucous membrane is congested from irritation by cold and damp air, and therefore tend to increase the hypertrophy.

Referring to acute catarrhal pharyngitis, De Schweinitz and Randal say, "Exposure to cold really means lessened

resistance of the tissue to germ vitality and germ entrance into the substance of the membrane."* And, referring to acute naso-pharyngitis, they say: "Exposure to cold and damp plays the chief exciting rôle. Here also should be borne in mind what has already been said regarding such exposure as related to temporary impairment of tissue vitality.† As occuring in very young patients, we generally find acute naso-pharyngitis associated with more or less enlargement of the pharyngeal tonsil, which in turn may have resulted from repeated attacks of acute rhinitis."

Whether the above considerations are considered valid or not, it is a fact that cold and damp localities are usually recognized as at least a predisposing cause of adenoids, and if the above explanation is correct, then, instead of cold and damp localities rendering the individual susceptible to adenoids in some vague constitutional way, we see that cold and damp localities cause adenoids, from the simple fact that the cold and damp air is the primary exciting cause itself.

Next, when we consider heredity, we read, for example, in Mr. McLeod Yearsley's book on adenoids, that, "although it cannot be positively said to be hereditary, hypertrophy of the pharyngeal tonsil often shows a distinct tendency to affect several members of the same family."‡ This is a significant fact, and indicates, in my opinion, that the mal-environment of certain families tends to produce the disease in each member of the family. If, then, "it is by no

* "Diseases of the Eye, Ear, Nose, and Throat," p. 939.

† *Ibid.*, p. 947.

‡ *Ibid.*, p. 17.

means uncommon experience for the surgeon to have to operate upon two, three, or even four or more in the same family for adenoids,"* and since "this fact has been referred to by nearly every writer of any consequence upon the subject,"* then it surely is evident that there must be a something in the nature of a very definite and direct cause of adenoids in some families, and that this definite and direct cause is absent in other families. That the definite and direct cause is cold and damp night air seems probable. If we consider treatment, a similar conclusion is enforced. Surgical treatment is recognized as being very satisfactory, although recurrence sometimes happens, but medical treatment — notwithstanding the tendency for the hypertrophied tissue to shrink—seems to be attended with very unsatisfactory results. If medical treatment does not recognize the cause, and if such directions are given as "especially should it be insisted upon that the child shall sleep in a room directly open to the outside,"† then, in a climate such as ours in winter, medical treatment will certainly be unsatisfactory.

It was a consideration of several of the above facts that led me to doubt the advisability of open windows at night in cold and damp weather, and it did not surprise me to find that a direct investigation into the relation between open windows at night and adenoids resulted in the figures which I have already given. Although the relationship seems to be unquestionable, yet, having regard for the other

* "Diseases of the Eye, Ear, Nose, and Throat," p. 16.

† *Ibid.*, p. 956.

conditions and predisposing causes, I am of opinion that a more extended investigation will not reveal such a startlingly close relationship, especially in those localities which are (unlike the Thames Valley, to which my figures specially refer) relatively free from cold and damp night air.

CHAPTER VI

ORAL BACTERIA AND ACQUIRED IMMUNITY TO DISEASE

Those bacteriologists who have devoted attention to the mouth have been impressed by the fact that it seems to be remarkably well adapted for the development of micro-organisms. Thus the late Professor W. D. Miller says: "If we compare the life conditions of bacteria . . . with the conditions prevailing in the mouth, it becomes evident that the oral cavity must be an excellent breeding-place for these organisms. It is equally clear that both their number and variety are continually being augmented by new germs which enter with the air, food, and drink."*

The fact that the mouth presents such excellent opportunities for the proliferation even of pathogenic micro-organisms has naturally been looked upon with a certain amount of alarm, for its position at the commencement of the alimentary canal seemed to signal it out as the very cavity of the body which should be kept most scrupulously aseptic. Yet it has been conclusively proved—(1) That even a healthy mouth is never free from micro-organisms; (2) that there are no secretions of the mouth which have

* "Micro-organisms of the Human Mouth," p. 68.

any appreciable antiseptic or bactericidal effect; (3) that the cleansing of the buccal cavity results from the detergent action of food, drink, and saliva; and (4) that the natural cleansing of the buccal cavity (or the removal of the bacteria and their products) is practically invariably accomplished by swallowing, or removing the bacteria and their products into the stomach. This all seems very dreadful and dangerous, but, on the other hand, we know, as a matter of fact, that, notwithstanding these conditions, disease does not normally supervene. The tissues of the mouth are particularly well able to resist the invasion of micro-organisms, and the stomach has the power to digest and kill the great majority of the bacteria which enter it, so that even although minute numbers of bacteria do gain entrance, disease does not result, because the tissues and the blood have a certain power of resisting the invasion of pathogenic micro-organisms. Disease only supervenes when the invading parasites overcome the natural defensive arrangements of the body.

"The first line of defence of the body resides, in all probability, in the epithelial tissues which oppose the entrance of infective agents into the body." "It clearly must be a local power residing in the epithelial cells themselves, or on the fixed cells on which they are situated, rather than any general condition, such as the presence of opsonins in the blood."* It is a somewhat significant fact that the tissues of the mouth are the most resistant to the

* Sir Watson Cheyne, "The Defensive Arrangements of the Body as Illustrated by the Incidence of Disease in Children and Adults" (Wightman Lecture, 1908).

invasion of micro-organisms. Even a severe injury—*e.g.*, the extraction of a tooth, which, indeed, is little less than a compound fracture, is very rarely followed by the invasion of pathogenic micro-organisms beyond the seat of injury. The walls of the stomach may not be so resistant to micro-organisms, but the stomach has the special power of digesting the bacteria, so that invasion through the stomach or alimentary canal seldom takes place, and even though some few bacteria should escape being digested, they would but rarely, in a state of health, at least, induce disease, because the tissues are not nearly so likely to be affected by small doses as by large ones.

Without going into further detail, I think the above facts indicate that the entrance of disease via the mouth is very well combated in a state of health. Yet, when disease does supervene, it undoubtedly does so in many cases by way of the mouth and alimentary canal. This may in some cases result from a specially large or virulent dose of pathogenic micro-organisms, but more generally it may be supposed to result from diminished resisting power of the body resulting from injury, cold, starvation, or irritants, which diminish the local resisting powers. A question naturally arises, however. Do the bacteria and their products which are normally swallowed produce any further immunity to the diseases which might, and occasionally do, supervene when the natural resistive powers are temporarily lowered from any cause? We know that the injection of vaccines under certain conditions renders the blood more immune to corresponding diseases. We know also that a similar immunity can be

gained by swallowing the vaccines.* We are therefore led to believe that the bacteria and their products which are produced in the mouth may tend to establish a similar immunity under normal and healthy conditions, provided the dose be not unduly large.

