

SOME PRINCIPLES OF DIETETICS.

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SOME fifteen years ago the study of the etiology of dental caries led me to conclude that there must be something radically wrong with dietetic habits which were current in civilised communities. Further, it became impressed upon me that the dietetic precepts emanating from the highest quarters were possibly on the whole productive of harm rather than good, for it was by no means apparent that dental caries and other diseases resulting from bad dietetic habits were less common among the children of professors of physiology than among the children of the relatively ignorant poor. In fact, in time it became evident that the teeth of the children of poor peasants and even of those living in slums were rather less ravaged by caries than were the teeth of those who were supposed to be enlightened in the science of dietetics. Naturally I tried to inform myself in the subject. Among other things I bought a book on "Food and the Principles of Dietetics," and therein found quite a mass of information on the chemistry of foods and certain physiological details associated therewith, but I found remarkably little about the principles of dietetics. It is not, therefore, my intention to treat the subject as it is treated in books on dietetics, but rather to indicate that the principles of dietetics branch naturally from the tree of knowledge and bear fruit which is, or may become, of great value. I shall endeavour to state some principles of dietetics and add a few words to each of them.

The first principle I would refer to is that the kind of food for which man is adapted is the same in all essentials as that on which he has subsisted for countless generations. This principle is lacking in direct practical utility, first, because we may not know exactly the kind of food on which primitive man and his ancestors did subsist; secondly, because we are not all agreed with regard to what are the essential elements of food; and thirdly, because man has introduced methods of preparation of foods which, though in some cases they may destroy or impair certain essential qualities, so far improve others that a reversion to primitive foods would be a retrograde step. The value of constantly bearing in mind this important principle, however, will be seen from some of the others which follow, for without this one a certain guide for the search for others would be lacking.

The next principle to which attention may be briefly directed is that the anatomy of the organs of digestion indicates the type of food which is most generally suitable for the animal under consideration. This has long been recognised by those who have concerned themselves with palæontological zoology. It has, however, been most completely disregarded by medical experts, who have occupied themselves with framing a pap dietary for young children which still too generally holds sway. It is now many years since the dental profession recognised that the complete temporary dentition indicated that the most suitable diet for a child was not pap, but should be of such a nature that the teeth and jaws would require to be used. Moreover, we recognised still further that the coming into position of the milk teeth indicated how the transition from the purely milk diet to the solid and varied diet suitable for children with a complete dentition should be brought about.

A correlated principle which we have to note is that the physiology of the organs of digestion indicates to some extent the type of food suitable for man. To begin with, however, what is the outstanding physiological process for which the first part of the alimentary canal is adapted? The incisor teeth incise or cut off portions of food, and the molars crush, tear, or physically disintegrate it, while at the same time the saliva and mucus are secreted. The muscles of mastication concerned with the closing of the mouth are physiologically adapted for the exercise of enormous pressure in order to disintegrate the food, while the muscles which open the mouth are relatively weak. If the food were intended to be swallowed without undergoing physical disintegration in the mouth there would be no need for the large muscles and elaborate physiological coördination which at present (necessarily) exist. As far as the digestion of food is concerned, the obvious inference is that with regard to the mouth and teeth the physical disintegration of the food is practically its one and only function, notwithstanding the fact that we may have books written on "The Work of the Digestive Glands" in which the salivary glands are largely referred to. Do not let us be befooled into believing that the physiological *raison d'être* of the salivary glands is solely or even primarily for the sake of digesting food. The salivary glands exist and function for the purpose of facilitating the movements of the mouth and food, for facilitating its disintegration, for facilitating deglutition, and for helping to clean it out of the mouth as rapidly as possible after the disintegration of the food is sufficiently advanced. We have heard a great deal about the digestion of starch by the ptyalin, and although the amount is very trivial it was well dinned into us that the function of the ptyalin was to digest starch (for nutritional purposes). Why a copious flow of saliva is poured out when sugar is taken into the mouth did not seem to suggest the idea that the function of the saliva was to clear substances out of the mouth which might be or become harmful to the teeth and mucous membranes during or after mastication. So again, we were taught that acid vegetable foods gave rise to a copious flow of alkaline saliva rich in ptyalin, but physiologists were silent with regard to the why of the ptyalin in this case. That the flow of alkaline saliva was to neutralise the acid was indicated, but that the saliva similarly became alkaline on eating meat was not mentioned and the rationale of such alkalinity was not indicated. So, too, we were led by physiologists to believe that the reason why ptyalin did not exist in the saliva of an infant till it had reached about the sixth month was that up to this age the child should not get starch in its dietary. No doubt an infant should not get starch in its dietary before this age, but why a ferment from the pancreas capable of digesting starch before this age existed was not told to us. The fact that the appearance of ptyalin in the saliva synchronised with the cutting of the teeth and that the saliva exists chiefly for the physiological cleanliness of the mouth and for the protection and preservation of the teeth was apparently never dreamt of. Although, then, the physiological reactions of the saliva to food show us clearly that they are adapted chiefly for facilitating disintegration of food and deglutition and to get rid of certain substances commonly associated with foods which are or might become injurious to the mouth and teeth, it would be a mistake to argue that whatsoever

