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A
PRACTICAL TREATISE
ON THE
DISEASES OF THE TEETH,
IN WHICH THE
ORIGIN AND NATURE OF DECAY
ARE EXPLAINED;
AND THE MEANS OF PREVENTION POINTED OUT,
BY
WILLIAM ROBERTSON.

WITH PLATES ILLUSTRATING THE AUTHOR'S VIEWS.

LONDON:

LONGMAN, REES, ORME, BROWN, GREEN & LONGMAN,
PATERNOSTER ROW;

AND J. BELCHER AND SON, BIRMINGHAM.

1835.

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PRACTICAL TREATISE
OF THE
WILLIAM LAWRENCE Esq F.R.S.

IN WHICH THE
ORIGIN AND NATURE OF DEAF
IS RESPECTFULLY INSCRIBED

AND THE MEANS OF IMPROVING THE SENSE
BY
THE FOREIGN AND ORDINARY SERVANT.

WITH PLATES ILLUSTRATING THE AUTHOR

BIRMINGHAM:
J. Belcher & Son, Printers,
High-street.

WILLIAM LAWRENCE

THIS TREATISE
IS RESPECTFULLY

HIS OBLIGED AND OBE

Old Square, Birmingham,
July 2, 1835.

TO

WILLIAM LAWRENCE, Esq. F.R.S.

THIS TREATISE

IS RESPECTFULLY INSCRIBED

BY

HIS OBLIGED AND OBEDIENT SERVANT,

THE AUTHOR.

Old Square, Birmingham,

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PREFACE

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PREFACE.

IN the course of a long and extensive practice, my attention has been often forcibly drawn to the great and too-frequently irreparable mischief which has arisen from the want of a correct knowledge on the subject of caries, or decay of the teeth. It is generally assumed that the structure of the teeth is similar to the other parts of the body; and consequently, that in the former as in the latter, the commencement of disease will necessarily be attended with pain, and that it will be time enough to apply for advice when pain has occurred. I have, however, in the pages of this treatise shewn the fallacy and danger of this mode of viewing the subject, and pointed out the incurable mischief which will inevitably result from it. I have been anxious to remove another popular error, relative to the period of life when the teeth are the most

subject to caries; I have, therefore, shewn that in youth, the time when it is least suspected, the liability to caries is greatest, and that its approaches are then to be the most attentively guarded against.

The few works of authority hitherto published, on the diseases of the teeth, are almost exclusively intended for the instruction of the medical student; and necessarily are, on that very account, but little adapted to afford information to the general reader. I trust that a careful perusal of the following pages will show how important it is that the latter, even more than the former, should possess an accurate knowledge of this subject. The evils resulting from a want of this knowledge may, in general terms, be considered of two kinds. In the first place, patients ignorant of the predisposing and exciting causes of caries, are not able to detect its presence until its destructive progress has placed the case beyond the means of remedy; and, secondly, it renders a large portion of the community the dupes of a class of practitioners, who can only be designated by their pro-

per title of charlatans, and whose
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which have possessed most

per title of charlatans, and whose absurd pretensions and promises of relief I should have thought too extravagant for the present age, if the instances of mischief produced by their nostrums were not so numerous.

As one of my objects, indeed the chief one, has been to make the non-professional reader acquainted with the nature and progress of caries, and with the preventive and remedial measures which it is necessary to adopt, I have entered no farther into the consideration of the anatomical structure of the teeth and of the parts connected with them, than appeared to me absolutely necessary in order to make that part of the subject, which is by far the most important, clear and intelligible; and this course I have pursued without hesitation, since the works of Hunter, Fox, and Bell, will furnish the most ample information on anatomical details, to those whose tastes or pursuits would lead them to enter more deeply into this enquiry.

The theories hitherto brought forward to explain the origin and progress of caries, and which have possessed most weight and influ-

ence both with the profession and the public, I have considered it right to submit to a free though not uncourteous criticism; because they are not only inadequate to explain the phenomena of caries, but are essentially fallacious, and have a tendency to lead their readers, in imaginary security, to wait till pain has been produced.

The theory, however, which I have advanced explains all the phenomena of caries, and accounts for all those circumstances which previous authors regarded as inexplicable anomalies. It is strictly the legitimate deduction from facts which every person can examine for himself, and it possesses this advantage over the explanations hitherto given, that it shews how caries may, in a great majority of cases, be altogether prevented; or where this cannot be accomplished, it explains to us the reason why, and teaches us how to detect the mischief at its early commencement, to arrest its progress, and to prevent its recurrence.

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ERRATA.

Page 24, line 15—For *existing* read *exciting*.

— 26, — 10—For *correspondence* read *coincidence* ;
and in the next line, for *coincidence* read *correspond-*
ence.

Page 73, line 16—For *if* read *is*.

In the first part of the paper, the author discusses the general principles of the theory of the origin of life. He then proceeds to a detailed examination of the various hypotheses which have been advanced to explain the origin of life, and finally arrives at his own conclusions. The paper is written in a clear and concise style, and is well illustrated by numerous diagrams and figures. It is a valuable contribution to the history of science, and is highly recommended to all students of the subject.

ERRATA.

Page 24, line 15—For "origin" read "origins".
Page 24, line 16—For "consequence" read "consequences".
Page 24, line 17—For "and in the next line" read "and in the next line, the consequences read consequences".
Page 24, line 18—For "V" read "v".

A

PRACTICAL TREATISE

ON THE

DISEASES OF THE TEETH.

THE object of the present work is to make the general reader acquainted with the insidious nature of the diseases to which the teeth are liable, to explain to him their causes and progress, and to shew that a knowledge of these is absolutely necessary, either, by early attention, entirely to prevent their occurrence, or, by timely application, to counteract the mischief before it has become irremediable.

It may be safely asserted, that none of the organs of the human body are so often the subjects of disease as the teeth; none, the diseases of which are so little understood, and yet, when rightly comprehended, none, more completely under individual control. When we reflect how few persons there are who have not experienced some of the ill effects of

diseased teeth, and how many there are to whom they occasion constant annoyance and pain, it is surprising that the subject should have so long escaped the minute attention of the medical physiologist. The celebrated John Hunter may be said to be the first to have entered upon this investigation, in his *Treatise on the natural History of the Human Teeth*, which appeared in 1771; and, as an anatomical production, this work must be allowed to stand pre-eminent; for so fully and so successfully has he treated this part of the subject, that he has left but little of importance for succeeding authors either to add or improve. Mr. Hunter, seven years afterwards, published a practical *Treatise on the diseases of the teeth*, intended as a supplement to the former work.

It can be no detraction from Mr. Hunter's reputation to state, that on this subject he has not been so successful as on the former; for it is well known that he did not devote much of his time to the practice of this branch of surgery, which at that period was imperfectly understood and but little attended to; it is only

within the last thirty years that Dental Surgery has become the exclusive profession of a distinct class of medical men.

Mr. Hunter had not, therefore, the advantages which may be derived from long and extensive practice, nor had he the opportunity of benefiting by the observations of previous authors; nevertheless without the aid of these advantages he approached nearer to the discovery of the origin of decay in the teeth, the most destructive disease to which they are liable, than any subsequent author.

Mr. Hunter, in the commencement of his inquiry into the nature of this disease, very justly observes that there is something more than mortification or a death of the part, that there is some operation going on, that is to say, some progressive morbid action, producing a change in the diseased part; and, after having minutely described the external character of the disease, and its first appearance on the enamel of the tooth; and most correctly distinguished the teeth and the parts of them most liable to its attacks; perceiving also that a disease originating in an inorganic substance could not arise from dis-

order of the vascular system and vitality of the tooth, and yet not being able to discover an external cause which would account for a disease so partial in its attacks on particular teeth and particular situations of them; he gave up the investigation without discovering the true nature of the disease and the agency by which it is produced.