If this be so, it would help to explain why ubiquitous pathogenic micro-organisms are, as a rule, innocuous, except in specially large doses or under exceptional conditions. It would also seem to explain why epidemic diseases claim so many victims, for if they are but rarely present there is little or no acquired immunity to the diseases. When we remember, too, how certain races are so severely attacked when a new disease is introduced into their land, we are probably justified in suspecting that those races had not acquired the immunization which other races had to these diseases. It seems possible that a gradual immunization even to epidemic diseases may at times result from the harbouring of some of the disease germs in the mouth, and consequently from swallowing a certain number of them together with their toxins. Now, although there is no doubt an inherent difference in the susceptibilities of different individuals to certain diseases, it is probable that the more marked differences result more especially from acquired immunization. It would be difficult otherwise to explain why a disease such as measles should have been so very deadly when first introduced to the natives of the Polynesian Islands, and within a generation have ceased to be nearly so deadly in its effects. It is not sufficient to say that the susceptible

* A. Latham, Trans. Roy. Soc. Med., 1908.

were weeded out and that a relatively insusceptible race has evolved. A type is remarkably persistent, and the extinction of even large numbers in *one* generation will hardly produce any pronounced difference in any characteristic. It is much more probable that some individuals became immunized by having had the disease, others (the supposed insusceptibles) became immunized by way of the mouth, and their offspring became more or less immunized by way of the placenta. If vaccines can immunize by being injected or swallowed, there is no reason to doubt that the fœtus may be immunized through the placenta. I think we are justified in saying that, in addition to inherent immunity, we also derive immunity from the environment in which we live; in early life through the placenta, later through mother's milk, and lastly through the lodging of micro-organisms in the mouth and the swallowing of their toxins.

Possibly toxins may be like some poisons: in small doses they may be beneficial, and the system may, as it were, become hardened to them.

It is not to be presumed that these facts or arguments would in any way justify us in introducing *living* pathogenic micro-organisms into the mouth even in minute quantities. For, although living micro-organisms seem to be absolutely necessary* in the alimentary canal, the introduction of pathogenic micro-organisms would be a very dangerous procedure in our present state of knowledge. Yet a hypothesis such as I indicate might help us to explain the immunity which some people seem to enjoy

* Halliburton's "Physiology," p. 510.

even when the mouth is in a most septic state. Mr. K. Goadby seems to believe in such an hypothesis; thus he says it is "possible that the property of natural immunity to many diseases is the expression of a gradually developed tolerance to the attacks of micro-organisms evolved over long periods of time, and produced in a manner analogous to artificial immunization."*

If we do not believe in a theory of acquired immunity such as I have tried to indicate, we would require to believe in each individual having a definite and hereditarily fixed amount of immunity, except in those cases where vaccination or disease had increased the natural amount. It would surely, however, be somewhat anomalous to conclude that the reaction to vaccines is not analogous to some natural process. Furthermore, it should be remembered that man is an animal having the power to adapt himself to almost any environment. It would, again, be anomalous to assume that in the matter of disease he was not capable of adaptation without the actual extermination of multitudes of his kind. At least, it seems to me more reasonable to conclude that he can gradually acquire immunity to ubiquitous diseases, and I would suggest that it is by means of the bacterial flora of the mouth, as indicated, that this comes about.

If the truth of the foregoing be granted, we see the extreme importance of a healthy, functional, and physiologically clean mouth. It will readily be granted that a healthy mouth may be competent to deal with dangerous micro-organisms, but we shall not be so ready to admit

* "Mycology of the Mouth," p. 80.

this beneficent rôle when the mouth is dirty and fermenting after ill-chosen and ill-arranged meals, poisoned from carious cavities and suppurating gums, and functionless even in regard to the simple act of mastication and the insalivation of food in the mouth.

CHAPTER VII

SOME OBSERVATIONS ON THE PREVENTION OF TUBERCULOSIS*

GENERALLY speaking, the healthy individual is an asset to the community, while the diseased is liable to be a burden. It would, therefore, seem to be to the advantage of the community to *prevent* disease. The treatment of disease is often quite a different matter. Once a disease, such as tuberculosis, effects an entry into the system, not only may the individual be completely incapacitated for work, but *curing* the disease is problematical, even with the aid of lavish expenditure. The extreme tenacity with which disease germs keep hold of their host once they have gained an entrance into it was well brought out in a recent address by Sir Hector Cameron,† but this fact is well known, and further reference to it is unnecessary here.

In days gone past the difficulty of expense in treatment was no doubt got over by the victim of such diseases entering an early grave; but it being impossible to countenance such a course of events now, we must consider whether it would not be profitable to direct more attention

* Published in the *Lancet*, January 6, 1912.

† "The Persistence of Disease Germs in the Human Body," *British Medical Journal*, 1911, vol. i., p. 973.

to prevention. It is particularly necessary to do so because the incubus of taxation for the treatment of tuberculosis and other diseases probably is a fruitful cause of tuberculosis and many other diseases.

There are two principal ways in which tuberculosis may be prevented: (1) The environment of the individual may be kept free, relatively at least, from germs which are liable to cause the disease; (2) the individual may be kept sufficiently healthy to resist the effective entrance of disease germs. That the first method is important, especially in the more infectious diseases, is, of course, recognized. In the case of tuberculosis it is not so obvious, but that it is so is noticeable when the question is gone into completely.* I do not intend, however, to deal with this part of the subject. It is to the possibility of more effectually keeping the body sufficiently fit to be able to resist the tubercle bacilli that I intend to direct attention, because the recommendations about to be made are as yet relatively unknown.

The two chief routes of entry of the tubercle bacilli into the system appear to be via the alimentary canal and the faucial and pharyngeal tonsils. With regard to entrance via the alimentary canal, we know that *in a healthy state* entrance in this way is hardly to be expected, and, as a matter of fact, though all people must swallow living tubercle bacilli many times during their life—perhaps, indeed, many times during each day—yet the tubercle bacilli do not by any means always gain effective entrance into the system.

* Newsholme, "Prevention of Tuberculosis."

In the past—attention being directed exclusively to the consideration of the nutritive values, the number of calories, the rapidity of digestion, the assimilability of the food, etc.—no real consideration seems to have been given to a most important, perhaps the most important, principle in dietetics—viz., the principle which claims that the meals should be so arranged that the mouth and alimentary canal shall be left in a hygienic state at the end of each meal.

With regard to the mouth, it may be said that but few could indicate with the slightest degree of accuracy the nature of the foods which tend to leave the mouth in a hygienic state. Yet this is the beginning of the trouble; for if the mouth is, generally speaking, in an unhygienic state after meals—as it, indeed, very generally is—then what chance has the stomach and alimentary canal to be free from injury from the constant swallowing of septic matter, polluted food, or decomposing food remains? Furthermore, if the mouth is left in an unhygienic state, what chance have the teeth of remaining free from caries or the gums from being injured between the teeth by the more or less constant lodgment of fermenting food?