stimulates the salivary glands should necessarily be regarded as specially desirable food. Rather should we surmise that in foods which excite a great flow of saliva there may be an element of danger, if for any reason the glands were not capable of responding adequately to the stimulus, or if the food were of such a nature as to hamper the saliva in its attempt to get it out of the mouth. There is, then, an element of danger in food which contains sugar in greater proportion than it exists in vegetable foods as presented in nature, and the physiology of the glands of oral hygiene indicates that sweets, bread and jam, bread and marmalade, and the like should not be eaten at the end of or between meals.

I have not referred to mucus. Its function is largely that of lubrication, but it is also instrumental in maintaining the hygiene of the mouth, and when thoroughly incorporated with the food during mastication it no doubt facilitates the action of the gastric juice when the food reaches the stomach. Possibly this explains to some extent why, as Dr. Francis D. Boyd has ably shown, digestion is so very much better when the food requires mastication than when it is given in the form of pap.

Here it may be noted that the various principles of dietetics cannot be altogether isolated from one another, or perhaps we should say that various principles serve to reinforce each other, so it need hardly surprise us that our fourth principle has been adumbrated in what has already been said. This fourth principle is most important not only because of its practical application, but also because it has hitherto been completely overlooked by physiologists. I refer to the principle that the food should be of such a nature or the meal so arranged that the mouth and teeth will be left physiologically clean at the end of the meal. When once this principle is stated no one can deny it, for it is simply absurd to say that meals should leave the mouth in an unhygienic state. The wholesale destruction by caries of the teeth in civilised communities, together with the equally wholesale destruction of the gums and alveolar processes resulting from oral malhygiene, should have been sufficient to call attention to the importance of this principle, and except among those physiologists and medical men who consider that the mouth and teeth are outside their domain, the principle is now fairly recognised amongst the educated. Since the teeth of animals and primitive man are kept in a hygienic state by their foods, it is a simple guide to say that food in its natural condition will, if taken at the end of a meal, leave the mouth clean. For various reasons I have drawn attention to the value of uncooked fruit for this purpose, and need only add here that unless we are to revert to primitive foods and eschew all the benefits which accrue from the preparation and cooking of foods, we must above all other principles insist on this one.

Moreover, recognition that food should be of such a nature that the mouth and teeth should be left in a hygienic state leads by extension to the idea that the whole alimentary canal should be left in a similar hygienic state, and this suggests a still wider field for investigation. I have read that the alimentary canal of children nowadays is little more than a series of pathological specimens, and although this may be an exaggerated way of putting it, there is too much truth in the remark;

and so long as the craze for nutrition and calorie values is considered to the exclusion of the hygienic value of food what truth there is in the observation will remain.

"Science knows no geographical boundaries," it only recognises the narrower limits of its own departments. Being under less than no obligation, however, to follow decadent scientific methods, we may be permitted to transgress the boundaries of our specialty and deal briefly with a few principles which have little or nothing to do with the mouth and teeth. They have, however, to do with the hygiene of the alimentary canal. As overeating is a common cause of alimentary malhygiene I shall deal with a few principles associated therewith. The first I shall mention is well known but seldom brought into force as it should be among the civilised. It is simply that "Hunger is the best sauce." Throughout the whole course of evolution our progenitors must often have been hungry, sometimes very, very hungry. If hunger had incapacitated them for food when it was found there would have been little chance for them surviving; fortunately it had quite the contrary effect. Pawlow has shown by approved experimental methods that digestion goes on best when associated with hunger, and in a general way we all know that it is so. Nevertheless I have practically never seen an emaciated child with an unhygienic digestive tract treated by keeping food away from it, and the unhygienic state of the alimentary canal is never given a chance of becoming hygienic.

