A great composer is reported to have said that there was music in the clinking of pots and pans. So is it with every study in morbid anatomy. The something to be learned from it is not to be found by the superficial observer. It is the perceiving mind and the educated eye which alone will profit by it, and be able to reason from it.

Having acquired sufficient knowledge, not to make him a specialist either in medicine, surgery, or obstetrics, but such as will enable him to understand the usual manifestations of disease, I hold that if a man is going to be an efficient teacher of pathology, he should on no account be engaged in practice; and the real work of his life ought now to commence. Medical practice and the teaching of pathology are incompatible, for not only must a teacher, in order to be efficient, be capable of explaining other men's views, but he must investigate everything for himself. Did the teaching of modern pathology consist in haranguing an audience for an hour daily for five months in the year, there is no reason why it should not be taken as a pleasant amusement in the course of the day's labours. This, however, I think, is hardly the sort of thing that it ought to be. The mere acting as a *middle-man* between those who are engaged in arduous investigation, and the listeners who are supposed to imbibe such teachings is, to say the least of it, not a very dignified position. It was not with this spirit that Carl Rokitansky, Rudolf Virchow, and John Goodsir made their fame. Their teachings were seasoned all through with the results of their personal labours; not a *résumé* of the theories of this, that, and the other man. It is, no doubt, a convenient thing for a man to receive a large competency for delivering a paltry hour's lecture for five months in the year, and to occupy the rest of his time by attending to the duties of a lucrative practice. I cannot but think, however, that such is extremely bad for the institution with which he is connected. It is bad in several respects. It is bad as evincing a commercial instead of a truly scientific spirit. It is bad as an example to those who are supposed to profit by his teaching. It is bad as degrading the science he professes: and it is bad as showing that he is not in earnest with the work he has undertaken. Teachers of practice of physic, surgery, therapeutics, obstetrics, and such like branches require to be constantly engaged in bedside study, and the fact of their practising means that they are getting so much more experience of that which they undertake to teach. The pathologist's labours should, however, be directed in quite a different line. It is the etiology, or cause of disease, that he is expected to reveal, and it is not his domain to be engaged for the greater part of the day in its diagnosis and treatment. So long as we are in the bondage of darkness which at present exists in regard to our knowledge of the causes of disease, pathologists ought to spend the whole of their energies in throwing light upon them. In this way we aid in the advance of therapeutics; and, by showing how diseased conditions are brought about, confer a direct benefit both upon suffering humanity and the brute creation.

This is not to be accomplished by mere bedside observation. Far be it from me to lead you to suppose that you as pathologists should neglect the clinical features of any disease. I have said enough previously to warn you against this, but what I most emphatically state is, that little progress in the special study of modern pathology will be made, if attention be chiefly directed towards this. Mere symptoms and diagnosis have been observed and noted from the days of Hippocrates downwards, while the causation of disease is a study of a few years old. All the easy means of tracing disease to its origin have been exhausted. Methods much more intricate than those hitherto employed must be called in to our assistance. We must aim at the precision of the exact sciences. We must reduce our statements to the accuracy of chemical formulæ.

All this requires time, and I think that those of you who know what original research means, will agree with me that it is simply an impossibility for a man to teach the subject properly and to be engaged in complicated original research, while at the same time he lavishes his services upon the public as a practitioner of medicine. The Latin proverb—"Duos qui sequitur lepores, neutrum capit," holds good of pathology as of other undertakings in this life. "No man can serve two masters." We have had enough of the rough-and-ready self-confident investigator who professes to be able to make all his analyses at the bedside, and who cannot see why everyone else should not do so likewise. Such pseudo-science is a species of quackery, and is worse than useless; it is misleading. In order to carry on reliable investigations in the great problems of pathology, we must have laboratories for the purpose, we must possess instruments of precision, and must utilise the results of other sciences, studying their means of investigation, and adapting them to the end we have in view.

I have spoken thus strongly on a subject which I have thoroughly at heart. I feel that there is too much of the commercial element con-

nected with scientific medical appointments in this country. Such a state of things is radically bad, and I have not the slightest hesitation in publicly denouncing it.

In this University, however, there is no chance of the Professor of Pathology being misled in the way I have indicated, seeing that he is bound down by the deed of foundation not to engage in practice. It seems to me that this is a wise regulation, and I trust that the benefit of it will be manifested in the illustrious line of professors of pathology who shall succeed me.

When I think what an intricate subject I have to teach, and when I consider how much responsibility rests upon me in teaching it, I fear for the result. Where the traditions and the practical working of a class are already established, it is a comparatively easy thing to slip into the beaten track. In the present instance, however, we shall be for some time, so to speak, exploring; and I only trust that we may be guided in all we do by a sense of justness and thoroughness. Above all things, let us discourage a supercilious dilettantism, and reach forward with a determined purpose, "Heart within, and God o'erhead." Remember the advice given by a personage not usually considered to be a sound adviser, but, nevertheless, good advice, to the ardent young student—

"Gebraucht der Zeit, sie geht so schnell von hinnen,
Doch Ordnung lehrt euch Zeit gewinnen."

The greatest of poets has declared that "All the world's a stage, and all the men and women merely players." In drawing aside the curtain from this, which, to you and to me, is one stage in our history, knowing, as I do, that you will play your part satisfactorily, I only trust that you will forgive the many shortcomings in the performance of mine. In the crude remarks which I have placed before you, there are many points which perhaps you may not see the force of at present; but, if in any respect these remarks have inspired you with zeal for a subject which is fraught with the deepest interest, I shall consider that my purpose in addressing you has been accomplished.

A CONSIDERATION OF SOME OF THE CAUSES WHICH GIVE RISE TO DENTAL DECAY.*

BY ALFRED CARPENTER, M.D., Croydon.