We now know that dental diseases are in general neither hereditary nor constitutional, but that they are the result of habitual dietetic error. The dietetic error which brings on dental troubles has little or nothing to do with the question as to whether the food is nutritious or not. The point of importance is whether the food leaves the mouth in a hygienic state at the end of the meal or otherwise. It is not my intention to consider which foods

are cleansing to the mouth and teeth and which are not. Here it must simply suffice to say that those physicians who have really considered the subject now recognize that soft milk-soaked foods do not keep the mouth in a hygienic state, and, moreover, some note the probability that these foods are neither directly nor indirectly conducive to the hygiene of the alimentary canal. Thus, Dr. G. A. Sutherland, when referring to the preventive treatment of tubercular peritonitis, says that "*the real risk lies in an unhealthy condition of the alimentary canal, which may allow the penetration of the bacilli.*" He urges the wisdom of a type of diet requiring mastication such as would tend to keep the alimentary canal in a healthy state, and comments on the feeding of children with tubercular tendencies on "a sloppy diet—milk, bread-and-milk, and pudding." He says: "Experience has shown that this is the worst possible form of treatment."*

Further comment on the system of feeding which keeps the mouth and alimentary canal in an unhygienic state is not necessary. It behoves those who would lend a helping hand in the prevention of tuberculosis to become acquainted with the more recent views on diet from the point of view of oral and alimentary hygiene, lest they may help to continue "the worst possible" system of feeding children.

The other important mode of entry of the tubercle bacilli is via the pharyngeal and faucial tonsils when these are in a diseased state. This is, perhaps, the commonest way in which these micro-organisms enter the system. An

* "The Treatment of Disease in Children," p. 110.

interesting investigation of Dr. A. Osborne* shows how very constantly diseased lymphatic glands are associated with pathological hypertrophy of the pharyngeal and faucial tonsils. That "infecting organisms may obtain access more readily by way of enlarged tonsils and adenoids than through the healthy nose and throat" can hardly be doubted. It is consequently of great importance in the prevention of tuberculosis that the causes of adenoids and enlarged tonsils should be recognized and combated.

It is not my intention to enter into the question of causation fully; all that I would do at present is to recall the well-known fact that adenoids are more frequent in cold and damp localities, and in a short investigation which I made a few years ago it transpired that of forty-nine children who were brought up on the open-window principle in all weathers (whether cold and damp or otherwise), twenty-two of these children developed adenoids to such an extent that they had to be operated on; while, on the other hand, of sixty-nine children of a similar class, who had been brought up with the windows of their bedrooms shut at night, only two cases of adenoids were noted.

It may here be observed that the liability to catarrhal troubles of the naso-pharynx, or at least to adenoids, resulting from a strict adherence to the open-window system of ventilation in cold and damp nights is generally admitted now by those few laryngologists who have been persuaded to look into this subject. And it might be

* *British Medical Journal*, January 14, 1911.

well also to say that those medical men who still advocate the open window at night, in all weathers and under all circumstances, should bring forward statistics to justify their recommendations. At present, as regards adenoids, there do not seem to be any statistics whatever to justify the attitude which they take up; and, moreover, the fact that during recent years pneumonia has come to account for a greater number of deaths than any other disease whatsoever indicates most emphatically that care should be exercised before recommending or enforcing a procedure having no statistical evidence to support it, which is contra-indicated both by instinct and by reason.

But recognizing that there is difference of opinion on this important point, it is evident that we must have this question as to the causation of adenoids definitely settled. It is a very easy investigation for those who have the opportunity of seeing numerous school-children. It does not require a laboratory or expensive equipment, and yet this simple investigation will, I have no doubt, prove to the medical world—as it has done to those who have already looked into the subject—that adenoids are easily preventable in nine cases out of ten. There are, of course, other cogent reasons for insisting on the elucidation of the causation of adenoids. The sequelæ are often disastrous when the patient lives; moreover, the operation for the removal is not always productive of very satisfactory results as regards breathing, while the risk of death during or immediately after the operation is fairly well recognized.

Now, if we recognize the fact that there has been a

general diminution in tuberculosis due to cheap food, better housing, smaller families, and improved sanitation, we must also recognize that increased taxation, for the sake of State *treatment*, leaves less money for the individual to spend on food, clothing, medical attendance and proper housing accommodation.

Only a few hundreds of those treated in sanatoriums are physically rehabilitated so that they become useful members of the community; on the other hand, there are tens of thousands, nay, several millions, who can ill afford the money required by the tax-gatherers. There is, indeed, but a mere handful the taxation of whom would be beneficial for themselves and the community. Nor is it evident that, even though taxation were limited to the rich, the tax would not ultimately really fall upon those who could not afford it without denying themselves the comforts which are conducive to health.

It must not be thought, moreover, that it is only the very poor who would feel the pinch. Here, for example, are some statistics culled from a report by Dr. Leslie Mackenzie and Captain Foster, published by the Scottish Education Department:

Boys from five to eighteen years of age living in—	4-roomed houses weigh on the average	64·3 lbs.
	3- ,, ,, ,, ,, ,,	60·6 ,,
	2- ,, ,, ,, ,, ,,	56·1 ,,
	1- ,, ,, ,, ,, ,,	52·6 ,,

The average difference in weight of boys living in one-, two-, three-, and four-roomed houses is roughly four pounds for each additional room, and the height of such boys is correspondingly more for each additional room. We find

that a boy living in a one-room tenement is 4·7 inches shorter and 11·7 pounds lighter than one from a four-roomed house.* It is evident, therefore, that it is not only those who live in a one-, two-, or even three-roomed house who will suffer from increased taxation for the treatment of disease. Statistics similarly show that tuberculosis is more prevalent the smaller and more overcrowded the house.

The most rational, economical, and just system is for the State to do what seems necessary to prevent disease; everyone would participate in the benefit. The expense of the treatment of the individual should fall on the individual or those responsible. Of course, as a matter of charity the individual sufferer would in the future, as in the past, be liberally aided by those who voluntarily contribute for the relief of suffering, even though such suffering be the result of his own negligence or misdeeds.

Another aspect of the subject demands the most careful consideration. It would appear that there was a marked decrease in the mortality from phthisis from 1850 to 1894, since which time it has ceased to decrease so rapidly, or, to put it in Professor Karl Pearson's words:

"*The death-rate from phthisis during our period of sup-*

* It would appear that these statistics are subject to a little correction. Dr. David Heron, writing from the Galton Eugenics Laboratory, informed me that "in getting the averages boys of all ages were lumped together. When correction is made for age, instead of boys from one-roomed houses being 11·7 pounds lighter and 4·7 inches smaller than boys from four-roomed houses, these differences become 5·5 pounds and 2·4 inches."

posed greatest knowledge, and during the time of our most-active campaign against tuberculosis, has ceased to be reduced at the old rate. There is actually a slackening in the rate of fall. Increased knowledge and increased medical activity have not been associated with that acceleration in the fall of the phthisical death-rate which we should have anticipated."