This leads us to state another principle—namely, that tempting the palate habitually is contrary to the dictates of evolution. As the importance of economy in nutrition has throughout all ages only been transcended by the importance of getting enough we should recognise that a flagging appetite is a signal that amply sufficient has been consumed. We may be assured that as in past ages unlimited supplies of food were seldom available, as much as possible would be eaten of any food which contained the elements for supplying immediate needs and a reasonable reserve for the immediate future without special temptation. One might have thought that a scientist who recognised that hunger was the best sauce might also have recognised this principle. Nevertheless we read in Pawlow's work on the digestive glands: "The custom of the chief meal of the day also corresponds with our physiological results. After this or that *hors d'œuvre*, perhaps also with a liqueur of brandy (especially customary in Russia), both of which are designed to awaken the appetite, the repast proper begins, and, in the majority of cases, with something hot, consisting mostly of meat broth (*bouillon*, different soups, and so on). After this comes the really nourishing food—meat of different kinds served in various ways, or, in the case of poorer people, stews made with vegetables, and therefore rich in carbohydrate material. This sequence of foods, from the standpoint of physiology, is quite rational. Meat broth, as we have already seen, is an important chemical excitant of gastric secretion. An attempt is therefore made in two ways to secure a free secretion of gastric juice to act on the chief food: first, in the excitement of the appetite juice by the *hors d'œuvre*; and, secondly, in the promotion of the flow by the action of the meat broth." It would appear from this quotation and other similar statements that no effort either in the way of chemical or psychic excitant has to

be spared to secure the activity of what seems to be presumed to be an otherwise insufficient organ for carrying on the work of digestion. Pawlow's ideas are interesting and instructive; unfortunately, however, they are not principles of dietetics: rather are they principles of gluttony. Much that is written about the arrangement of the meal from the glutton's point of view may be interpreted quite differently and more correctly. The meat or vegetable broth which so frequently commences a meal may have little or nothing to do with stimulating digestion; they may have chiefly to do with economy. A proportion of the available nutriment in yesterday's joint might be lost if the remains were not boiled and the resulting "stock" used on the following day. The words "stock" and "*pot au feu*" both suggest this interpretation. Pawlow follows what I have already quoted with the sentence: "The usual termination of the repast is also, from the physiological standpoint, easy to be understood. The chief meal is generally ended with something sweet, and everybody knows that sweets are pleasant. The meaning of this is easy to guess. The repast, begun with pleasure, consequent on the pressing need for food, must also, notwithstanding the stilling of hunger, be terminated with an agreeable sensation." Let us consider what is meant by "something sweet." Jam rolls, bread-and-honey, chocolate, &c., may all be recognised as something sweet or sweets, but yet, as it appears to me, his meaning in saying that the meal should be terminated by something sweet, yet which does not burden the work of the alimentary canal at this time, is not at all clear. It is quite obscure unless (which may be his meaning) we assume that sweet things do not burden digestion at this stage. But this would be quite erroneous. He refers also to acids, and attempts to show how acids one way and another assist digestion. He never appears to have dreamed that acids in foods were concerned with dental hygiene; in fact, the whole of his arguments indicate a conviction in the insufficiency of man's organs of digestion except when they are excited, whetted, and tempted by all sorts of psychic and chemical stimulant, and the philosophy of the correct termination of the meal is overlooked.

That the gustatory secretions should be stimulated at the end of a meal, not by sweets but by food of a natural, hygienic, or detergent nature, is evident to all who admit the principle that the mouth should be left physiologically clean. Now what does so most effectually? Fresh fruit certainly does; not only the dilute sugars but the acids, the aromatic and even the acrid substance in the fruit do so most effectually. Fruit contains but little nutriment, and its real value is hygienic and not nutritive—much less is it a digestive tonic. Foods in the form of sweets, jam rolls, bread and marmalade, chocolate, &c., are to be condemned absolutely as meal terminals, as their effect is the opposite of fruit, which leaves the mouth in a hygienic state. Read in the light of my theory I believe Pawlow's experiments are most instructive. Read in the darkness of the old craze for nutrition they are misleading, dangerous, and contradictory.