GENTLEMEN,—When I consented, at the request of your President, to address you this session, I somewhat underrated the importance of the work I undertook to perform. I ought to have hesitated before agreeing to do a duty, which involved something more than the expression of my own views upon points concerning which I might have felt myself competent to advise you. But, having accepted the duty, it would scarcely be in accord with my ideas of an Englishman's character, if I did not at any rate attempt to do the work I had undertaken to perform. I propose, therefore, to follow up the line of thought which is ever in my mind upon the causation of disease, and to consider that subject in its relation to the teeth, on the principle that prevention is better and easier, in a large proportion of cases, than cure; and also, that there is a field for observations and practice here, as well as everywhere else in the domain of medicine and surgery.

This will especially apply to caries, and several other maladies which naturally come to the notice of the surgeon-dentist in the practice of his profession.

Are diseases of the teeth more common in our time than they were in the early days of civilisation? Has the artificial life in which we live now seriously damaged the dental organs, and has it promoted their earlier decay than was the case in the time of our forefathers?

To solve this question, we must go to ancient history. Diseases of the teeth were not unknown to those nations regarding whom we have early records. We gather from Herodotus that there were dentists in Egypt in the times of the Pharaohs, and it is said that Belzoni discovered artificial teeth in the sarcophagi of the Egyptians. Erasistratus, Hippocrates, Heraclides of Tarentum, and other Grecian writers, speak of diseases of the teeth as if they were not uncommon in their days; whilst Celsus describes the dentist's duty very accurately, and gives us a clear insight into the system in operation among the Romans in his time; Galen also is particular in his descriptions of dental diseases. Dental caries was common enough among the ancients; and, from all that we can learn, these diseases are not a new class, and do not therefore show a new departure in pathology. Yet there is sufficient evidence to tell us that luxury, indolence, and vice, tend very much to promote the development of such diseases, and to lay the foundation for those conditions which produce decay of all kinds in the dental organs, as well as elsewhere. This evidence is given by the state in

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which the teeth are generally found in the mummies of ancient Egypt, and in the jaws of those skeletons which have been preserved to us from the early days of Christian sepulture; disease in the teeth was the exception in those times, whilst in our day it is the rule. It may be true that those teeth which decay had touched during the lifetime of their possessors had been unable to stand against continuing decay after death, and that sound teeth alone remain in the original form to our time. This is not, however, all true, for decayed teeth are sometimes found. Teeth giving evidence of caries which had existed during the lifetime of the owner, do continue to remain *in situ*. There would be also vacancies in the jaw-bone indicating the position of the absent teeth, if such decay had taken place.

According to the accounts of some travellers the majority of Egyptian mummies which are unrolled to-day exhibit perfect sets of teeth; and the majority of those jaws which have been examined in some of the catacombs in which the early Christians were buried, are perfect, whilst it is the exception now to find a middle-aged person who has not lost many of his dental appendages.

Before proceeding to discuss the principles which promote decay I will run over a list of conditions which, in my opinion, may be first causes for the foundation of change, and for the continuance of active decay. These causes are very various, and each may be distinct in itself, or conjoined with one or more in the class; and thus a kind of hybrid may be produced, which prevents a distinct classification.

In the first place, there cannot be any doubt as to the effect of inherited tendency; some state which has been engrafted into the constitution by the acts, the habits or the vicious conduct of preceding generations. This state may give rise to irregular development as to shape and size, or the order in which the teeth are set in the jaw-bones, and may introduce a race of beings in which the new condition becomes all but natural; or it may show itself in those forms of constitutional disease, the presence of which does not appear to have arisen in the early days of the world, as far as we can learn from ancient history; for syphilitic conditions, which are common now, find no representative in the Egyptian tombs.

These conditions, descending in later times from grandfather to grandson, or even from ancestors more distant still, show the taint in the unnatural form and early decay of both the temporary and the permanent sets of teeth. Syphilitic states have their first causes in alterations of the protoplasm or primary germ of the new life; for when the tooth is developed, as I shall show later on, conditions and consequences arise, for which the parent must be responsible. A similar condition is met with to some extent, though not with so determined a result, in those persons who have had gouty ancestors. Children who have inherited a gouty constitution, suffer to some extent according as to whether that gouty state was inherited by the parent himself, or purchased by his own acts. In some cases, it falls with double vengeance upon the child; for the parent has not only inherited the condition, but he has added to it by his own love of vicious feeding and strong drink. The young man who makes a god of his belly, and thinks more of his eating and drinking than of his children's welfare, or of his own future state, may procreate a generation of persons, who may suffer much from dental as well as from other defects; and the pains which the children innocently endure in this world are, to my mind, the punishments which will have to be borne by the father in the next. They assist to make up the measure of that future punishment, which we are taught to regard as the result of the wrath of our Maker for our own sins, whilst, in reality, it is simply the sequence of our own acts and deeds. This sequence arises in consequence of the immutable laws which the Creator has given to matter; it is the result of those laws and not the anger of a revengeful deity. Besides syphilis and gout, both of which have a direct action upon cutaneous surfaces, and, as I wish to show, a special action upon the teeth, we have constitutional diseases affecting development of the other parts of the primordial utricle, or first layers of the original protoplasm. This shows itself in defective nerve-power and in the want of that nutritive force which promotes the growth of the homunculus. Then there are all the consequences of accidental damage or injury to the foetus, or to the young child, producing immediate effects, or shewing themselves later on in life. Causes which have been in temporary operation, or which may have been continuous; causes which have produced immediate results, or which have only developed their natural sequences years after such causes have ceased to be; causes connected with the simple wear and tear of the organ itself, and which has been induced by a wrong kind of food, by defective muscular action, one muscle acting stronger than its fellow, or by an improper proceeding on the part of the nurse or guardian, or, perhaps, of the family doctor in prescribing dangerous remedies at the wrong time, or in wrong doses: and causes which have been induced by the cupidity of man, in adulterating food with articles which were not intended for the human teeth to grind,

or the human stomach to digest—all these causes and conditions operate to provide work for the dentist, and all are, more or less, preventable in future generations, if not in our own time.