The two best Treatises which have appeared on the diseases of the teeth, since those of Mr. Hunter, have proceeded from writers who have practised Dental Surgery as a distinct profession; the one by Mr. Fox, in 1806, and the other by Mr. Bell, in 1829. Each of these authors has promulgated a Theory on the nature and origin of decay of the teeth, and both with the professed object of supplying the deficiency of Mr. Hunter. These two scientific and able writers are considered the principal authorities in their particular department of the profession, and their views may be said to represent the opinions of its members generally.

In venturing therefore, to point out the erroneousness of the doctrines laid down by these

eminent authors on this most important subject, and to bring forward what I consider a correct theory of the nature and cause of caries or decay of the teeth, I trust I shall obtain credit, when I declare that I undertake the task with considerable deference, and that I am only influenced in doing so, in opposition to such influential names, by a strong conviction of the practical importance of the opinions which I have been led to adopt. For upon a correct knowledge of the causes by which this disease is engendered, and the true development of the nature of the morbid process, must depend all the rules of treatment both for the prevention and the timely correction of the diseases of the teeth.

The mistaken notions which have been advanced upon this subject, it is of the more importance to correct, because they erroneously suppose the proximate cause of decay to be inflammation of the internal substance of the tooth, commencing, according to the theory of Mr. Bell, upon the surface of the bone within the enamel, and according to the doctrine of Mr. Fox, originating in the internal membrane;

and consequently, the primary seat of the disease being in the interior of the tooth, it does not discover itself externally until it has made considerable ravages in the internal substance of the organ; an error of the greater importance because it leads the public in general, to whom the influence of the opinions of eminent men naturally extends, to neglect the disease during its first stages, when its progress might be arrested, and to withhold their attention until acute suffering and irremediable mischief have been produced.

The views which I have been induced to take of this subject, from a long course of practice and observation, are of a nature altogether different from those above alluded to; and I feel assured that the evidence which I shall be enabled to produce in the following pages will satisfactorily prove the disease in question to have an origin entirely different from, and a progress diametrically opposite to, those insisted upon by the authors before mentioned; and should I succeed in establishing my opinions, they will necessarily lead to consequences of the first importance, by shewing the

possibility, with proper care and timely attention, of permanently arresting the disease during its first stages, and before the vital parts of the tooth have been exposed and inflammation consequently excited; an object which the doctrines hitherto inculcated could not embrace, because they assume extensive mischief to have taken place before any visible signs of it are discoverable.

The best way to find remedies for a disease is to begin by ascertaining its origin; I shall therefore, in the first place, endeavour to trace caries or decay of the teeth to its true source, and explain to the general reader the predisposing and exciting causes, and the nature of that morbid process by which the destruction of the teeth is gradually and insidiously effected; and, in the second place, shall lay down rules of treatment for the preservation of the teeth. But, in order to make myself clearly understood, it will be necessary to give a short description of the structure, organization, and arrangement of the teeth.

A tooth consists of two parts, one of which is called enamel, and is composed almost alto-

gether of the phosphate of lime; that part of the tooth which is exposed, and which is named the crown* of the tooth, is covered over with this dense substance. The other part, consisting of the fangs† which are imbedded in the sockets, and the body‡ of the tooth contained within the enamel, is of the same composition as other bones, but more compact and close in structure, containing more of the phosphate of lime and less of animal matter. The enamel is complete at the period when the tooth appears above the gum, and no addition takes place afterwards, as erroneously supposed by some persons. It is quite the reverse with the bony portion, for at this period the fangs are very imperfect in their formation, the openings at their points where the nerves and blood vessels enter, and the ducts through which they pass, are large,§ as is also the cavity of the tooth; but a deposition of bone continues until the cavity becomes comparatively small,|| and the same thing goes on with the fangs until the open-

* Plate IV. fig. 5, a. † Plate IV. fig. 5, c.

‡ Plate IV. fig. 9, c.

§ Plate IV. fig. 9, f, e, d. || Plate IV. fig. 10, d, e, f.

ings at their points will scarcely admit the smallest needle.

The nerves and arteries which enter the fangs of a tooth branch out upon a fine membrane that lines the cavity within the tooth. There is another membrane, namely, the periosteum, which lines the socket and envelops the fangs; we shall find in the following pages the absolute necessity of protecting these membranes from the influence of foreign bodies, and the mischief which results from their becoming exposed.

A complete set of teeth comprises thirty-two in number, sixteen in each jaw, and they are arranged in the following order, namely,

Two front Incisores, or cutting teeth.

Two lateral Incisores, or cutting teeth.

Two Cuspidati, or canine teeth.

Four Bicuspides, or small grinding teeth.

Four Molars, or large grinding teeth.

Two Dentes Sapientiæ, or wisdom teeth.*

Having given this brief description of the teeth, which I trust will be found sufficient for the general reader, to whom alone it is

* Plate I. fig. 1 & 2.

addressed, I shall now proceed to examine the theories advanced by Mr. Fox and Mr. Bell, as explaining the origin and progress of decay in these organs; and to point out the erroneous views which these authors have taken of this subject.

“The proximate cause of caries,” says Mr. Fox, “appears to be an inflammation in the bone of the crown of the tooth, which, on account of its peculiar structure, terminates in mortification.”

“The membrane which is contained within the cavity of a tooth is very vascular, and possesses a high degree of nervous sensibility; and inflammation of this membrane is liable to be occasioned by any excitement which produces irregular action; and as the bone of the tooth is very dense, and possesses little living power, a death of some part of it may speedily follow an inflammation of the vessels of the membrane which is contained within the cavity. When this membrane becomes inflamed,” he says, “it separates from the bone, and the death of the tooth is the consequence.”*

* Fox's Nat. Hist. of the Teeth, part ii. page 12.

According to Mr. Fox's theory, inflammation of the membrane within the tooth is the original and immediate cause of decay in the tooth. If this were so, we should be subject to tooth-ache, which is nothing more than pain produced by inflammation of the membrane, previous to the commencement of decay; consequently we could have no intimation of the disease until it was placed beyond the means of cure, and should be under the necessity of having recourse to the operation of extraction in all cases.

The doctrine which will be insisted upon in the following pages, is the very opposite to that which has just been quoted, and I shall have no difficulty in proving inflammation of the internal membrane to be the result of previous decay in the tooth, not the cause of it, and that decay may be detected and permanently arrested, before the membrane of the tooth has become exposed and consequently before inflammation has been excited.

Mr. Bell, the author of a work before alluded to, entitled, "**The Anatomy, Physiology and**

Diseases of the Teeth," differs from Mr. Fox in his view of this subject, although like Mr. Fox, he makes the proximate cause of decay of the teeth to consist in inflammation, but in inflammation of the external surface of the bone immediately under the enamel. "The true proximate cause" says he "of dental gangrene (caries) is inflammation; and the following appears to me to be the manner in which it takes place; when, from cold or from any other cause, a tooth becomes inflamed, the part which suffers the most severely is unable, from its possessing comparatively but a small degree of vital power, to recover from the effects of inflammation; and mortification of that part is the consequence."

"The situation in which gangrene invariably makes its first appearance, immediately under the enamel upon the surface of the bone, is, I think, explicable only with the view I have taken of the structure of the teeth, and the nature of this disease. As the vessels and nerves, which supply the bone of the teeth, are principally derived from the internal membrane,

it is natural to conclude that, in so dense a structure, the organization would be less perfect in these parts which are farthest removed from its source.”*

Now there is one simple, and, I think, conclusive argument, both against the theory of Mr. Bell, who refers the origin of decay in the teeth to inflammation in their bony structure, and to that of Mr. Fox, who refers it to inflammation of their internal membrane; namely, that as all teeth are furnished with a similar lining membrane, and all are possessed of the same bony structure, they should all (according to these views) be equally subject to the same disease, and no one class of teeth should therefore be more frequently the seat of caries than another; and yet it is a fact universally admitted, and acknowledged by the authors just quoted, that this is not the case.