The amount of food eaten should not be regulated by principles of gluttony: it should be regulated indirectly by recognising the principles of dietetics. That the palate is a useful guide is not to be denied, and when it is given a chance to act it acts usefully. If the

palate is given the opportunity to discover and appreciate the quality and quantity of the food which passes it, as when the food requires to be disintegrated and retained in the mouth for a time, then it will be a useful guide. If, on the other hand, food is given in the form of pap and is slipped past the palate without mastication, as it so often is in the feeding of young children, and geese which are being stuffed for *pâté de foie gras*, then the palate is but an imperfect guide both as regards quality and quantity. Nevertheless, let me say that instinct, custom, and common sense are not invariably to be relied upon. A new environment may come into existence relatively suddenly and the safeguards of necessary limitations existing in the aboriginal environment may disappear. Thus, for example, a relatively unlimited supply of carbohydrate foods may now be easily procured; in addition to this a gratuitous advocacy in influential quarters of the things most to be guarded against may usurp the place of natural limitations, as, for example, the advocacy of highly nutritious foods, the value of sugar as an economical foodstuff or as a proteid sparer, the advocacy of jam and marmalade instead of butter on bread, or the extolling of cocoa and chocolate instead of more hygienic and cheaper foods. It is for reasons such as these that we must have something more than instinct and custom. We need the principles of dietetics and a touch of common sense to be able to coördinate and make practical use of them.

With regard to a balanced dietary little need be said; the principles which regulate this too are similar to those which regulate the amount. Like the amount it is very variable, and if the organism, when restraints such as nature presents are imposed, is not fit to seek for and procure the balanced dietary required, no artificial endeavours will be likely to avail in the long run. The possibility of getting a fair choice and variety is of course necessary. Variety, however, should not simply be with regard to proteid, carbohydrate, fat, &c.; it should include also *uncooked* food. Fresh fruit, vegetables, and gustatory stimulants without regard to calories at all are necessary. Throughout the whole course of evolution uncooked food was consumed, and we certainly have not as yet sufficient evidence to make us disregard the probability that certain essential qualities are destroyed by cooking. Possibly the craze for having everything made easily digestible and sterilised before it enters the mouth accounts for much dyspepsia, and may explain why uncooked milk though full of germs, is such a useful drug in restoring what is sometimes necessary for healthy digestion.

I indicated above that restrictions on eating certain foods should be imposed to compensate for the lost restraints which nature imposed. If restraints in the nature of taxation for revenue on consuming alcohol, tea, and coffee are conducive to more good than evil, then surely the taxation of sugar, sweets, chocolate, and cocoa might for similar reasons be imposed, for, as Sir William Osler has maintained, decayed teeth are responsible for greater harm to the community than alcohol. Surely the proportion of misery which alcohol causes is not greater than the amount of dental troubles brought on by the eating of sweets. Indeed, Dr. Wheatley's statistics with regard to sweet-eating and caries clearly show this to be the case.

A further principle to which we may refer is that economy in diet is beneficial physically and morally. A long sermon might be preached on this subject; it is not, however, my intention to do so, firstly because it would be more instructive to hear how it is done from a housewife with a family, let us say, of five children and a husband with 30s. a week. Secondly, because it involves other considerations besides caloric or hygienic values. Thirdly, because the poor housewife in general does exceedingly well with the money at her disposal compared with those who usually give advice to this class. She does not require to be told that bread, oatmeal, and potatoes are economical compared with many other foods often belauded in medical journals, nor that cheap cuts of meat or cheap cheeses are of as high nutritive values as the more expensive kinds. All that I would say with regard to this principle is that to judge the value of a food by laboratory tests regarding its caloric value has been, and is, most misleading. A food such as uncooked fruit may have a high hygienic value. This may at times be wanted, but though it has caloric value is valueless when it is not wanted. Moreover, the judging of the cheapness of food by the amount of calories procurable from a given sum has led to advice which is worse than useless. Because an amount of sugar representing a large number of calories can be bought for a relatively small amount, it has been argued that sugar is an important and valuable food *for the poor*. Since, however, force of circumstances compels the poor to obtain the great bulk of their nourishment from bread or cereals and potatoes, and inasmuch as these contain relatively a superfluity of carbohydrates every penny spent on sugar by the poor is, from the point of view of nutrition, simply wasted. But this is not all. The sugar is often taken in a particularly obnoxious form, either as sweets between meals or as jam spread upon bread. Not only then is the money spent on the sugar wasted, but the fruit which is made into jam has most of its virtues destroyed as far as oral hygiene is concerned, and this at the considerable expense which is entailed in reducing it from the hygienic and palatable form in which nature provides it to the unhygienic form in which we see it prepared to destroy the teeth of the present day.