I need not detain you by a discourse upon the chemical constituents of the teeth. The nature of those constituents, as well as of bone in general, is well known to you. I will simply recall to your mind the fact that phosphate of lime is the principal inorganic matter in the substance of the teeth, but that, when all the mineral matter is removed from a tooth, there is a skeleton of organic matter remaining, which is equal in volume to that of the tooth itself; but that, whilst dentine contains twenty-eight parts per cent. of organic matter, it falls to less than three per cent in the enamel. I may also remind you that the crista petrosa is closely allied to, if not identical with, true bone. You are fully acquainted with the course which is taken in the development of the teeth, the first step in that development being a visible thickening (in the sixth week of foetal life) of the epithelium which covers the free border of the jaw; that a groove, which has been styled the primitive dental groove, forms upon it; and that it is from the epithelium in this groove (from a part of the system which, therefore, corresponds to the skin) that the teeth have their primary origin; that the deeper layers of this epithelium send processes down into the substance of the mucous membrane, which is indented by a papilla; but the sides of the indentation are separated by loosely arranged star-shaped cells. The embryonic tooth is the speck which is now entirely enclosed in its dental sac. The papilla moulds into the shape of the crown of the tooth; the epithelium upon it, in the course of time, changes into enamel and dentine. The latter increases in thickness by addition to its interior, which is in close contact with the vessels from which it soon gets its own nourishment. Ossification commences by the deposition of calcareous matter in the cells of the membrane at the top of the pulp. It appears in the ivory membrane first, and soon afterwards is seen in the cells of the enamel membrane, for so these two layers are styled. The point of most importance in this description is, that the teeth are epithelial structures, and differ, to some extent, from bone, like that of the thigh-bone, in their liabilities to disease; for the ordinary bones are derived from a different part of the skeleton, and are not liable to those mischiefs from which the teeth suffer.

A study of the teeth among the lower animals is especially interesting to the searcher after first causes, and throws a flood of light upon development. Among some of the invertebrata, the teeth are clearly gastric, being a part of the stomach. In this position, they do not depart from their epithelial character, for the mucous membrane of the abdominal tract is as epithelial as is the skin, and has the same origin. These teeth are composed of chitine, impregnated with lime or silica. The teeth of the sea-urchin are made up of prisms of carbonate of lime, with leaflets interspersed between the prisms, and in them we find a fine plexus of anastomosing canaliculi. It is among the shells of the molluscs that we first find a division into an outer prismatic or fibrous, and an inner laminated tissue, similar to that in vertebrate teeth. Among the terebratulæ, we find (according to Dr. W. B. Carpenter) tubes traversing the substance forming branched horizontal channels, sometimes connected with rounded cavities, which seem to be analogous to the lacunæ and canaliculi of the crista petrosa. The shell of the mollusc which has become calcified corresponds to the epidermis of the higher animals, and thus their teeth have the same origin as those of vertebrata, viz., being epithelial. The prism-like appearance is due to the cellular structure, and the transverse striæ corresponding to the thickenings of the cellular membranes, where the layers come into contact with one another. My great namesake states that, in his opinion, the calcareous network, which is seen in the shells of the invertebrata generally, corresponds to the fibrous structure of the cutis of the higher animals, which has obtained a calcified condition.

Let us now ask a question or two as to epithelium, and the duties it has to perform. 1. It is protective; of that there can be no doubt. 2. It is excretory.

That which applies to the whole may apply to any part. The nails and the hair are undoubtedly epithelial, and equally liable to changes which indicate alteration in the primary cells from which those organs spring. There is a difference, however, between the teeth on the one hand and the hair and nails on the other, inasmuch as the latter are made up principally of organic substances, and are of a horny nature, which is almost indestructible; it is allied to, but somewhat different from, gelatine, and is sometimes styled keratin. This material, therefore, occupies the position of indestructibility which is held by the enamel of the teeth, but which, in the latter case, is mainly due to inorganic matter. Its chemical character is not clearly set out; but, whilst enamel has a minute portion of organic matter in its composition, horn and nail have but little inorganic deposit—perhaps even less of the inorganic matter than enamel possesses of the organic. There is

thus a curious though antagonistic analogy. The minute quantity of organic matter in the structure of enamel is the channel by means of which the life of the tooth is kept up; and a dead tooth, like a dead shell, is somewhat different from one that is still in living contact with the body of its owner. A necrosed tooth as well as a dead shell will easily take on decay. If an expert examine the collection of a conchologist, he will be able, without hesitation, to separate in the collection those shells whose original bearers had died a natural death, and which had been afterwards exposed to external influence as a sequence to that death, from those which had been taken alive. A shell picked up on the sea-shore without a living inhabitant is quite different from those which are taken with the animal living in them, and which alone make fit addition to the collector's drawers. Changes take place very rapidly in the one kind of shell, which do not show themselves at all in the other. The organic matter of the living shell is a reality, and it lives with the animal itself. The changes which take place in the dead shell are rapidly promoted by friction, by the action of the air, and by water acting upon the organic matter, which, being deprived of its vitality, allows alterations to take place in it, to which it was able to furnish a complete barrier when in the living state, and in absolute union with the living animal, although it is not permeated by blood-vessels, and there is no evidence of nerve-tissue in its substance. The friction on the sea-shore is not greater; the action of salt water upon the dead shell is not different from that which it has upon the living shell and animal together; yet these actions are operative on the dead shell in the one case, and are without injurious effect in the other. Suppose we examine the oyster-shell. Sections of this shell, when carefully prepared, make very pretty microscopical objects, and show markings which correspond very closely with the lacunae and canaliculi of the *crusta petrosa* of human teeth. Oyster-shells consist mainly of carbonate, not of phosphate of lime. The phosphorus is retained by the animal, and it does not become an excretion; it is a constituent of the tissues. The phosphate, not the carbonate, is the principal inorganic ingredient of the human tooth. There is here, then, a manifest difference between the excretion which forms the shell of the mollusc and that which forms the tooth of the vertebrate animal. You may ask what I mean by this expression of excretion. It is simply the statement of a fact. Every deposit which is made by any organ in the body is an excretion as far as the rest of the body is concerned. The deposit is able at times to destroy the life of the rest, if it be kept in contact with the body at the wrong time. Whether it be urea, which is the organic salt excreted by the kidneys; or the carbonic acid which is thrown off by the lungs; the cholesterine which the liver gets rid of, and which is probably one of the products of nerve-action; the epithelium which is shaken out of one's flannel shirt when the latter has been worn too long; or even any secretion, such as milk or saliva,—all these are excretions. Once formed, they must not be retained in the organ which has formed them, or mischief will result to that organ. The hair and nails are the manifestation of an excretion; the materials forming those parts, which are intended as defensive organs, have been used up in some special work about the body, and are no longer required within the precincts of that body; and, being done with, the materials which form those appendages are extruded from the body. The elements of which the shell of a mollusc is formed are in the same category as those of the nails and hair of the vertebrate animals. They are done with as far as the nutrition of the active organs of the body is concerned; they become excretions, and at the same time are made into protective organs. The phosphate of lime, of which the bones and especially the teeth of the vertebrate animals are formed, is in the same position, for it is an excretion. It is done with, and ordinarily it cannot again enter the circulation and be used up for any other purpose.