Mr. Fox says “the molares (or large grinding teeth) are more subject to this disease than any other teeth; and that the incisors of the upper jaw are very frequently affected by it, whilst the

*See Bell on the Diseases of Teeth, pages 124 & 125,

incisors of the lower jaw very seldom become decayed.”*

Mr. Bell says, “The teeth most liable to mortification are undoubtedly the *dentes sapientiæ*; the first molares are also frequently decayed at an early age; so much so that it is often necessary to remove those teeth in consequence of severe suffering from tooth ache, even before many others of the permanent set are perfected. The *cuspidati*, both superior and inferior, are comparatively seldom the subjects of disease; and the inferior *incisores* still more rarely.”†

Mr. Fox has attempted no explanation of these facts, and Mr. Bell has only endeavoured to account for the greater liability to decay in the *dentes sapientiæ*, or wisdom teeth.

“This probably arises,” he remarks, “from their being formed at a later period of life than the other teeth, when the constitution is doubtless in a less favourable state for the production of newly formed parts, than

* Fox on the Teeth, part ii. page 9.

† Bell on the Teeth, page 133.

during early infancy, when the process of new formation is going on with rapidity in every part of the system."*

The statement of Mr. Bell, as to the greater liability to decay in the *dentes sapientiæ*, is perfectly in unison with my own experience; but his attempt to explain it, is not satisfactory, and it appears to be inconsistent with other statements made by him. If this liability depended, as Mr. Bell suggests, on their being formed at a later period of life than the other teeth, why should the molar teeth, which are formed in early infancy, and at the period which, according to him, is most favourable to the process of new formation, be so peculiarly disposed to decay? Mr. Bell himself in describing the various predispositions of the teeth to caries, has placed the molar teeth next in order to the *dentes sapientiæ*, and Mr. Fox has declared them more subject to this affection than any of the other teeth.

The same objection which has been made to the proximate cause of decay, as depending on inflammation of the bone, or in-

* Bell, page 133.

ternal membrane of the tooth, is equally applicable to the supposed exciting causes of the disease; such for instance as hot and cold climates, the taking of food at a high or low degree of temperature, the drinking of strong spirituous and fermented liquors, a disordered state of the stomach, a debilitated constitution, &c. If decay in the teeth were occasioned by any of the above-mentioned causes, all being equally exposed to their operation, they would in like manner be equally the subjects of disease.

It must be evident, from the preceding observations, that no satisfactory reason has been assigned for a fact, which is acknowledged by all writers on the subject of caries, however dissimilar their opinions as to its nature; namely, that the different classes of these organs are liable in different degrees to the disease; and it must be equally evident, that no theory which is founded on the internal structure of the teeth is calculated to explain this anomaly. It is therefore necessary to look to some other source for an explanation of this predisposition, a point which

is in every disease indispensable to a just theory of it; and accordingly, I propose to shew in the subsequent remarks, that the predisposition to caries, and also the nature of the causes which excite it, are to be discovered in the external form, configuration and the juxta position of the different classes of the teeth.

This principle I shall now proceed to establish, by passing successively under review the several divisions of the teeth in the order of their liability to decay; and consequently the first that claim our attention are the molares, including the *dentes sapientiæ*, which, from the circumstance of their appearing at a period of life subsequent to the formation of all the other teeth, are frequently considered as a separate class, yet they undoubtedly belong, as shown by their structure, to the molar division of the teeth.

It has before been admitted that these are more subject to decay than even the molar teeth, but the aptitude arises from a different cause which will be afterwards explained; for the present I shall include them with the

molar teeth, because they are similarly constructed, and on that account are equally liable to decay.

The molar teeth are much larger than any of the other teeth,* their grinding surfaces are broad, and present an irregular cavity bounded by an elevated and uneven ridge. This surface is often intersected with numerous smaller projections or ridges running transversely and in various directions, and corresponding with an equal number of depressions, which constitute so many smaller cavities or deep pits; occasionally a fissure extends across the ridge of the masticating surface, and forms a cavity in the side of the tooth;† in other cases the masticating surface presents three or four prominences around a deep pit in the centre.‡ These indentations are in size, depth, and number infinitely variable, so much so that we rarely meet with two molar teeth exactly alike, with the exception of the corresponding teeth of the same jaw,

*Plate I. fig. 1, & 2, e, e, e, e.

† Plate II. fig. 1, d, e & fig. 7, q, r.

‡ Plate II. fig. 1 & 2, a, f, h.

in which we always find a great similarity of structure.

The liability to caries in the class of teeth now under our notice (which, as before asserted, are of all the teeth most frequently affected with this disease) will be found exactly to coincide with the irregularity of their surfaces as just described, and particularly with the depth of their indentations. Accordingly the masticating surfaces in which the deepest depressions are met with, are in the great majority of cases the seat of decay, and the first to be affected with it; and the part of these surfaces in which the disease is always found to originate, is the bottom of one or more of the deepest indentations.

The next class of teeth most liable to decay are the bicuspides of the upper jaw;* their grinding surfaces are much smaller than those of the molar teeth; and consist of an anterior and posterior eminence, with an intermediate chasm open to its extremities, and not, as in the case of the molares, shut in by lateral prominences, thereby producing a hollow cavity

* Plate I. fig. 1, d, d.

or pit; these teeth are not subject to decay in the situation above described, except in occasional instances where these fissures are found to be deep and irregular. On the other hand the bicuspid is principally, and perhaps more than any other, affected with caries on its sides, which from the thickest part of the crown downwards become suddenly flat and contracted, so as to form a neck or groove immediately below that point where it comes in apposition with the contiguous tooth.* In this situation we find the disease to commence.

The next in order of liability to the disease are the incisors of the upper jaw. The surfaces of these teeth are broad, the anterior being smooth and convex, the posterior, on the contrary, being rather uneven and concave; the broadest parts of these teeth are their cutting edges, where they are placed in apposition with each other; from this part which is thin and smooth, they gradually increase in thickness towards their fangs, so as to represent the form of a wedge; from the same point and in the same direction they diminish still more

* Plate II. fig. 5 & 6, l, m, n.

considerably in width, so that their roots diverge from each other and thereby leave interstices* or openings, between them. Decay is never found upon the cutting edges of the incisors, nor is it found upon their plain convex surfaces, excepting where there is some defect† in the formation of the enamel, and on their posterior surfaces, we only meet with it when they are deeply indented,‡ which is rarely the case. The situation where decay takes place in these teeth is at their sides¶ immediately above the points where they unite with each other.

The incisores of the lower jaw are less subject to decay than any of the other teeth. They are more regular and uniform in their shape, and their fangs are thicker in proportion to their bodies than those of the upper jaw, consequently, they do not present necks and interstices of the same kind.¶ For the same reason the remaining class, the cuspidati, or canine teeth are comparatively little subject to

* Plate III. fig. 2 & 4. † Plate IV. fig. 2, 3 & 4.

‡ Plate IV. fig. 1, b, b.

¶ Plate III. fig. 2 & 4. || Plate III. fig. 7 & 8.

decay, particularly those of the lower jaw; but there is another reason why the incisors and canine teeth of the lower jaw are less subject to decay than any other teeth, which we shall hereafter point out.

The next thing to be considered, and the only thing left unnoticed relating to the structure or position of the teeth, as far as this enquiry is concerned, is a peculiarity connected with the *dentes sapientiæ* or wisdom teeth, the consideration of which was before purposely deferred. It has been admitted that they are more liable to decay than any of the other teeth, and this liability arises not only from their indented surfaces, which have been before described with the molar teeth, but also from another cause peculiar to themselves. These teeth come at a later period of life than the others; they rarely begin to appear before the age of eighteen or twenty, and often much later than that, whereas the other teeth (comprising twenty-eight in number) are completed, and have taken up their stations at the early age of ten or twelve years, and generally fill up the whole extent of the jaw, so as to

leave but little space for the dentes sapientiæ; the consequence of which is, that when these are prepared to emerge through the gum, their progress is slow on account of their confined situation; when the one half of the surface of the tooth has made its appearance through the gum, the other half continues for a considerable period of time covered, thus forming a recess between the concave and pitted surface of the tooth and the overlapping gum.* It is in this situation that decay, which is so frequent in these teeth, is found to commence, and in many instances to have made considerable progress before the whole surface of the tooth has risen above the gum.