Another principle which should be considered by those who issue dietetic precepts is that functional activity is generally necessary for the most perfect development of an organ. A conspicuous illustration of this may be seen in the muscular development of the blacksmith's arm. This principle applies also with regard to the development of the salivary and probably also to other glands for the hygiene of the alimentary canal. Similarly without any doubt the muscular development of the organs of digestion is affected by the physical nature of the food. This is notably so in the case of the muscles of mastication; moreover, the development of the muscles of mastication has a distinct influence on the development of the jaws, and this again has its influence on the arrangement of the teeth. The anatomical perfection, then, of the first part at least of the digestive apparatus of man is quite appreciably affected by the physical nature of the food consumed in childhood.

I might refer to other principles which indicate, for example, that eating between meals should be avoided; that the concentration of the different elements composing foods (especially sugar) should not exceed the concentration habitually found in

such foods as man throughout his evolution must have subsisted upon; that three meals a day are to be preferred to any greater number, &c.; but as these and other principles dealt with in this paper have been gone into in much greater detail in my books there is no need for further elaboration at present.

I should, in conclusion, like to refer to two reasons for bringing forward this communication. The first is to indicate that principles of dietetics might be formulated; and the second that the principles of dietetics or the value of foods cannot be established by those who set up laboratory tests and standards as criteria. Nor can they be deduced from the most elaborate statistics having reference to caloric values. The accumulation of statistics on nutritive values, however accurate, gives no more guide to hygienic values than do hygienic values give a guide to nutritive values, and the use of such statistics as a basis for generalising only prevents us from doing what science ought to do—namely, to methodise knowledge and reduce it to principles.

THE STERILISATION OF ALBUMINOUS CULTURE MEDIA BY ETHER.

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At the present time, when many require sterile serum and ascitic fluid for the cultivation of certain bacteria, it may be opportune to publish a method for the sterilisation of such materials which we have utilised successfully.

When sterilised by heat, serum, and in particular horse serum, is apt to undergo changes which render it unsatisfactory for use. For instance, many samples of horse serum as obtained at a slaughter-house when heated to 60° C. become more or less completely "set," and thus cannot be mixed with other constituents in a culture medium. Further, the method of sterilisation by heat as applied to such fluids is far from being invariably successful in destroying contaminating bacteria.

Various volatile antiseptics, such as chloroform and toluol, have therefore been used for this purpose, but in our hands these additions have not always produced sterility, and, further, have the disadvantage of throwing down precipitates which take months to settle completely. On the other hand, ether as used by Ori¹ has been entirely satisfactory.

We have applied the method in the following way. 1. The serum or ascitic fluid is collected without any particular aseptic precautions and enclosed in a well-stoppered glass bottle. In the case of the ascitic fluid, which varies greatly in reaction, acid or alkali is added to render it neutral to phenolphthalein, and, if necessary, it is filtered through paper. 2. Ordinary methylated ether is added to 3 per cent. and the stopper tied in. 3. The bottle is then placed in a water-bath at 45° C. for one hour or longer to ensure that the serum is actually heated for the full time. 4. At the end of this time the fluid is found to be sterile and is stored for use. 5. When required a sample is removed from the bottle and placed in a sterile test-tube or other vessel. The test-tube is then thoroughly agitated in a water-bath at about 55° C.

¹ A. Ori: Biochemisches Centralblatt, 1906, v., 193.