There are some exceptions to this rule, which allow the excreted material to be altered in its chemical character when required for admixture with other extraneous matter, and then, it may be absorbed again for immediate use and ultimate removal; but, as a whole, the rule is as stated. An excretion is a poison as far as the rest of the body is concerned. If that excretion be suddenly checked, and the materials which form it be thrown back again into the animal economy, mischief will result and disease be set up. With regard to some secretions, the quantity is comparatively unlimited, but with others it is not so, the quantity is small and cannot be largely increased. We have instances of abnormal growths, such as Mr. Darwin alludes to in his work on *Animals and Plants under Domestication*. In this work there is a notice of the relation which holds between the abnormal growth of hair as compared with teeth; it sometimes happening that excessive development of hair has been attended by an edentulous state, as if Nature could not form more than a certain quantity of some kind of materials; and if one be formed in excess, there is deficiency of the other. Two

men were shown in Paris some years ago, who were father and son; they were without teeth, but with their faces and necks completely covered with shaggy hair, like unto Scotch terriers. It seemed as if, in these cases, the organic matter required for the hair was provided at the expense of the phosphate of lime, or perhaps the absence of the latter excretion allowed the hairy development to take place, and then the organic matter which was required for tooth-development could not be diverted back to the dental tissues, or was not at hand at the moment when it was wanted. If the organism be defective in its constitutional parts at its first foundation, if the products necessary for first development be wanting, we may have defect in the first lines of life, and hence a tendency to decay may originate at the first moment of our birth; and we may say with Pope—

"That man,
The moment of his breath,
Receives the lurking principle of death;
The young disease, which must subdue at length,
Grows with his growth, and strengthens with his strength."

It has been fully recognised that phosphate of lime is the principal inorganic element in the chemical constituents of the teeth. It also forms a large part of all bony matter; it has been assumed that the formation of bone is the main purpose for which the phosphates are required. I am bold, however, to think that this is clearly not so; phosphate of lime is a constituent of all organic life, or at least some salt of which phosphate of lime is the result. The phosphate is probably the sequence of the act of living. Some portion of it plays an active physiological part in the manifestation of vital phenomena, and no life can be carried on without it, either as an active part or as the result of action. It is the principal inorganic matter which is first used in the progress of development, and there must be depôts for the used up material. There exists no tissue in animated nature which does not contain phosphate of lime in some form or other as the sequence of the activity of that tissue. It has an influence upon organic life, possibly in the more soluble form of superphosphate; and its presence is most likely absolutely necessary for the changes which take place in cell-life. It is known that it exists largely in nerve-matter; that phosphorus, or some salt of phosphorus in some form or other, is indispensable for nerve-development, and it is probable, therefore, that those bodies which are placed low in the scale of creation, and which do not possess a distinct nervous system, have a certain power resulting from the presence of a salt of phosphorus, which enables them to carry on their nutritive actions without the intervention of a brain or spinal cord, or even a nerve-ganglion of any kind. The presence of some salt of phosphorus is absolutely indispensable for the formation and continuance of cell-growth; and in the production of new cell-life the phosphate is formed, and after a time has to be removed from its position in the animal economy. It becomes an excretion, and has to be removed from the tissues of the animal. Even before a regular nervous system is found, and in the early days of organic life, we find it exuded from the system by the epithelial structures. Phosphorus is present in the lowest forms of vegetable life, as well as those which are animal. It exists in an appreciable quantity wherever there are fibres and cells. It is found as a necessary constituent in our daily food. It is abundant in milk, in fish, and in wheat. The more active the process of development which is going on, the larger is the quantity of phosphorus in the organic matter of the specimen under examination. It has been shown that wheat grown in a soil completely deprived of phosphates can grow into a plant, but cannot produce grain. There is a great difference—an antagonism, indeed—between animal and vegetable life in this matter, so that phosphates are not excreted as if they were used up material by plants, but they are laid up principally as store in the seed of the plant for future use. The phosphate does not form an intrinsic part of the skeleton of the plant, but it accompanies the albuminoid substance whose existence is anatomically independent of the solid tissues. It appears to be a special part of the work of the plant to secrete this in the material which it prepares for the nourishment of animals. They feed upon the result, and are able to carry on their own functions by its means. There is an important distinction, therefore, between the position of the phosphates in the one, as compared with the others, and it corresponds to some extent to the position occupied by carbon and oxygen in the two kingdoms. The latter element is, as you know, excreted by the plant as the result of its organic life, the carbon being retained and used in building up the tissue of the plant; but, in animal life, it is the carbon which is excreted as carbonic acid, which is exchanged for oxygen. The phosphorus is in combination with the organic, not the inorganic, parts of the body. The larger the amount of phosphoric acid in a given quantity of organic vegetable matter, the more vigorous are the actions which are going on, and the greater is the vitality at work in the material under examination; not, however, for the purpose of forming