Professor Pearson's *statistics* must be considered, and the sooner the better. They seem to me to emphasize the points which I have drawn attention to at the beginning of this paper. We need not be disheartened by his *inferences*; for by overlooking the fact that age and environment bring about a certain immunity to tuberculosis he has obviously been led into error.

Professor Pearson's charts, however, showing the rapid decline in mortality until recent years are worthy of consideration. To many they will be startling, but there is, indeed, nothing very surprising in them to those who recognize that the welfare of children has been most seriously compromised by the current unhygienic system of feeding them, together with the unhygienic state of the mouth and alimentary canal which has resulted therefrom. Still less will his statistics cause surprise among those who recognize also that adenoids and diseased tonsils are common roads of entrance for the tubercle bacilli.

Let us, however, leave out of account considerations with regard to the causation of adenoids, upon which subject there is still marked difference of opinion. Let us consider solely the fact that about 40 per cent. of

children suffer from "extensive and injurious decay of teeth,"* and that dental caries "must be considered as an outward and visible sign of methods of living which produce other and still greater harm."†

Surely, when we consider such facts it is obvious that if the medical profession would help in the costless campaign against such methods of living, which cause such disastrous results, it would confer an even greater benefaction on humanity than it has as yet been able to do, for if instead of advocating the "worst possible" it were to introduce the hygienic — the obviously physiologically correct system—an untold amount of suffering and disease would assuredly be prevented.

* Sir George Newman, Report of the Chief Medical Officer of Board of Education.

† "The Prevention of Dental Caries," James Wheatley, M.D. Lond., D.P.H., School Medical Officer, Salop County Council.

CHAPTER VIII

OBSERVATIONS ON THE PREVENTION OF DENTAL CARIES *

When your hon. secretary wrote asking me to read a paper before the Society of Medical Officers of Health, I naturally felt much honoured, because medical officers of health generally know much more about the prevention of disease than those who are engaged in treating it. Moreover, medical men are not always anxious to hear the views of a dentist on subjects which may be regarded as medical rather than dental. Not so many years ago I complained of the difficulty of bringing this subject before medical men, because they did not seem to care to listen to what a dentist had to say on dietetics, while they appeared to think that the teeth were the concern of the dentist and no special concern of theirs.

The subject which your hon. secretary chose for me was what he called "my own" subject—namely the prevention of dental caries. For several years the theory of prevention which I am going to talk about might appropriately enough have been referred to as "my own,"

* A paper, with additions, read before the Home Counties Branch of the Society of Medical Officers of Health at their meeting on March 21, 1912.

for during that time I was but a voice calling in the wilderness; but of recent years this has been completely changed, and now practically the whole of the influential part of the dental profession hold views similar, if not identical, to mine. Moreover, investigations by others have amplified and verified the evidence upon which the theory was based.

It is not my intention to enter into a full exposition of the methods of preventing dental caries. I only want to refer to some points of special importance and to try to elicit from you, in the discussion which follows, what improvements or what theoretical or practical objections you, as medical officers of health, may have to the methods suggested.

A point of fundamental importance and interest to you is, no doubt, the question whether dental caries is essentially hereditary and practically unpreventable, or whether it is essentially not hereditary and consequently preventable. Until recently it was assumed that caries was practically inevitable with the great majority of people even though they brushed their teeth diligently. That the brushing the teeth might do a considerable amount of good was indeed hoped for, but it never became very markedly evident. Advice with regard to brushing the teeth was conjoined—cynically or otherwise—with the advice to visit the dentist every six months, for it was recognized that with many people, brush as they will, the teeth would decay. The easy and at one time apparently obvious explanation of this was that the hereditary or constitutional susceptibility of the teeth to decay was the

dominant factor in the causation of the disease; and, not having the key to the true solution of the problem, the everyday facts which dentists met practically compelled them to accept the hereditary and constitutional explanation. The fact that the children of parents with very carious teeth almost invariably had more carious teeth than the children of parents with more or less perfect teeth, led the dental profession and the public to believe that the hereditary predisposition was so strong that the idea of being able to prevent the disease in those hereditarily predisposed was held to be practically untenable. Furthermore, there was little known or even conjectured, from the pathology of the disease, to account for its increasing prevalence, and the hereditary degeneracy of the teeth seemed undeniable. Further, it was said that "in spite of Tome's classic definition of dental caries, and in spite of the researches of Underwood, Miller, Black, Leon Williams, and others, we can no more tell why one mouth is immune and another riddled with caries than we could before their investigations were made." * Profitable investigations on the prevention of dental caries was indeed almost paralyzed by the views on the hereditary nature of the disease then prevalent. On quite other lines, however, the advance of knowledge came to point in other and more profitable directions. The Neo-Darwinians had shown that acquired characters were not transmitted, and thus to them the idea of the hereditary degeneracy of

* Editorial, *British Journal of Dental Science,* November 1, 1905.

the teeth collapsed. By chance it happened that I was brought up in the Neo-Darwinian school, and I became an enthusiastic disciple of the new ideas with regard to heredity. At that time, now some twenty years ago, the pathology of dental caries had been definitely established, and keeping that in mind I commenced to try to formulate some theory which might account for the prevalence of the disease. This was rather a difficult thing to do, although it all seems so simple now. It is remarkably easy to see something when we know where it is or are shown it, and so very difficult to see the same thing when we do not know where to look for it and know not where it is. After about ten years groping, chiefly in the dark, however, I was able to formulate a theory * in which I contended that the solution of the mystery as to the causation of dental caries was simply errors in diet, and this is now generally admitted. The reason for the apparent hereditary predisposition was shown to be almost entirely due to the fact that dietetic habits ran in families. Those with good teeth had good teeth because of their good dietetic habits, those with bad teeth had bad teeth because of their bad dietetic habits; and, moreover, the badness of the teeth engendered even worse habits, because food of a fibrous nature such as fresh fruit and vegetables which are so cleansing to the teeth and antagonistic to caries, cannot be eaten comfortably when the teeth are decayed. We see in this, too, an explanation of why it was actually believed by many that bad teeth seemed to be "inherited with greater certainty than good teeth."

* "The Cause and Prevention of Decay in Teeth," 1900.