From the review we have just taken of decay in the different classes of the teeth, it will be perceived that in regard to situation, it takes place on the surfaces of the teeth, in excavations formed between them and the projecting gum, in cavities, indentations, and irregularities on the external substance of the tooth itself, and that it occurs at their sides, in their necks, and spaces produced by their formation and relative posi-

* Plate I. fig. 1 & 2, g, g.

tion; in regard to frequency, that it is in proportion to the depth of the superficial depressions, and the degree and nature of the lateral projections and interstices.

This being the case, and decay never being found to take place upon the plain and smooth surface of the tooth, it cannot for a moment be doubted, that the predisposition to caries depends, as I have already proposed to prove, upon the external configuration or conformation of the teeth. It must be equally evident from the partial nature of the disease, and from the insufficiency of all general causes, as before pointed out, to explain this circumstance, that the existing cause of caries must be one whose operation is partial, and which has a peculiar action upon those parts of the teeth which are by their structure predisposed to the disease. The only cause capable of explaining the partial operation and the particular situations of decay, is the corrosive or chemical action of the solid particles of the food which have been retained and undergone a process of putrefaction, or fermentation in the several parts of the teeth best adapted for their reception.

This explanation will be found to apply to all other facts connected with the history of caries, as given by different authors ; such for instance as the liability of the teeth in general to decay in pairs ; the rare occurrence of decay after the age of fifty, as compared with its frequency in the early periods of life ; the great susceptibility to caries in the teeth of particular families. In reference to the first of these facts, Mr. Hunter says, "decay of the teeth does not seem to be so entirely the effect of accident as might be imagined ; for it sometimes takes place in them by pairs, in which case we may suppose it owing to an original cause, coming into action at its stated time ; the corresponding teeth being in pairs, with respect to the disease, as well as to situation, shape, &c."

"This opinion," he states, "is somewhat strengthened by the fore teeth in the lower jaw not being so subject to decay as those in the upper, although equally liable to all accidents arising from external influence, which could produce the disease in general. The fore teeth in the lower jaw appear to be less subject

to this disease than any of the others ; the fore teeth in the upper jaw, and the grinders in both are of course more frequently affected.”*

It is truly extraordinary that Mr. Hunter, whose attention, as shewn by the passage just quoted, was so particularly drawn to the correspondence in shape and situation of the pairs of teeth which so frequently decay together, should not have immediately perceived that the correspondence of decay was the necessary result of the coincidence of formation. If this had occurred to his mind, (and with such strong evidence before him, it is wonderful that it escaped his penetration) he would not have had recourse to the vague and unsatisfactory supposition of some unknown original cause coming into action at its stated time ; but would have seen that the corresponding teeth have the same aptitude for retaining particles of food ; that the parts of the teeth, where decay has its seat, are the deep indentations or angles where the food is deposited ; that the disease takes place in both these teeth in precisely the same situations,

* Hunter's Nat. Hist. of the Teeth, part 2, page 7.

and that consequently they are similarly liable to decay because they are similarly constructed.

The oversight of Mr. Hunter is perhaps the more astonishing, as he was inclined to suspect that, during life, there is some operation going on which produces a change in the diseased part. "The most common disease," says he, "to which the teeth are exposed, is such a decay as would appear to deserve the name of mortification. But there is something more ; for the simple death of the part would produce but little effect, as we find that teeth are not subject to putrefaction after death ; and therefore I am apt to suspect that, during life, there is some operation going on, which produces a change in the diseased part. It almost always begins externally in a small part of the body of the tooth." *

We have seen that Mr. Hunter has left the cause of the liability of the teeth to decay in pairs undefined ; and the only explanation suggested by Mr. Fox, which is altogether gratuitous and far from satisfactory, is "that

* Hunter, part 2, page 1.

they acquire this disposition to decay from some want of healthy action during their formation." * Mr. Bell explains this fact on the same principle as Mr. Fox, which principle we have before seen him apply with so little success to explain the frequency of decay in the dentes sapientiæ. †

The next fact to be noticed is the rare occurrence of decay in the teeth after the age of fifty, as compared with its frequency in the early periods of life. "This disease, and its consequences," says Mr. Hunter, "seem to be peculiar to youth and middle age; the shedding teeth are as subject to it, if not more so, than those intended to last through life; ‡ and we seldom or never see a person whose teeth begin to rot after the age of fifty years. This might be supposed to arise from the disproportion that the number of teeth after fifty bear to them before it; but the number of diseased teeth after fifty do not bear the same propor-

* Fox, part 2, page 16.

† Bell, page 129.

‡ Mr. Hunter is mistaken in this observation; the temporary teeth are not so liable to decay as the permanent teeth.

tion.”* This statement is also in accordance with my own experience ; and although it has not been accounted for by Mr. Hunter, or the other writers on this subject, it can readily be explained on the principle insisted upon in this treatise.

It has before been shewn that the grinding teeth are most liable to caries in consequence of their deeply-indented surfaces. In early life, when the teeth appear through the gums, the prominences upon their grinding surfaces are higher, and their depressions consequently deeper,† than at a more advanced period ; and should the formation of these indentations be calculated to retain particles of food, the operation of decay would immediately commence ; and the loss of these teeth in early life would be the result. On the other hand, it may be safely presumed that the surfaces of such teeth as remain sound to the advanced period alluded to by Mr. Hunter, never were deeply indented,‡ or they would not have escaped decay ; but having escaped it, they

* Hunter, part 2, page 7. † Plate II. fig. 1 and 2.

‡ Plate II. fig. 3.

are, in every succeeding stage of life, less and less disposed to the effects of this disease ; for, we generally find that, at the age of fifty, the surfaces of the teeth are worn down,* and become smooth from a long course of mastication, consequently the cause of liability to decay in this situation (which of all others is the most liable in youth) is entirely removed ; and when decay does occur, it is principally confined to the sides of the teeth,† and is occasioned by a lodgement of food in the interstices produced by a receding of the gums.

If the doctrine insisted upon by Mr. Bell were correct, the teeth would be more liable to decay at the advanced age above alluded to than during the earlier stages ; for at this period a filling up of bone has taken place within the tooth, thereby lessening the internal cavity and increasing the distance‡ between the external surface of the bone and the centre of circulation. But, as this is not the case, Mr. Bell's notions regarding the primary cause of decay must be fallacious ; and moreover,

* Plate II. fig. 4.

† Plate II. fig. 6.

‡ Plate IV. fig. 7 and 10.

we constantly find decay to commence in the depressions and irregularities of the teeth in situations the nearest to,* and not the most remote from, the centre of circulation.

The next fact under this head to be explained, is the great susceptibility to caries in the teeth of particular families; and it is a remarkable circumstance that there is no feature in which the different members of a family bear so striking a resemblance to each other as in the formation of the teeth; this similarity may always be perceived, upon minute observation, when there is nothing particularly conspicuous in the formation or position of the teeth. But when the teeth are of a large size, crowded and irregular from the want of expansion in the jaw, defective in the formation of the enamel, or indeed presenting any other peculiarity, the resemblance which the teeth of children bear to those of one or other of the parents is very obvious; and the similarity is equally great in regard to the indentations and fissures upon the surfaces of the grinding teeth, and also the depressions and necks in the interstices between

* Plate IV. fig. 13. b.

them. I have likewise found, when a predisposition to caries exists in the teeth of a family, that decay generally commences upon the same teeth, and in similar indentations or interstices in the different individuals of the family; and this circumstance alone is a strong corroboration of the principle which I have insisted upon in the former part of this treatise.