a skeleton. I wish you to bear in mind that it is in the albuminoid material, and not in the skeleton of the plant, that phosphoric acid, or some salt of which phosphorus is the base, is most abundant; and that at least some plants cannot perfect their species, and prepare seed for future developments, if phosphorus be withheld. There is also a point in which there is no antagonism between plants and animals, and which is worthy of notice as bearing directly upon our subject. There is a special liability to disease among plants as well as animals under certain conditions. The epidermis of plants which are not sufficiently supplied with phosphoric acid is prone to suffer from disease; and a wheat-crop in a field in which the soil no longer contains phosphate salts is very liable to blight and rust, and to mildew. There is a kind of defective nerve-power, so to speak, in the structure, which lays the plant more open to the attack of outside enemies. Whilst there is absolute failure in its ulterior development, it cannot perfect its epidermis properly. If there be no phosphate in the soil at all, the plant will grow as long as there is phosphorus in the seed itself, but no longer. As soon as this reserve is used up, the nerve-force is lost, and the plant decays. Can we not, in this view of the matter, which we obtain from the vegetable kingdom, draw some inference which may be of service in considering the cause of decay of teeth in animated nature? If phosphorus, in some form or other, be not provided in the food we eat, it is found by every-day experience that the constitution suffers exceedingly. There are conditions of life in which it is not so provided.

In some of the great cities of the empire, there is, or was, a great deficiency in the natural food which infants require for proper growth. In those places, rickets (or rachitis) abounds. This is a disease of bone in which the phosphate of lime is very deficient; the bones are soft and cellular; the teeth are also defective; and the intellect inferior, from inertness of cerebral action. I am of opinion that this state is brought about by a deficient supply of proper pabulum, for natural development. The child is not nourished by its own mother's milk, and cow's milk cannot be obtained in sufficient quantity and quality by the poor people in such cities; they either do not get it all, or if they do get it, it has been watered; or it is supposed by the ignorant parents that something else is better for their children. They do not get fresh vegetables which contain phosphates in the soluble form, and they are supplied with farinaceous food, in which the larger portion of the cuticle which contains much of the phosphate salt has been removed by decortication. The result of this kind of feeding is, that the nervous system does not get its proper supply of food for healthy development; and, as a sequence, those organs which are dependent for their own development upon the composition which results from the act of brain-cell growth, cannot be perfected; the teeth fail in their proper construction, there is more organic than inorganic matter in their structure, and, like the proper skeleton, they cannot perform the functions which nature intended that they should do. A purely flesh-diet, one that is too nitrogenous, will produce rickets and lead therefrom to failure in the teeth.

On the other hand it has been noted that, if phosphorus be given in excess of the requirements of the system, as has been done sometimes by experiment, it will itself set up mischief in the bones, especially if the lime-salts be withdrawn; and it is found that in those animals in which rickets have been thus produced, another material called lactic acid is found in excess in their structure and in their excretions. If lactic acid, such as usually develops in milk which has been kept too long, and which the poor children in our great cities too often get every day when they get milk at all, be given as a food, whilst phosphorus and lime-salts are withheld, rickets may be rapidly developed. In some large cities, such as Glasgow, for instance, it happens that lime is not a constituent of the water-supply. Children, therefore, run the chance in that and in similar cities of having no lime provided in the water, whilst no phosphate is provided, such as milk and vegetables give; they ignore the advantage which oatmeal supplies, and which Scotchmen, as a rule, think much of; and as a consequence rickets and states allied to it are common disease.

There is another disease which used to be very common in the naval service of this country in the last century, viz., scurvy. Two centuries ago, it was a complete scourge in all northern Europe, as well as in our own marine service; but the discovery of its cause has materially diminished its incidence, though it is even now in our own day much more frequent than it should be, and its effects are not always recognised in the minor form in which it does even now appear amongst us, both in the sick-room and also amongst poor people in thickly peopled districts. Its first incidence is upon the gums; the teeth loosen, there is a tendency to hæmorrhage and effusions of blood from mucous membrane; the slightest injury to the skin produces a bruised appearance. The cause for this condition, in my opinion, is the

absence of fruit and vegetables from the common diet of the sufferers. The effect of fresh fruit is to diminish those acids which result from the consumption of a flesh food which is too highly nitrogenous. The alkaline vegetable salts which fresh fruits contain, become decomposed into carbonates which pass off with the urine, and take with them some of the nitrogenous matter which exists as *débris*, which would, if left there, form lithic acid and its allies. The small quantity of a phosphate salt is used up in nerve-nourishment, and a phosphate of lime is formed. Fruit and vegetables are extremely advantageous, therefore, in those conditions of the system in which there is a lithic acid diathesis, and prevent the formation of urate of soda, which often by its deposition in the circumdental membrane produces those diseases of the teeth to which the gouty classes are especially liable. Improper food in infant life does lay the foundation of disease in the dental appendages, which, following upon those produced by hereditary causes, are very serious in their result; so improper feeding in our later days will do the same. I sometimes meet with people who never touch fruit and vegetables in their daily diet. They are on the high road to suffer from those diseases which result from a diet which is too nitrogenous, such as gout, fatty degeneration, or scurvy; they are depriving themselves of the pabulum which is necessary for the proper nourishment of both nerve and bone, and are keeping within the precincts of their bodies material which ought not to be there. They either have lost or will lose their teeth sooner than other people, simply because the supply of necessary material is not afforded. I sometimes meet with sick persons who have bleeding gums, continuous neuralgia, and a tendency to hæmorrhage which is produced by the slightest injury, who never touch fruit and seldom eat vegetables, because they believe that those articles disagree with them, by setting up dyspepsia and other gouty complaints; just as some people will not allow the housemaids to dust their libraries and book-shelves, because of the dust they are likely to kick up, and the displacements which are sure to follow. Is it a wonder that dust and dirt abound in that library, and *débris* of a wrong character finds a settlement in those positions in which such *débris* is out of place? It is just so in the human economy. If the diet be not of a proper kind—if some elements be ignored altogether, which nature intended us to take—there is sure, sooner or later, to be a defect in our excretions, and the fundamental condition of the body is altered. It is possible that the teeth are the *dépôts* for the deposit of the phosphate of lime, which is formed in very minute quantity in the first months of human life, and before the bones are ready to receive, it may be, the *débris* of the first nerve-cells which form in the infant. Let there be some defect in innervation, as may arise in the progeny of a syphilitic individual, and we see the result in the defective character of the phosphate of lime which is deposited in the cells of the ivory and the enamel membrane of the new development. It is not a pure salt; it contains something else besides phosphate, and, as a result, the cells themselves are imperfect, both in shape and number; the strife upon them are unerring witnesses of the taint which the father has inflicted upon his own progeny, and which taint will probably show itself later on in the life of the child, by defective nerve-centres, by a mental weakness, or it may be by paralysis or by insanity, and other nerve-disorders, which will require much care to stay their progress even if they can be prevented.