But as we now know that it is certain types of food which tend to keep the mouth physiologically clean and prevent caries, and other types of food, which tend to lodge and undergo acid fermentation in the crevices of the teeth, which cause caries, we are able to claim that dental caries is essentially a preventable disease. It is impossible here to go into the evidence for coming to these conclusions. But in order to appreciate the principles of the prevention of caries satisfactorily, it is important to know the cause of the disease. This was the subject of much discussion in the past, but since it has been very fully elucidated, it is not now at all difficult to grasp. Briefly the steps in the elucidation of dental caries were as follows: Firstly, it was proved that micro-organisms were essential. Secondly, it was shown that fermentable carbohydrates were also necessary, for without carbohydrates acid was not produced. Thirdly, it was shown that the carbohydrates and micro-organisms must be located at the spot where caries commences. Micro-organisms adherent to tooth surfaces without carbohydrates do not cause caries, nor do carbohydrates lodging on an enamel surface cause caries if the micro-organisms have been removed from that surface. Fourthly, the located mass—*i.e.*, micro-organisms and carbohydrate—must be of such a nature, or so related or located, or so covered by some impermeable substance that the acid formed does not diffuse rapidly in the saliva, or that the saliva does not penetrate the mass easily. We may say, therefore, that the cause of dental caries is the undue lodgment of plaques of acid-forming micro-organisms together with fermentable carbohydrates,

when the acid formed is protected from the action of the saliva by the impermeability of the mass.

The recognition of the cause of caries makes us able to indicate the kinds of meals which tend to keep the teeth free from caries on the one hand, and those which, on the other, tend to induce the disease. And in proof of the correctitude of these indications clinical and statistical evidence has been brought forward which shows that the types of meals indicated actually do produce the expected effects. We may first give the types of meals which prevent dental caries:

Breakfast.—Fish, bacon, toast and butter, followed by coffee or tea.

Luncheon.—Meat or poultry, potatoes, salad, baked bread, pudding, fresh fruit, water.

Supper.—Rusks, toast, or bread rolls and butter, chicken or fish, an apple, tea or coffee or water. Secondly, we may outline the kind of meals which induce dental caries.

Breakfast.—Porridge and milk, bread and marmalade. Then perhaps a supplementary breakfast a few hours after of a glass of milk and a sweet biscuit.

Luncheon.—Mashed potatoes and gravy, or minced meat, milk and pudding.

Supper.—Bread soaked in milk, or bread and jam, cocoa and cake, and a supplementary supper on going to bed of a glass of milk and a biscuit, or just "a tiny piece of chocolate."

Certain rules naturally follow this conception of the causation and prevention of dental caries:

1. *During the first two and a half years of life all*

starchy or sugary food (except milk) *should be given in a firm or fibrous form*, so as to stimulate mastication and insalivation, and thus to promote the healthy growth of the jaws and the regular arrangement of the teeth. Bread, rusks, or any other farinaceous food, should never be added to or soaked in milk. Bread with crust (and butter), toasted bread (and butter), should form a considerable part of the solid part of the meals habitually given to children of this age. As the infant passes from the milk diet to the more solid diet the milk should be more and more diluted with water. During this period also the solid food should be eaten first and the milk and water taken after.

2. The food in later life must be of such a nature that it will insure a hygienic state of the mouth and teeth and not induce disease.

3. The meals must be arranged in such a way that no fermentable carbohydrate food will lodge unduly about the teeth; consequently, although any kind of food may be eaten as part of the meal, the last part at least must be of a cleansing nature—*e.g.*, fresh fruit.

4. Sweets or other food liable to lodge about the teeth and undergo acid fermentation should not be eaten between meals nor before going to bed.

Objections have been raised to certain points in these recommendations. It has been said that the régime is either expensive or unkind, for children must either have fruit, which is expensive, or they must be denied sweets and foods containing much sugar, such as jam and marmalade. A good meal may cost more than a bad one, but the rich might be reminded that the fees paid in visits to the

dentist would go a long way in buying a barrel of apples. The poor, who cannnot afford fruit or other edible raw vegetable foodstuff suitable for the termination of a meal, are obliged to live largely on bread, as this is the cheapest food obtainable. Bread, however, contains an excess of carbohydrate, so that it would be poor economy to spend money on sweets or jam when the crying need of the child is protein, fat, and fresh vegetable juices. Considerable attention has of late been given to the question of sweets in childhood,* and although certain laboratory experiments would indicate that cooked starch was more harmful to the teeth than sugar, yet clinical and statistical evidence indicates that sugar is the greatest offender. I explained this by drawing attention to the fact that in addition to fermentation leading to the production of acid, sugar undergoes a mannitic and gummy fermentation, and thus prevents the saliva from clearing it out of the mouth or neutralizing the acid formed. Moreover, sugar is itself viscous, and at body temperature is not so very soluble as might be thought. In fact sweets—*e.g.*, chocolate—may be actually seen in the deeper crevices more than an hour after they have been eaten; probably it could be seen much longer if chocolate were given just before the child went to bed. It has been suggested by Dr. Black† that a glutinous deposit from the saliva may cover over the micro-organisms and thus prevent the acid which they form from being washed away by the saliva. Possibly this is so, although I think that the flow of mucus and

* *British Medical Journal*, 1911-12.

† "Operative Dentistry," vol. i., p. 137.

saliva which is stimulated would rather help than hinder the washing away of the sugar. However this may be, the fact remains that sugar does lodge and undergo an acid and a viscous fermentation in the crevices of and between the teeth, and thus leads to dental caries.

Another objection has been made to advocating fruit at the end of meals. It has been said that foods which contain acid tend to decalcify the enamel and to render the teeth liable to become carious. I came to suspect the validity of the objection to fruit and vegetables in regard to this from a consideration of the nature of the food of our simian ancestors.* Moreover, clinical and statistical evidence showed that such foods were beneficial as regards the teeth, and I suggested the following explanation, which is now pretty freely accepted: "When acid is taken into the mouth not only is the saliva stimulated directly, but the acid which reaches the stomach stimulates the flow of saliva also. . . . The importance of what we may call the after-flow of saliva can hardly be doubted; for the frequent swallowing which it causes after meals is a most potent factor in the self-cleansing of the mouth."† . . . "Professor Pawlow says: 'It is apparent that acidity enjoys a special preference in the human taste' ('The Work of the Digestive Glands,' p. 141). This beneficent preference is beneficent for the teeth also; in fact, there is no doubt in my mind that one of the chief causes of the extreme prevalence of caries in children may

* "The Rôle of Modern Dietetics in the Causation of Disease," p. 8.

† "Supplementary Essays on the Cause and Prevention of Dental Caries," p. 33.

be attributed to the bland alkaline milk-soaked diet which they are compelled against their will to subsist upon."* Furthermore, mucus "clings to the surfaces with which it comes in contact, and thus, besides deglutition, it coats the teeth when they are not subjected to friction, and being of an albuminous nature it does not induce the acid-forming bacteria to proliferate, while if the food is acid it becomes insoluble and forms a more or less impassable barrier for the acid."†

I shall now indicate briefly the general acceptance which these views have gained.