Mr. Bell particularly alludes to this hereditary predisposition of the teeth to caries, and perfectly agrees with me in describing the facts; but differs entirely in assigning their cause. "It often happens," says Mr. Bell, "that this tendency exists in either the whole or greater part of a family of children, where one of the parents had been similarly affected; and this is true to so great an extent, that I have very commonly seen the same tooth, and even the same part of the tooth, affected in several individuals of the family, and at about the same age. In other instances, where there are many children, amongst whom there exists a distinct division into two portions, some resembling the father, and others the mother, in features and constitution, I have observed

a corresponding difference in the teeth, both as it regards their form and texture, and their tendency to decay.”*

Here Mr. Bell most explicitly confirms what I have stated as to the hereditary resemblance and hereditary decay of the teeth ; and after having observed this similarity of formation, and that decay commonly begins in the same tooth, and even the same part of the tooth, in several individuals of a family, and at about the same age, he misses the only adequate and satisfactory cause, by overlooking the peculiar formation of that part of the tooth where decay first commences ; and in order to account for this hereditary predisposition, he again resorts to his vague and improbable theory of an internal and undefined constitutional cause, occurring during the formation of the teeth, and producing in them a disposition to decay.

In concluding my notice and explanation of the facts to which our attention has just been directed, and from which Mr. Hunter, Mr. Fox, and Mr. Bell have been led to ascribe the predisposition to caries in particular teeth and

* Bell, page 128.

families, and at certain periods of life, to "a disease arising originally in the tooth itself," as Mr. Hunter has indefinitely called it, or to some want of healthy action during its formation, as Mr. Fox and Mr. Bell have supposed; I may further remark, with regard to the cause and primary seat of the disease, which all these writers, on the suppositions above named, have concluded to be one originating in the tooth itself, that Mr. Hunter, who was the earliest writer of any authority on the subject, approached much nearer to the discovery of the origin of the decay, although he has left the nature of it undefined, than either of the other authors, who, principally on the facts and conclusions of Mr. Hunter, have severally proposed a theory of the disease as before stated; in doing which, however, they have not only deviated farther from the true source of the malady, but in many instances have evidently misunderstood the tendency of Mr. Hunter's observations.

Mr. Hunter remarks that the disease begins externally in a small part of the tooth, that it appeared to deserve the name of mortification,

but that there was something more, some operation going on which produced a change in the diseased part ; he also observed, that the teeth were subject to decay in pairs, and that the pairs corresponded in situation and shape ; he also admits the greater liability to decay in particular classes of teeth, and lastly, he remarks, “ if it had been always in the inside of the cavity, it might have been supposed to be owing to a deficiency of nourishment in the vascular system, but as decay begins most commonly externally, in a part where the teeth in a sound state receive little or no nourishment, we cannot refer it to that cause.”* He then directs his attention to external injuries and to menstua, which have the power of dissolving part of a tooth ; but, in doing so, it is evident that the only menstua which occurred to his mind, were those of a transitory kind, namely, the food acting upon the teeth during the short period it remains in the mouth on its way to the stomach. Perceiving that this could not act so partially, he leaves the origin of decay undetermined, and concludes by sup-

* Hunter, part 2, page 8.

posing that it is a disease arising originally in the tooth itself.

Had Mr. Hunter, in looking for an explanation of the disease in the action of menstrea, considered that, besides the food, which is transient in its passage, and the operation of which upon the teeth is general and equal, there are portions of it which are liable to be retained in particular parts of those organs, and which, by remaining there for a time, acquire by putrefaction the property of corroding them ; he would have discovered the menstrea which he wanted, and which would have removed all the difficulties, and accounted for all the facts which he has so ably described. He would have seen at once why decay occurs externally in a small portion of a tooth, in particular parts of it, and more frequently in one class of teeth than in another ; he would have perceived in what way their shape and situation concurred in the production of the disease, and why it was so common to particular families and certain periods of life ; and finally, he would have discovered the nature of the morbid process constituting decay, which he

has left in uncertainty ; and not have concluded, as he has done, that the only cause which has a partial operation on the teeth is a spontaneous disease, but entirely the result of external agency.

Mr. Fox expresses surprise that, “ although Mr. Hunter went so far, he gave no correct idea of the manner in which the disease can alone originate.” But in this observation Mr. Fox appears to have forgotten the general character of Mr. Hunter, and his aversion to generalize. It is more astonishing that Mr. Fox, with Mr. Hunter’s observations before him, and his own opportunities for practical information, should not have perceived that the theory which he has brought forward to supply the deficiency of Mr. Hunter, is not only at variance with the statements of this author, but contrary to experience ; for, as we have before observed, if inflammation in the internal membrane of the tooth were the original and immediate cause of decay, we should be subject to tooth-ache previous to the commencement of decay ; the reverse of which is known not only to every

practitioner, but almost to every one who has suffered from this disease.

With regard to Mr. Bell's theory of inflammation in the bone immediately under the enamel, he has come nearer the true source of the disease, in so far as he has approached nearer to the surface of the tooth; and it appears to me, he must have taken a hasty and imperfect view of the subject, or he would have perceived that the disease did not commence on the parts which are the most remote from the centre of circulation in the tooth, which ought to be the case in order to make his theory consistent, but that it first begins in necks and indentations, which, upon examination, will be found to be the nearest* to the internal membrane.

Having stated what I consider to be the primary cause of caries in the teeth, and pointed out the situations where decay first begins, I shall now endeavour to describe the progress of the disease through its different stages to that period when tooth-ache is produced. When decay commences upon the surface of

* Plate IV. fig. 9, b. and 13, b.

a grinding tooth the disease is confined to one or more of its deepest indentations, and may be discovered by a brown discolouration of the part, which discolouration is produced by a chemical action of the food lodging in that situation ; and as this action proceeds and increases, the bottom of the indentation becomes black and corroded, and soon afterwards (by the application of a pointed instrument) a small opening may be discovered through the enamel.* When the putrid substance has been admitted through this orifice to the softer bone within the enamel, decomposition in this situation proceeds with much greater rapidity, whereas the opening through the enamel increases but little, its texture being better able to resist the effects of the chemical action, on account of its greater density ; but when decay has proceeded so far as to make an excavation, by the destruction of a considerable portion of the bone under the

* Upon sawing through, in a longitudinal direction, a deeply-indented tooth, the fissure will often be found to extend to the surface of the bone within the enamel before decay takes place.—See Plate IV. fig. 9, b.

enamel, the support being removed, the enamel suddenly breaks in during mastication, and a cavity is laid open which, till this period, was not suspected, in consequence of the smallness of the orifice, and the destruction of the tooth, up to this stage of the disease, being unaccompanied with pain. At this period, or soon afterwards, by the continued operation of the same morbid action, the internal membrane that lines the cavity of the tooth becomes exposed, and consequently inflammation occurs, the pain produced by which is tooth-ache.

The description of the progress of decay above given will equally apply to the disease in whatever situation it occurs, with this difference, that in the interstices of the teeth it is not so easily detected in its first stages, and is seldom found out before an excavation has been made, and a portion of the enamel is broken off. This is more particularly the case with the molares and bicuspidés whose adjoining surfaces are deeper, (particularly those of the molares,) and consequently the seat of the disease is more concealed from

view ; whereas the lateral surface of the incisors being thinner, the early stage of caries in them is readily discovered.

It is evident that Mr. Fox, and other writers upon the subject of caries, who have supposed the primary seat of the disease to be in the interior of the tooth, have fallen into this error in consequence of having overlooked the small external aperture in the enamel, through which the disease gains admission into the internal structure of the organ.