The dentist has a duty, when these cases come to his notice—viz., to inform the parent of the constitutional taint which exists in the child, and to advise that measures be taken to diminish its incidence by counteracting its influences, by temperance, by chastity, and correct diet. The children of this class are more prone to nerve-disorder than other people, that nerve-disorder being of the most painful kind. A warning should be given to the parent, and, if the child be old enough, a warning to himself, that there is very much to be done to get rid of a taint which touches the foundation of life itself, and affects the battery before it can show its results in the *débris* of that battery. How this effect is first produced is unknown to us; but that it does show itself in the second, and even a third generation is now fully acknowledged; and it ought to be taught to young men as one more argument against the vice of unchastity and the danger of uncleanness. The sequence is probably due to failure of nerve-growth as much as to caries, and the teeth are sometimes shed even before they are fully formed. The teeth cannot develop, because the material required for their production is not properly formed; there is no *débris* of the right kind.

Caries is also favoured by the condition which promotes tubercular tendencies; a minute particle of perverted protoplasm is laid down in the cell-membrane which forms the dentine, and which is chemically defective from having a tendency to fatty degeneration rather than to a proper deposit of phosphate salt. A

single cell may be thus invaded by defective structure, or half-a-dozen cells may be touched. As time goes on, the defective cells soften; and, by means of the imperfection of the organic matter which pervades the tooth in excess of the latter's requirements, there is a want of proper balance in the enamel, and the dentine, as regards the organic matter; the latter is defective in its composition, as well as in the support which it requires, and, in consequence, is more liable to wear and tear than would have been the case if the inherited defects had not existed; a small hole is punched in the tooth, which, if not remedied by the dentist's drill, will give a *locus standi* to foreign bodies, to vibrios, and to bacteria, and thus allows assaults being made upon the tissue which is still sound, by the secretions which the living organisms produce in the tooth, and caries then arises. An attempt is generally made, though unsuccessfully, by nature, if not assisted by art, to remedy the mischief. A small amount of chemical action takes place in the hole, which, failing in its object, in the course of time leads to extension into the pulp-cavity, and ultimately to the total loss of the tooth. It is necessary, for the best interests of the children of tuberculous parents, that their teeth should be frequently inspected by the dental surgeon, and those punch-like holes cleared out and stopped before the pulp-cavity is reached. In these cases, the conservative power of the dental surgeon is very manifest. He should advise a close attention to the rules which the tendencies to tubercle require to be observed, and urge upon the parents of such children to beware of the mischief, which, unless due care be exercised, must be in store for them; because it is manifest that, if germs of perverted protoplasm are to be found in the dental organs, it is certain also to be found in other tissues. I have reason, however, to believe that, when such tendencies show themselves on epithelial structures in early life, and when the deeper-seated organs are not at the same time affected, there is a much greater chance for hereditary conditions to be overcome. The tendencies to disease being limited to epithelial tissues, it is reasonable to hope that, with due attention to the rules which should be observed for securing a healthy state of body, there will be an evacuation of the *materies morbi*, and so the child may escape from the evil consequences which it has inherited. I have seen in some families, where the syphilitic taint has been undoubted, that those children with defective teeth, and who have skin-eruptions, and in whom the defect has been recognised, and all exciting causes for further mischief withheld—such as the use of mercurial medicines—and when an excessive animal diet—that they have escaped the evils which have befallen other members of the family, in whom the epithelial structures have not been at first affected, but in whom cerebral mischief has been the first to show itself, sometimes at an early date. I have seldom seen the presence of tertiary eruptions on young children, without finding evidence of mischief in the teeth, the hair, the nails, the epidermis—all more or less showing the taint; but, in other instances, I have also seen the teeth alone giving such evidence, and in those cases the individuals have grown up to man's estate in fairly good health, though the chances of such result were not great. But if, in addition to the taint as shown by the epidermis, there is also some organic disease in some of the splanchnic viscera, there is no likelihood that the child will make old bones. A large number of those cases in which early death arises from cerebral disease, are closely connected with hereditary syphilitic or tubercular taint; and the insight as to cause is obtained from the irregular, the jagged, and stained condition of the dental organs. We get a similar insight into tubercular tendencies in certain families. The teeth are not irregular, and jagged and stained, but they are thoroughly carious; there is a want of true bone and of true enamel. The material provided is fatty and friable; and, with this state of the teeth, we have often a tendency to bow-legs and soft irregular skulls. In these cases, it is defective innervation, which has arisen from foul and deficient sunlight and bad food. All these causes have been at work in the organisation of the parents, and show themselves in their progeny. A continuance of such causes, acting upon the child, increases very much the tubercular tendencies which exist in the constitution, and render him more easily liable to be influenced by cacozymes or septic bacteria, which are developed and flourish in foul air and dimly lighted dwellings. Children, therefore, having the first set of teeth carious, require something more than surgical aid. The parents should be advised to avoid the causes which promote septic developments, to cultivate the benefits which are to be derived from the influences of sunlight, from a pure dry air, and from simple unstimulating food. The surgeon who only attends to the teeth has done only a part of his duty. I have seen conditions in strumous children similar to those met with in children who have been born of syphilitic parents. When the evil has fallen upon the epidermis, and has shown itself in defective teeth, with scaly or vesicular eruptions upon the skin, the internal organs have escaped; and the children, having thrown out the morbid matter

which they appeared to have inherited, have grown up into healthy and well developed individuals; provided the laws of health have been observed, good unstimulating food, fresh milk, and vegetables, being provided, and fresh dry air, with sunlight, used and sought for. I have, on three or four occasions, seen two or three children in the same family, with bad temporary teeth and eczematous eruptions, grow up satisfactorily, whilst those with clear skins and not showing any defects of the epidermis, have died in early life of cerebral or menseptic disease of a tubercular character.