Mr. J. F. Colyer, formerly Dean of the Royal Dental Hospital, and author of the most widely read textbook on dental surgery and pathology, expresses his conviction that dental caries is a preventable disease. He advocates lines of prevention very similar to those just indicated. I need hardly say that he did not come to do so without a thorough investigation of the various grounds on which the method was based. He, like others, recognized that "the acceptance or non-acceptance of the doctrine of the inheritance of acquired characteristics profoundly alters our conception of disease," and, referring to my criticisms of the views which used to be dominant in our speciality, he said: "These criticisms made us think, with the result that our views on the inheritance of bad teeth, crowded arches, and so forth, have greatly changed. We have examined the problem from a broad point of view, and we, too, find

* "Supplementary Essays on the Cause and Prevention of Dental Caries," p. 77.

† *Ibid.*, p. 40.

that much we considered as due to heredity is in reality 'similarity of environment'—a view which does give us some hope that the problems of disease confronting us are not insurmountable."*

The following quotation from Mr. Colyer's book on dental surgery and pathology will indicate what dental students are now taught on this subject:

"In discussing the cause of caries, attention was drawn to certain matters which appear to have a special bearing on the increase of caries—namely, the feeding in infancy, and the character of the foodstuffs, etc. A consideration of these seems to indicate that preventive treatment should be based somewhat on the following lines:

"(*a*) The insistence when possible of breast-feeding.

"(*b*) The use in early years of life of foodstuffs which require efficient mastication.

"(*c*) The use of carbohydrates which are not easily fermentable.

"The use of such *foodstuffs* as call for some effort in mastication is important, and 'pap' food should, as far as possible, be carefully avoided. A very little experience of children will demonstrate the importance of this point. Bread soaked in milk is bolted, while bread given in the shape of a crust or a piece of toast is chewed, simply because the chewing is physiologically necessary. For similar reasons, meat, when given, should be cut in strips and not minced. Mastication promotes a healthy flow of saliva, and the saliva assists in cleansing the teeth

* "Recent Views on Heredity and Variations," *Dental Record*, January 1, 1908.

"There is little doubt that of the carbohydrate foods, the sugars are the most harmful, especially when taken between meals. '*Sweets*,' *as popularly understood, should be forbidden.* As carbohydrates are now known to be the source from which the lactic acid is derived, it is advisable so to arrange a meal that the last foodstuff taken is neither a sugar nor a starch. A meal should, if possible, finish with fruit or cheese. Fruit is especially beneficial, as it is slightly acid and stimulates the saliva. Meals should be given at regular intervals. If the salivary secretion is constantly being stimulated by incessant 'nibbling' at food it is probably robbed of its physiological properties, and the supply required for the regular meals is depleted and probably altered in character."

I need not refer to the artificial methods which Mr. Colyer regards as of secondary importance.

Another eminent dental surgeon, Mr. J. H. Gibbs, F.R.C.S., L.D.S., and Examiner Royal College of Surgeons of Edinburgh, said: "The causation of dental caries was known, and it was also known how by very simple dietetic measures the amount of caries could be reduced to very small and almost negligible proportions. The only feasible way of attacking the problem of dental caries in the children of the masses was by prevention, and the cost would be trifling and the educational value enormous. One of the great obstacles to progress along this line was the ignorance, apathy, and even opposition of so many general medical practitioners. One had only to glance at any orthodox book on dietetics to see that the whole teaching was calculated to the production not only of

dental caries, but of gastro-intestinal and other disturbances. Naturally one could not expect the average general practitioner to be more enlightened than the dietetic specialist, but one must recognize the fact that until medical men discard the suppositions upon which the present teaching of dietetics are based, dental caries and many other children's ailments would flourish."*

Next I shall quote from Dr. Harry Campbell, who, among physicians, and therefore from a different point of view, has done so much to add to our knowledge and to help forward the cause by his writings on mastication and the evolution of man's diet. He is a most enthusiastic supporter of the new views, and believes that we have it in our power to rear a race with just as perfect teeth as those of our primitive ancestors were. As it is important that every medical man should have a far more complete knowledge of the subject than I can give you now, and as I should very much like you all to get a copy of a little book I have recently published on the prevention of dental caries to facilitate this end, I shall quote a statement recently made by Dr. Campbell. He said: "In regard to the question of sweets in childhood, I share Dr. Sim Wallace's views entirely. It would be difficult to exaggerate the importance of his work in showing the connection between faulty dietetics and dental disease. I estimate that among the inhabitants of these islands there are upwards of two hundred million carious teeth and as many alveolar abscesses. By following the simple rules

* *Lancet*, June 15, 1912.

laid down by Dr. Wallace, both these diseases can be almost entirely prevented."

Some medical officers of health have for some time recognized the grave importance of the subject; thus, Dr. James Wheatley has been most enthusiastic in his advocacy of the new views on oral hygiene, not only because of the teeth, but because of the beneficial results which the proposed reform would bring about with regard to other diseases. In fact, because of its direct and indirect results he regards it as the most important problem of preventive medicine.

I suppose you are all acquainted with the excellent summary which Sir George Newman has written in his last annual report as Chief Medical Officer of the Board of Education, together with the equally excellent statement on children's diet in relation to dental disease prepared for him by Mr. Norman Bennett, the hon. secretary of the British Dental Association, so I need only call attention to one sentence in Sir George Newman's report. He says: "There are few questions of greater moment calling for the attention of the Health and Education authorities than this one of diet, both in relation to teeth and to the general nutrition of the child. The problem concerns both the most suitable forms of food and the best methods of feeding at the different periods of life. A suitable and sufficient diet is one of the most pressing requirements in relation to the national health."

Another quotation which I shall make is from a paper read by Mr. George Thomson before the Royal Sanitary Institute Congress at Belfast on Dental Hygiene of Childhood. This paper was published in the *British Dental*

*Journal** with the editorial note that it "sets a model for an educated lay audience." Mr. Thomson therein referred to the fact that "up till quite recently the cause of caries in teeth has been regarded as a very complex one, but as all things, when viewed from a simple standpoint and divested of erroneous preconceived ideas, become simple in themselves, so in this matter. . . . it has been possible to demonstrate to proof that caries is due to a particular form of diet." It is important, I think, to realize that the theory of the cause and prevention of caries is a matter which may now be easily mastered by anyone who cares to take the trouble to do so.