Having thus shewn the incompetency of the theories hitherto advanced to explain the facts upon which they profess to be founded, and also their inconsistency with themselves, and having established, by proofs which I believe are incontrovertible, that, contrary to the opinions insisted upon in these theories, caries commences on the external surfaces of the teeth, and is occasioned by external agency ; I now proceed to point out the practical and important application to which this view of the disease necessarily leads, by shewing the possibility of preventing its commencement, or

arresting its progress before it has effected any serious and irremediable mischief. But I shall first make a few observations regarding the mode of treatment necessary for the preservation of the temporary set of teeth ; and also the attention which is required at the period when the permanent set begin to make their appearance, in order to ensure the regularity of those teeth that are intended to last through life.

The temporary teeth, although not so liable to caries as the permanent set, are nevertheless the subjects of decay, particularly the molar teeth. The disease generally commences in the interstices of these teeth, and is commonly attended with inflammation of the periostium and the gums ; when this is the case, relief can be obtained only by removing the carious tooth. It is of great importance to preserve those teeth in a healthy state, and to prevent the necessity of their being extracted before the bicuspidæ, which supply their place, are ready to make their appearance ; for should it become necessary to remove them early, the permanent molar teeth, which take their stations immediately behind the temporary set,

incline towards the front of the mouth, and encroach on the space allotted for the front permanent teeth.

The only means of prevention that I should recommend, is the daily application of the tooth-brush, with water only, in order to keep the teeth as clean as possible. This simple treatment will be found, to a considerable extent, a preventive of decay in the temporary teeth, and consequently of much pain and suffering; and, moreover, will be of great service by initiating the child into habits of cleanliness, which will afterwards be of the highest importance for the preservation of the permanent teeth. The period at which the temporary teeth become more particularly an object of attention, is at the age of from five to seven years, when they are to be succeeded by a permanent set, more numerous, proportioned to the increased expansion of the jaws, of a larger size, firmer texture, and better adapted for the purpose of mastication.

About the age of three years, when the temporary set of teeth are completed, the form of the jaw is that of a semi-circle, and it is filled

up to its whole extent with these teeth, twenty in number, ten in each jaw ; namely,

Two central Incisores, or cutting teeth.

Two lateral Incisores, or cutting teeth.

Two Cuspidati, or canine teeth.

Four Molares, or grinding teeth.

This part of the maxillary arch increases afterwards very little, if at all. In the course of between two and three years from this time, that is to say, a few months previous to the shedding of the temporary teeth, the two extremities of the jaw have elongated posteriorly to allow room for the first molar teeth of the permanent set. These teeth, from the inattention which is so general in the treatment of the temporary teeth, are liable to be affected with caries at an early period ; and when it becomes necessary to remove them, in consequence of acute pain produced by decay, the parents are often astonished when they are informed that these teeth belong to the permanent, and not to the temporary set.

The jaw continues to elongate in the same direction, so as to admit successively of the second molar teeth and the *dentes sapientiæ*, thus completing the permanent set ; and at this

period, the jaw, which at the completion of the temporary set, presented the form of a semi-circle, approaches to that of part of an ellipsis, or, in other words, resembles a horse shoe in shape. According to this arrangement of nature, it will be seen that the room occupied by the twenty temporary teeth is filled with the same number of permanent teeth; but as the teeth of the two successive sets are not respectively equal to one another in size, it will here be necessary to explain how they come to be arranged in the same space. This is of the more importance, as the irregular position of the teeth is one of the principal predisposing causes of caries.

The incisores and cuspidati of the permanent set are considerably larger than the corresponding teeth of the temporary set; whereas the molar teeth of the temporary set are much larger than the bicuspidates of the permanent set, which succeed them. And here it is obvious, that the additional room required for the permanent incisores and cuspidati is compensated by the smaller space occupied by the bicuspidates.

The formation of the maxillary arch in different individuals is exceedingly various. When we find the jaw sufficiently expanded, and the temporary teeth a little separated from each other, the arrangement of the permanent set may be safely left to nature ; but when the jaw is contracted, and the temporary teeth arranged closely together, it becomes necessary, in order to ensure the regularity of the permanent teeth, that nature should be assisted ; and with judicious management, there are but few cases which are not under the controul of the operator, by the removal, from time to time, of the temporary teeth, to make room for those of the permanent set which succeed them.

The shedding of the teeth commences with the central incisores of the lower jaw ; sometimes the fangs of these teeth are absorbed, and their crowns fall out spontaneously, that is, when the permanent teeth come up immediately under them. But even when this is the case, the space previously occupied by these teeth may be too narrow to admit of the permanent teeth ; and if so, they are forced

out of the circle by the contiguous temporary teeth, and stand either obliquely or the one before the other. In order to remedy this defect, it becomes necessary to remove the lateral temporary incisores ; and for the same reason, when the lateral permanent incisores make their appearance, the temporary cuspidati must be removed to make room for the lateral permanent incisores. When these six temporary teeth have been removed, we generally find the greater part of the space which they occupied filled up by the four permanent incisores.

When the permanent incisores of the lower jaw appear behind those of the temporary ones, absorption does not take place in the fangs of the temporary teeth, and consequently they remain firm in their sockets ; nevertheless they ought to be removed, in order to admit of the permanent teeth coming forwards into place.

Similar treatment to that above described will be necessary for the regulation of the teeth in the upper jaw. When the temporary incisores and cuspidati have been removed, a

considerable period may be allowed to elapse before any further assistance is requisite. In twelve or eighteen months from this time, the fangs of the temporary molar teeth become absorbed, the bicuspidates generally coming up immediately under them, and their crowns drop out of their own accord, or become so loose as to be easily removed ; but should the bicuspidates take an irregular direction, either inside or outside of the circle, the temporary tooth must be removed to allow the permanent one to take its place.

The cuspidati seldom appear before all the temporary teeth have been shed, and the bicuspidates and incisores have been arranged in their respective situations ; and these teeth, the bicuspidates and incisores, sixteen in number, frequently fill up the whole of the space previously occupied by the twenty temporary teeth, so as to prevent the cuspidati, particularly those of the upper jaw, from falling into the circle. In this case, the cuspidati occasion great deformity by projecting beyond the range of the other teeth. Unskilful practitioners frequently remove these teeth, in order to re-

medy the deformity, thereby destroying the symmetry of the mouth, and sacrificing a class of teeth which, from their strength and durability, are of the greatest importance in after life ; whereas the removal of the anterior bicuspides, which are teeth of much less consequence, because more liable to decay, and the abstraction of which does not interfere with the symmetry of the mouth, would effect every purpose by allowing the cuspidati to fall into their proper places in the arch of the jaw. The remaining teeth which have yet to appear, are the second molares and the dentes sapientiæ, which take their places in due course, and complete the permanent set.

Before dismissing this part of the subject, I shall point out some of the bad effects which result from inattention to the teeth during that period which is termed the shedding of the teeth. We have before stated that when the teeth are irregular in their arrangement they are more subject to caries, inasmuch as there are situations produced by this irregularity calculated to retain particles of food, which in a well-arranged set of teeth would not be

the case ; and moreover, that it is scarcely possible to prevent an accumulation of a substance called tartar from taking place on those teeth which stand out of the range, as they escape the friction of the brush during the process of cleaning. The irregularity of the teeth, in many instances, also occasions very considerable deformity in the appearance of the face ; this is more particularly the case when the upper front teeth, instead of closing over the lower ones, shut within them, and consequently give an unnatural projection to the lower part of the face. When one or more of the teeth take this position, it becomes necessary to have recourse to artificial aid, otherwise the defect will be permanent. In order to rectify this deformity, a plate is adapted to the lower range of teeth, and so constructed as to produce pressure upon the irregular ones ; by which contrivance the rest of the teeth are prevented from coming in contact with each other, and the whole pressure of the mouth in shutting is thrown upon the irregular teeth, which act against the inclined surface of the plate, and by degrees

are moved forwards into their proper situations.*

Having laid down rules for the management of the temporary teeth, and for regulating the permanent ones, I proceed now to consider the further treatment of the permanent teeth, as regards the prevention and cure of their diseases; and here I would impress the reader with what, I flatter myself, constitutes the great value of the suggestions contained in this treatise, and which are, I trust, sufficient to prove that the most watchful attention should be paid to these teeth from their first appearance; for such is their susceptibility to disease in youth, that caries produces its greatest ravages before the age of fifteen or twenty years; and such is the insidious nature of this disease, that it effects irreparable mischief, often before it has been suspected to exist.