The effects of the gouty diathesis do not show themselves so markedly upon the teeth in early life as is the case with the syphilitic and the tubercular states. The tendency to disease which this diathesis does promote among the descendants of gouty people is more likely to manifest itself in another way, and other tissues suffer more than the teeth, though caries is not uncommon. The quality of the nerve-cells is not necessarily damaged in a gouty man, and, as a consequence, the teeth do not suffer so much in their first development.

The children of gouty people suffer from tendencies to blood-maladies which (just as syphilis does in the beginning) affects, in the end, every organ of the body, but it is in connection with nitrogenous material, and not the phosphorus in which changes arise; the organic rather than the intellectual regions of the body suffer from its incidence. The rise of gout and its sequences are connected with excess of material, and with derangement of the digestive organs, which is the consequence of that excess, rather than with the introduction of an extraneous poison or arrested growth. Syphilitic taint is probably due to a parasitic life, and tubercular growth arises from the presence of perverted protoplasm in the blood, in which bacteria or other forms of parasitic life can increase and multiply. Syphilitic conditions are due to a taint which will affect every person into whose organisation its first cause finds admission, and from whose tissues it has not been immediately ousted. The tubercular will only develop in those persons who have lived: unhealthy lives; it is caused by their surroundings: whilst gout is not produced by either of these conditions; it is a state induced by excess, and its sequences are on different lines; the surroundings may be quite healthy, but the habits of the victim are vicious, indolent, self-indulgent.

The conditions which induce it are not common to young people, and are not obtained in early life. They more often arise after the man has attained his full growth. His progeny are born into the world, in the majority of cases, before the humours of the body have been able to act injuriously upon the sexual organs. It is seldom that a constitution is thoroughly gouty before a man is forty or fifty years of age; and thoroughly gouty men do not have families to any extent after they have become saturated with gout; thus the specimens afforded are limited as far as children are concerned. Still it is, I think, a fact that the teeth do decay sooner in those who are descended from gouty parents; they are more subject to caries, which disease has its origin in fatty degeneration of the dental cells, and the subjects of it are especially liable to those peridental inflammations which ultimately lead to necrosis. Gouty men and women also suffer very much from neuralgia and other conditions of the system which have their origin in a lithic acid diathesis; and they can only be properly cured by associating the dental treatment with a proper diet, and the judicious use of remedies against the gouty diathesis. The presence of a lithic acid diathesis is often accompanied by pain, which reflects itself upon every function which the body has to perform. Indeed, the state of the mouth is frequently the Nemesis which attends upon over-indulgence, for the tender state of the gums and teeth puts an end to feasting, and induces that fast which is the true cure for excess of nitrogenous material in the blood.

Future history will show whether the children of total abstainers have an advantage over those of non-abstainers as regards soundness of teeth. At present, there is no proof that the acknowledged benefit of total abstinence does give any immunity as regards hereditary dental disease; but there is evidence that abstinence does assist to save the teeth of the goutily inclined. I have had too many instances before me to doubt the fact that the suffering which stimulants induce in those who indulge in them is also as manifest. Celsus writes, in his sixth book, *De Medicinâ*, "In dentium autem dolore, qui ipse quoque maximi tormenti, primo annumerari potest, vinum ex toto circumcidendum est; cibo quoque abstinendum."

That ancient and generally accurate writer is very decided upon this point, and yet it is curious how some modern physicians ignore the teaching of that acute observer, and prescribe alcohol in all its forms and in excessive doses, for the relief of dental neuralgia, with the moral certainty that they are only postponing the evil day, and adding to its ultimate intensity. The paralysis which alcohol induces in the vessels supplying the sentient nerve gives temporary relief; but the

pain of to-morrow is all the greater from the anæsthesia of to-day. Of two patients suffering from dental caries and who are intent upon continuing the presence of the offending organ in the mouth, the one who submits to the pain without using anæsthetic remedies will get over the action which is causing the neuralgia much sooner, and will get better with a far less expenditure of patience in suffering than the man or woman who flies to stimulants for temporary relief from distress. The alcohol simply delays the action which is necessary for the removal of the exciting cause, and does not at all assist to its cure. In theorising, however, upon the subject of alcoholic indulgence, we must bear in mind that, as a rule, children are total abstainers; and I believe that, if we could separate those who have no hereditary taint in their dental appendages, and then follow the total abstainers through life, and compare them in their decline of years, it would be found that the total abstainers had suffered comparatively little from neuralgia or any painful malady in the dental organs, as compared with the wine-bibber.

I do not yet know enough of the alliance between dental diseases and rheumatism, or of the connection, if any, with the cancerous cachexia, to make any specific allusion to those tendencies, even if time would allow me to do so; but there is a field for observation in connection with the development of lactic acid in the constitution, and the rheumatic diathesis, which the state of the teeth might assist to determine. I leave that for others to follow out. If I have given lines for future thought to those who have a more immediate connection with the results of dental disease than I have, I shall have effected my object. I think that our design should be, not the establishment of a foregone conclusion by bending our facts to our theories, but a steady observance of facts, a correct registration of conditions; and then in the end a proper generalisation may be obtained, which will be based upon the truth. This should be the desire of every one of us to get established upon a sound and satisfactory line, even if its establishment should lead to a large diminution of that work, which diminution has already made conservative surgery of more importance than heroic performance, and which will materially diminish extractions, and render prevention of disease of greater importance even to the surgeon-dentist than its radical cure can ever be.