Even those who believe that, owing to the abeyance of natural selection, the teeth are degenerating in some way which makes them susceptible to decay, put emphasis upon the importance of diet as a means of preventing dental caries. Thus Mr. Stanley Mummery, who claims "that the chief cause of the increasing prevalence of dental caries among civilized races lies in the *teeth themselves*," says there are two distinct types of cleanliness—natural cleanliness and artificial cleanliness. Of these, natural cleanliness is by far the most desirable. . . . It consists chiefly in the regulation of the diet, preference being given to such foods as do not tend to stick around the teeth, and the elimination from our diet, as far as possible, of soft, sticky, and easily fermentable foods which are not easily washed away by the saliva during mastication."†

* October 2, 1911.

† Proceedings of the Royal Society of Medicine, vol. i., part iii., p. 117.

Those dentists and doctors who put the theory into practice in their own families half a dozen or more years ago are still able to record most excellent results, and thus have indicated in a practical manner their belief in the new method.

I have quoted those authorities to indicate that there is now great unanimity as to the preventability of the disease and as to how it may be prevented, but it need not be assumed that all details in regard to the etiology and prevention of the disease are settled beyond controversy. There is still room for further investigation, and medical officers of health have an excellent opportunity for research of a statistical nature which would be of great value.* Naturally, of course, further research should be preceded by a thorough acquaintance with the pathology and etiology of the disease, for the pathology is thoroughly worked out already, and it is doubtful if there are many diseases on which we have such a good knowledge of the etiology as we now have of dental caries. If it be assumed, however, that we have still got something important to learn with regard to questions of susceptibility and immunity to dental caries, as is contended by some, we are surely justified in applying the knowledge which we do possess in order to prevent the disease. Because our knowledge of susceptibility and immunity is not perfect with regard to disease in general, this is no reason for folding our arms and not joining in the campaign against disease,

* A most important investigation of this kind has just been published by Dr. James Wheatley, M.O.H. for Salop. Fourth Annual Report of the School Medical Officer.

nor does the presence of susceptibility alter our methods of prevention. In the case of dental caries, moreover, we have a guiding principle which is now beyond controversy. I refer to the principle which claims that the mouth should be in a hygienic state at the end of meals, whether artificial aids to this end have been practised or not. We all admit that it is most undesirable for the mouth to be left sticky with fermentable carbohydrates or other food-stuffs, as such a state of affairs is not only dangerous to the mouth and gums, but it is also a constant menace to the stomach and alimentary canal, either from swallowing large quantities of bacteria and septic products, or from polluting the food which is taken into the mouth to be swallowed.

It is an easy matter to master the principles of the hygiene of the mouth, but however simple it is few seem to take the trouble to do so. Here I think medical officers of health have an excellent opportunity. It is not rare to see embodied in their reports advice as to the feeding of children. The question arises, Should it be bad advice or good advice. Bad advice, as all admit, has at times been given in the past, but this is, I hope, not nearly so likely to occur again. It may do so. Errors in judgment are pretty certain to occur, but those who have taken the trouble to follow the progress of medical and dental science are not likely to follow the errors of the past. A few days ago I happened to read a review of a book on the medical diseases of children, by a physician. It was said by the reviewer that his advice on the feeding of children "from the ninth month to five years is quite

inadequate. No notice has been taken of the recent contributions to the dietetics of children made by dentists and physicians. The diet recommended is as 'sloppy' as if Dr. Sim Wallace had never existed. This is the more unfortunate because dental caries receives recognition as an extremely common disorder of childhood." I trust that it may never be possible to subject the report of any medical officer of health to such a criticism. As the ordinary general practitioner is apt to be specially concerned with diagnosis and treatment rather than with the problems of prevention, and as the medical officer of health is specially concerned with prevention, it is but natural that the general practitioner should look to the health officer for guidance in these matters. It consequently follows that medical officers of health are peculiarly suited to bring such subjects as the prevention of dental caries before the medical men in their neighbourhood either by lectures or otherwise. Furthermore, school teachers might be instructed in elementary hygiene with regard to the mouth, and, finally, leaflets with brief rules could be prepared by the medical officers of health for the guidance of mothers. These methods of bringing the subject home to medical men and the public have already been very successfully pursued by Dr. James Wheatley, and I hope the day is not far distant when it will be the ambition of every medical officer of health to report that the number of children who have decayed teeth in his district is practically a negligible quantity, and that, moreover, this result may have been brought about by the medical officer of health without increasing

the rates for school clinics and without the tortures occasionally associated therewith.

In conclusion, it should be noted that hitherto the authorities on dietetics have neglected considering the value of diet from the point of view of the hygiene of the alimentary canal, at least from the point of view of the hygiene of the mouth, and if the hygiene of the mouth is at fault, what chance has the rest of the canal? The nutritive value of every foodstuff has been tabulated, but the question whether the food lodges and ferments in the mouth, or by lodging stimulates the growth of obnoxious bacteria, together with their toxins, seems never to have been given a thought. Yet the mouth is the entrance-portal of disease, and what chance has a child with an unhealthy mouth when persistently supplied with unhygienic food and poisoned with decomposed products? Is it of any great consequence how nutritious the food may be if the teeth and alimentary canal are ruined? But this is what the so-called science of dietetics as currently taught is bound to lead to unless, as frequently happens, the child instinctively revolts at a continuance of the kinds of food which have brought on its troubles. It should surely be a recognized principle that the mouth and alimentary canal ought to be kept in a hygienic state, and if some relatively innutritious food is required to do this, then such relatively innutritious food must be given. It is useless to force nutritious food into an unhygienic alimentary canal. At the present time, however, when a child is suffering from lack of appetite and emaciation, resulting from the unhygienic state of its mouth and alimentary canal, it is almost invariably given

highly nutritious food without the slightest regard to whether such food will restore the mouth to a state of reasonable cleanliness, and the alimentary canal to a hygienic state, and as if to add insult to injury, it is frequently ordered malted food or medicated syrups, three times a day after meals.

The amount of disease and suffering which could easily be prevented by the dietetic régime which has been proved to keep the teeth free from disease is simply incalculable, and it would certainly appear that the impending triumph of medicine not only in the prevention but in treatment of disease, is the putting in practice the dietetic principles which we have indicated.