The greater liability of the teeth to decay in the earlier than in the more advanced periods of life, was formerly alluded to when I noticed it as a fact brought forward, but not explained, by Mr. Hunter, and shewed that it

* Plate V. fig. 1 and 2.

admitted readily of explanation by the theory which I have advanced, namely, that disease in the teeth is caused by external agency, that is by the decomposition and chemical action of particles of food retained in the cavities and interstices of the teeth.

The greater frequency of caries in youth has been shewn to arise from the irregularities of the surfaces of the grinding teeth being deeper, and therefore more liable to retain food at their first appearance, and in the youthful stages of life, than at a more remote period; and hence their greater tendency to decay.

In the early periods of life too, the progress of decay is more rapid in effecting the destruction of the teeth, because the internal cavity of the tooth being larger, and the wall of bone between the cavity and enamel being consequently thinner, the disease has a shorter distance to penetrate before it accomplishes the exposure of the internal membrane;* whereas, in the middle and later stages of life, the bony partition becomes considerably thickened, so as to increase the distance be-

* Plate IV. fig. 6.

tween the surface of the tooth and the cavity.* It also too often happens, and is another cause of the frequency of caries during the period of youth, that, at this time, when the greatest liability to the disease exists, the precautionary measures for preserving the teeth are the most neglected ; and it is only after acute suffering and irremediable mischief have been produced, by the loss of several teeth, that means are adopted for preserving those which remain.

The first, and one of the most important precautionary measures to be adopted, is that of cleanliness ; and I have been the more particular, on a former occasion, in insisting upon the early use of the tooth-brush, not only as the means best calculated for the prevention of decay in the temporary teeth ; but in order to establish and confirm those habits of attention so necessary for the preservation of the permanent teeth.

In order to preserve the teeth from caries it is absolutely necessary that they should be brushed once in twenty-four hours, and

* Plate IV. fig. 7.

so effectually as to remove any portion of food which may have adhered to them. This will prevent the remains of food from suffering decomposition in the situations already described, the putrid matter arising from which has been pointed out as the active agent of destruction ; it is better, however, to clean them morning and night ; but the strict rules of cleanliness require the use of the brush at the termination of every meal.

The ablution of the teeth, in many instances, is performed in that superficial manner which does little or nothing for the prevention of decay. The operation of the brush is generally confined to the front teeth ; and whether confined to these or extended over a larger range, it is almost always applied across their anterior surfaces only ; and the irregularities upon the masticating surfaces of the double teeth, and the interstices in which the food is the most liable to lodge, and consequently the most subject to decay, are altogether neglected.

The most effectual method for removing the particles of food from the interstices of the

teeth is to brush them upwards and downwards, and the brush should be firmly applied across the masticating surfaces of the double teeth ; and if it were possible by these means to keep the teeth perfectly clean, and to dislodge all the food which is retained in their indentations and interstices before decomposition could take place, it is not improbable that caries would be as seldom met with in the teeth as in other bones, in which it sometimes takes place indeed, but is a circumstance of rare occurrence. But it must be allowed that, in a vast number of cases, from the deeply indented and irregular structure of the teeth, it is not practicable, by the most rigid attention to the rules of cleanliness, to prevent the decomposition of food in some of the situations already noticed ;* the consequence of which is that decay must and does ensue ; and here it is obvious that another mode of treatment becomes necessary in order to arrest the further progress of the disease.

I scarcely need remark that the only treatment which can be adopted under these circumstances, for the preservation of the teeth,

* Plate IV. fig. 9, b.

and the only one which has ever been found effectual, consists in filing away the carious part, or in eradicating the spongy and decayed portion, and subsequently filling the cavity which the disease has produced. But such, unfortunately, is the insidious character of the disease, and so unacquainted are the generality of people with its nature and progress, that application is rarely made for assistance until it is too late to be effectual. This false security, which is so common among mankind, arises from a prevailing prejudice that, as in the other organs of the body, so in the teeth, disease cannot commence without pain. This impression is so generally true, with respect to diseases of most of the internal organs, whose functions, being immediately necessary to life and health, cannot be deranged without uneasiness and suffering, and also to most of the external parts, which are endued with such extreme sensibility that the slightest and most superficial injury causes acute pain, that it has become a received principle with respect to the diseases of all parts of the system.

Persons are either ignorant, or do not consider, that the enamel of a tooth is an inorganic substance, and perfectly insensible, and that the bony structure beneath is so void of feeling, that disease may effect the destruction of these parts without pain or suffering. They are further so universally led to believe that decay originates in the internal structure of the tooth, and that the exciting causes operate by inducing some internal morbid process, terminating in inflammation of the membrane or of the bony substance of the organ, that they have never suspected the true cause to be a chemical agent acting upon the external crust and material substance of the tooth itself.

The consequence of these misconceptions is that the practitioner is hardly ever consulted before pain has been experienced ; and, in not a few instances, it is a subject of surprise to the patient when told that the disease is irremediable, and that the only resource is the extraction of the tooth.

The facts just stated, with regard to the almost imperceptible approach of caries of the

teeth, will, I trust, sufficiently impress on the mind of the reader the necessity of a careful and continual watchfulness over these organs so important to health and comfort, for the purpose of detecting the disease in its first stages, before it has proceeded so far as to produce pain or even tenderness.

This attention to the teeth should commence at the early age of six or seven years, when the first molar teeth of the permanent set have pierced the gums. As these teeth are very subject to decay soon after they have made their appearance, it therefore becomes the duty of the parents and guardians of the young, to have the teeth regularly inspected, and this examination should take place at least once in every twelve months ; and to insure their safety should be continued throughout the future periods of life. If this system were more generally adopted, the necessity of extracting teeth, which so constantly arises, would be of less frequent occurrence, and consequently much pain and inconvenience would be prevented.

An experienced practitioner will have no difficulty in discovering the first stages of

caries ; nay, from the first appearance of the teeth through the gums, he will be able to foresee, from their construction, which and what parts of them are predisposed to the disease. The only situations where caries may commence and proceed without detection till it becomes incurable, are the interstices of the double teeth ;* and even in those situations, in a vast majority of cases, the disease may be detected before much mischief has been produced.

The object and advantages proposed by the system of constant watchfulness and regular inspection of the teeth now suggested, are to arrest the progress of decay before it has penetrated to the internal cavity of the tooth and exposed its vascular membrane to the influence of foreign bodies ; this is accomplished by filing away the carious part, or by eradicating the spongy and decayed portion, and subsequently filling the cavity which the disease has occasioned. For the successful practice, however, of either of these processes, it is evident that we ought to have a clear idea of the object proposed by them.

* Plate II. fig. 6.

The cause of caries being, as we have minutely pointed out, the corrosive action of decayed particles of food, it must be obvious that the method that we propose for preventing the further progress of the disease, must consist in remedying the peculiarity of structure which led to it. If, for example, decay takes place in one of the deepest indentations of the masticating surface of a grinding tooth, in order to arrest its progress, the decayed part is removed and the cavity stopped up; consequently a future lodgement of food is prevented.