THE TREATMENT OF RHEUMATISM BY BLISTERS

By A. B. R. MYERS, M.R.C.S. Eng.,
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ABOUT twenty-five years ago, I had the opportunity of studying the treatment of rheumatic fever by two physicians in the same wards. One of them prescribed opium freely, and the other gave no internal remedies; both had the affected joints carefully enveloped in cotton-wool, as they became attacked, and then firmly bound with flannel bandages, free perspiration being encouraged also by blankets, etc. The result seemed to me to be much the same: that the affected joints rapidly ceased to be painful, and that the patients made, as a rule, a good recovery.

Since that time, my treatment of rheumatic fever has kept very much within those lines (with, in some cases, the addition of salicin); and though I have seen many methods of treatment tried, and much extolled, I cannot say that they have appeared to me to have any special recommendations. But against one treatment I cannot resist, at the present moment, raising my humble protest, viz., the "garter blister," as again advocated by Dr. Davies in the *JOURNAL* of October 28th. When so eminent a physician, with all the authority of long experience of a treatment originated by himself, can still advocate it, he must be very confident of its specially beneficial action, and no doubt must have many followers; but of all treatments (except packing) it is the one which I would not have tried upon myself. I had quite hoped that, long ere this, it had died a natural death. I have seen patients suffer such great discomfort from the raw surfaces of these circular blisters above the knee-joints when other joints have become affected, as to make them beg not to have any more applied. I ask, therefore, why should patients be given this additional suffering as a local treatment, when rapid freedom from pain can almost certainly be obtained by careful bandaging, as above stated; and if it be intended as a constitutional treatment, why choose such a specially painful form of blister as the "garter"?

It is some time since I have been able to watch closely this circular blister treatment; but it made a very decided impression upon me that it did not cut short the attack, and that it was very objectionable from the patient's point of view.

BRITISH MEDICAL ASSOCIATION.

FIFTIETH ANNUAL MEETING.

PROCEEDINGS OF SECTIONS.

ON THE RADICAL CURE OF HERNIA, BY REMOVAL OF THE SAC AND STITCHING TOGETHER THE PILLARS OF THE RING.

Read in the Section of Surgery at the Annual Meeting of the British Medical Association in Worcester, August 1882.

By W. MITCHELL BANKS, F.R.C.S.,
Surgeon to the Liverpool Royal Infirmary.

A HERNIA which demands radical cure appears to me to be one which cannot be kept up by a truss, so that the patient shall be in comfort, and shall be able to follow his avocation. But, what is meant by a radical cure? In the strict sense, it means that the patient shall be restored to the original state of integrity in which he was before the hernia appeared. If a man have a hernia which no truss will keep up, which is a perpetual source of misery to him, and which prevents him from earning his living; and if, by an operation, you put that man in such a condition that, with a light truss, he can go about his work in comfort, I think the title of "radical" should hardly be grudged to such an operation. While, therefore, no patient, who, after an operation, is still obliged to wear a truss, can strictly be said to be radically cured, yet his condition is so little different from that of a sound man, and so enormously better than his previous state, when a truss was useless, that to him the operation has been much more than palliative. It has been practically curative, and so, in that sense, radical.

I need not enter into the history of the various operations for radical cure, beyond saying that the plan of invagination, practised by Wutzer, and that of injecting the neck of the sac, originated by Velpeau, and recently revived in America, are, to my thinking, useless. With Mr. John Wood's operation, you are all familiar; nevertheless, although it is twenty years since it was first brought out, it does not seem to have become a generally popular proceeding. Although, in the hands of the inventor, it is probably easy enough, to those who only read it up, it seems a complicated proceeding; and, moreover, there is a strong feeling that so large a percentage of cases turn out failures, that the game is not worth the candle. I am not in a position to adduce figures in support of this statement. I only mention it as a current opinion among operating surgeons, and as a reason why they do not more frequently perform the operation. Again, everything that can be got by Mr. Wood's operation, can be obtained by the simple and beautiful device of Mr. Spanton of Hanley, whose corkscrew operation fulfils all that is required for a simple case of inguinal hernia in a young person, where the sac is capable of being returned.

But, of late years, there has been a revival of one of the oldest method of cure—that by removing the hernial sac. That surgical bogie, the peritoneum, has been exposed; and we now know that, if not poisoned, it is a very tractable and inoffensive membrane. Indeed, even in cases of death after operation for strangulated hernia, it is very rarely that peritonitis kills the patient. Moreover, the confidence inspired by Listerism has made an astounding change in our views of the surgery of serous membranes; and to Lister is due the credit of having been early in the field, even in the department of curing hernia. So far back as 1871, he related two cases to the British Medical Association, at Plymouth, which stimulated many surgeons to follow in his footsteps. Among the most indefatigable has been Professor Annandale, who, in December 1880, contributed an admirable article on the radical treatment of rupture to the *Edinburgh Medical Journal*. He there enumerates four operations that have been performed upon the sac: 1. ligature of the neck of the sac alone; 2. ligature of the neck of the sac, with invagination of the ligatured sac into the abdominal opening; 3. Ligature of the neck of the sac, and excision of the sac below the ligature; 4. Ligature of the neck of the sac, with excision of the sac and stitching together the margins of the abdominal opening. He says: "Having used all these methods, I have no hesitation, from my experience, in giving the preference to the fourth plan." This is the plan which I have myself adopted; and I have no hesitation in saying that it is the best plan yet found out, and the one which will, in a short time, prove by far the most popular. It is applicable to every case of hernia that requires to be interfered with, and every surgeon can do it.

In performing it, I use thorough antiseptic treatment, and make a point of having the pubes, and parts around the anus, most carefully