CHAPTER IX

OBSERVATIONS ON INFANT MORTALITY AND MILK

In recent years considerable attention has been given to problems associated with infant mortality. To a small section of scientists there may be some considerable satisfaction in the fact that the mortality in infants is at present high, for in this they see how the unfit parents are prevented from continuing their stock beyond infant life. Leaving out of account poverty, drunkenness, and neglect, one of the commonest indirect causes of infant mortality is bottle-feeding. To these scientists each woman who loses a child through lack of ability to suckle it reduces the total number of those who in the following generation are likely to be unable to suckle their children, and so the inability to suckle children naturally should become a less and less common event in years to come. When, however, we consider the importance of the function, and how long the suckling of infants has been established, and until recently how essential to the continuity of the species, we are inclined to think that practically every case of inability to suckle an infant is the result of conditions other than those which may be called "hereditary." The importance of the subject demands that some attempt should be made to get at the root of the causes of deficient lactation instead of

directing all attention to the benefits of a clean supply of cow's milk, for cow's milk must always be unsatisfactory for children. It would appear that it is not the poorer classes which suffer most from deficient lactation. In general, it may be said that the poor are usually able to suckle their children, while in general the rich cannot, or at least do not. It seems that in a considerable proportion of cases they cannot without injury to themselves, and sometimes to their babies also. From time to time we see suggestions as to the reason for this, and they generally reflect some form of moral discredit on the mothers. I doubt, however, if blame should be put on the mothers. Certainly in my experience the great majority of mothers seem willing and anxious to do all that can reasonably be expected of them, and it would appear that it is inability rather than unwillingness which prevents them from suckling their children. In a number, probably in the majority, it will be found that there is something the matter with the *prima via*. Few mothers can be said to be free from "oral sepsis;" many suffer more or less from indigestion; and constipation, associated probably with septic absorption, may accompany both. If this is so, and it certainly is so in many cases, it seems strange that so many nursing mothers should be ordered to drink large quantities of milk. There are few articles of diet which are less conducive to oral hygiene than a milk diet. If we can place any reliance on the tongue as an index of the state of the alimentary canal, then, again, milk would not appear to be a particularly suitable food. If, again, we are agreed that constipation is an undesirable state during lactation, then for that reason

also is milk contra-indicated. It may be, it generally is, presumed that a milk diet must be a very suitable one, because milk is so easily assimilated, and contains all the requisite elements for the formation of milk; but such an argument ignores a most important principle of dietetics, —namely, that the diet must be of such a nature that the alimentary canal is kept in a hygienic or healthy state.

Moreover, it is by no means undeniable that milk is suitable for the production of milk. Certain it is that cows produce an enormous quantity of milk for long periods, though their diet consists very largely of grass, and it is doubtful if they were put on a milk diet if they would produce as much. Of course, it may be said that grass is the natural food of cows. But is milk a natural diet for adult women? It frequently happens that women dislike being put on a milk diet, often, too, they are persuaded to drink it even though they loathe it. They may come to tolerate it, but many things may be tolerated that are far from ideal. Whatever may be the results at other parts, one thing we can safely say — a milk diet in adults is never conducive to oral hygiene. The ordinary diet of an adult may be, very frequently is, satisfactory, and with regard to the solid part of it comment is unnecessary here. We need only refer to the liquids consumed by nursing mothers. A custom supplanted to a certain extent by forced milk feeding at the present day was that of allowing or advocating a certain amount of stout or some similar liquid at these times. With regard to the mouth we may say that this is unlike milk, for instead of inducing oral malhygiene, being acid and bitter, it helps to keep the

mouth in a hygienic state. It may in many cases stimulate digestion—at least, bitter tonics are sometimes advocated for this purpose, and it is frequently maintained that alcohol in moderate amounts does so. Possibly also by its depressant effects on the higher centres the vegetative ones may have all the better chance. I have not been in a suitable position for making an extended investigation, but in a limited number of cases I endeavoured to find out if milk-fed women had been successful in nursing their babies. I found in about twenty cases all were unsuccessful, and although one was able to continue nursing her child for six months, the rest all fell short of this by three or more months. On the other hand, some women who did not drink milk nor concern themselves about their diet beyond satisfying their appetites and their natural inclinations as regards the quality and quantity of liquid consumed, were able to continue nursing for a year or more.

Akin to this subject we may note the prevalent habit of putting girls, if they show a tendency to emaciation, on a milk diet. No doubt forced feeding of the kind will frequently produce the desired effect, and probably the effect persists permanently in some cases. When continued only for a limited time, it may do no appreciable harm. It is, however, different when girls are induced to drink pints of milk year after year. It may simply be oral and alimentary malhygiene together with concomitant derangements which account for the ultimate results.

Frequently these pernicious results are intensified when the milk diet is supplemented with much sugar,

which is so frequently recommended for fattening purposes, or because it is a "protein sparer." However, to many it does not appear to be very philosophical to ruin the teeth and alimentary canal for life, even though some temporary or even permanent fattening can be brought about.

From general observation I believe, if statistics were taken, it would be shown that the average milk-fed girl does not in womanhood develop such a womanly figure as the girl who has shown aversion to milk and a preference for more hygienic liquids throughout her life. It may be maintained that it is because of some defect that the milk diet is generally ordered year after year. Sometimes it is; but considering the ultimate result, even excluding the state of the mouth and teeth, we may say that the treatment is seldom justified.

Another subject of even greater importance in the prevention of disease is the eradication of poverty. For poverty breeds disease; and disease breeds, not only poverty, but also disease. There is no complete solution of the problem of how to prevent poverty. There is, however, one which all might countenance instead of issuing dictates against it. I refer to the voluntary limitation of the size of the family when the income is so meagre that it is impossible to provide adequately for its needs. We hear much of the advantages of a simple life, and to do away with all useless luxuries is no doubt to be commended; but when we consider the necessary expenses associated with the proper education, the adequate housing, clothing, and feeding of children, we find

that, however economically it may be done, it is impossible to do it efficiently and hygienically, especially in towns, on a wage such as is earned by a great number of the working classes. A small income, say thirty shillings a week, *may* be sufficient for the parents and one or two of a family, but when half a dozen or more children have to be provided for out of this income, the possibility vanishes sooner or later. There is no need to follow the course of events as the family grows larger without a corresponding increase of income.

Notwithstanding the best of intentions and the strictest economy, the hygiene of the house may become more or less neglected, or the food may become unduly curtailed in quantity or quality, or both. Sufficient clothing and fires may become impossible; the mother, instead of nursing her children, may require to go out to work to supplement the insufficient income; and a neglected house, together with substitutes for mother's milk, which require most careful supervision, relegated to someone who is never likely to be as careful as the mother. Disease in one or other of the children is sooner or later almost inevitable, and the general discomfort, to put it mildly, may induce the parents to seek some stimulant or narcotic which will at least appear to give some temporary relief from grief or the continual grinding struggle. The wisdom of the limitation of families when the income is very small is, indeed, so obvious that the point need not be argued. But it is not only the parents, their children, and their immediate associates, who would benefit by the small families among the poor, it would have a eugenic

benefit of importance. At present the well-to-do do not produce more of their kind to continue the species than the poor and the diseased, and so the general stock is not being improved as much as it ought to be, and future generations are condemned to have an incubus thrown upon them which they would be much better without. Moreover, the thriftier members of the community are at present taxed to support the limitless families of those who are not so likely, either from environment or heredity, to bring up children of any use to the State. Here, then, is a case where both considerations of heredity and environment fortunately point to a similar solution.

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