When we have recourse to the process of filing, the object and principle are the same as in filling; for instance, when decay takes place on the side of an upper incisor, the carious part, owing to the thinness of the edge of the tooth, or the shallowness of the decay, its position or formation, may not admit the operation of filling; and, in such cases, filing is had recourse to, for the purpose of removing the carious portion and effecting a separation from the adjoining tooth, thereby making the part plane and smooth and doing away

with the necks and points of union which, by retaining the food, had laid the foundation of decay. It is, of course, to be understood that these operations have been performed in the earlier stages of the disease, and before it has penetrated to the internal cavity of the tooth, when preventive measures are no longer available.

I shall now point out that stage of the disease which is the most favourable for performing the operation of filling, and shew the practical advantages derived from timely attention, and the bad effects which result from neglect.

In order to make myself clearly understood I shall take, as an example, one of the molar teeth. These teeth, as before stated, are more subject to decay than any others, on account of the irregular formation of the enamel upon their grinding surfaces; and this formation is exceedingly various in different individuals; but, in all cases, the surfaces of these teeth are irregular, and indented to a greater or less degree. This tooth generally presents three or four prominences around its grinding surface, with a deep depression or pit

in the centre : this formation is peculiarly adapted for the retention of food ; and so deep are those pits in many instances, that it is hardly practicable, even with the most rigid attention to the use of the brush, to dislodge the particles of food. The rapidity of the corrosive action upon the tooth will depend upon the form and depth of the indentation, and in some degree upon the quality of the food ; but the effects of this chemical agent may in some degree be retarded, even in the worst cases, by the firm application of the brush across the masticating surfaces of the teeth, and thereby removing at least a portion of the destructive substance and lessening the power of its operation. The earliest effects of the disease become apparent by a discolouration of the deepest part of the indentation, and this may be considered the first stage of caries ; but, as the action proceeds, the part at first merely discoloured becomes black and corroded, and during this second stage the disease works its way through the bottom of the indentation, and commences its ravages on the surface of the softer bone within ; and

upon examining the tooth at this period, we shall find an easy passage for the point of a probe through the black and corroded portion of the enamel. When decay has proceeded thus far, no time should be lost in having the operation of filling performed; for after the disease has penetrated through the enamel to the softer bone, its progress upon this substance becomes much more rapid. At this stage of the disease, not even the slightest tenderness has been produced, for the internal cavity of the tooth, containing its blood vessels and nerves, continues protected by a partition of healthy bone, upon whose surface, as yet, the putrid action has only commenced; this is therefore, the most favourable period for performing the operation of filling, previously to which every particle of carious and corroded substance must be removed with small instruments adapted to that purpose. The cavity should be wiped perfectly dry, and then filled up firmly and securely with gold leaf, or with a substance not liable to undergo a chemical change. When this operation has been performed with skill, the disease is arrested in its

career, the lodgement of food, which was the original cause of the disease, is for the future prevented, and the tooth is permanently saved.

But here it may be necessary to remark, that the configuration of some of the teeth, particularly the molar teeth, is of a nature which predisposes them to become carious in more parts than one; for instance, instead of the more usual construction of a molar tooth, consisting of three or four prominences around its grinding surface, and one pit in the centre,* it often happens that a ridge extends across the surface, thereby producing two pits;† and in many instances also a fissure extends across the margin of the grinding surface, and forms a cavity in the side of the tooth.‡ All these circumstances occasion caries, because they all more or less cause the retention of food, and we shall find the situation which is the most calculated for retaining it, the first to require the operation of filling. I have often found it necessary to perform this operation in three distinct parts of the same tooth at different periods.

* Plate II. fig. 1 and 2, a, f, h.

† Plate II. fig. 1 & 2, b, c, g. ‡ Plate II. fig. 1 & 7, d, e, g, r.

I have been led to the particular notice and explanation of this fact, from the circumstance of Mr. Bell having brought it forward as a confirmation of his theory of predisposing causes, inflammatory action, &c. as has been stated in a former part of this treatise. Mr. Bell says, "the removal of one, and that the immediate and exciting cause of the progress of the disease, will indeed be effected;" that is by filling up the cavity, "but the predisposition will still exist in the apparently sound part of the tooth, and will be likely, at a future period, to give rise to the renewed appearance of decay. Hence it sometimes occurs, even when the gangrened part has been most completely removed, and the stopping effected in the best possible manner, that the disease will subsequently appear in another part of the tooth, while the stopping remains perfect and untouched. Without a proper understanding of the cause of gangrene, it would be impossible to explain this circumstance."*

* Bell, page 142.

It will be evident to the reader that the predisposition to caries in several parts of the same tooth, is not, as Mr. Bell supposes, a predisposition to inflammation from some original or acquired unhealthy condition of the tooth, but that it is occasioned by the crevices and indentations of the teeth, in which food is liable to lodge, and in which decay is exclusively found.

We have stated that when once the disease has made its way through the enamel to the softer bone, its progress becomes much more rapid, the substance now acted upon being of a soft nature compared with the dense and firm structure of the enamel. The corrosive action, during this the third stage of the disease, is principally confined to the softer substance, and the orifice in the enamel increases comparatively but little, whereas the disease proceeds with accelerated power in excavating that part of the bone immediately within the enamel; but even at this stage the disease may be permanently arrested in its progress, and the tooth saved by the same process as

that recommended during the second stage ; with this difference that it now becomes necessary to enlarge the orifice in the enamel for the purpose of accomplishing the removal of the carious substance within ; and when this has been effected, the cavity will be found much larger within than at the external opening. It will be evident that this operation must be useless unless a portion of healthy bone remain to protect the internal cavity of the tooth.

The beneficial result of the operation of filling depends in all cases upon the previously complete eradication of every particle of the carious part ; for should the filling be introduced over a portion of the decayed and spongy substance, the process of corrosion will go on, the morbid excavation increase, the filling become loose, and the operation prove altogether nugatory. This constantly occurs when the operation is performed by unskilful persons, who, from their ignorance of the nature and progress of the disease, and, from their not being aware that the sound parts of the tooth are contaminated by the corrosive

action of the unsound, are quite indifferent about removing the decayed portion.

In the opinion of the inexperienced practitioner, the utility of filling is limited to the exclusion of air from the interior of the tooth, and their patients are beguiled into a temporary false security that, this being done however superficially, every possible advantage has been obtained ; nor are such practitioners scrupulous by what means this is accomplished, frequently cramming into the decayed cavity of a tooth substances under the boasted name of specifics, which are liable to excite corrosion, and which consequently tend rather to increase than to retard the progress of the disease.

The next stage of caries is the period when application is generally made for assistance, but unfortunately it is also the period when remedial measures are no longer available ; for at this stage the disease has made its way through the bony partition, thereby exposing the internal cavity of the tooth and producing inflammation in its lining membrane, which is the origin of the pain and suffering called tooth-ache, and is one of the last and most

destructive consequences of the disease. To attempt the operation of filling at this period would be in the highest degree irrational, and indeed from the torture which it would occasion is impracticable ; the only relief that can be obtained under these circumstances is the removal of the tooth ; and this is the treatment that I should recommend in the great majority of cases, for reasons which shall be explained after I have made a few observations on the operation of filing the teeth, which is had recourse to in cases where filling is impracticable.

I have before stated that the object and principle of both these operations are the same ; I have shewn that by timely attention to filling, before decay has reached the internal cavity and excited inflammation in its lining membrane, the disease may be arrested in its progress, and the tooth permanently saved by effectually removing the carious portion and subsequently stopping up the orifice firmly and securely. But when decay commences on the side of a tooth, in a situation where it is impossible, from the obstruc-

tion occasioned by the adjoining tooth to make use of the excavating and filling instruments, or when the tooth is incapable of retaining the stopping, in consequence of the formation of the fissure which the decay has produced ; or if the side of the tooth be very thin, or the cavity shallow, in all such cases it is necessary to use the file till every portion of the carious substance is removed, and the cavity completely obliterated ; no food being then retained, the recurrence of the evil is prevented.

The passing of a file between two teeth, merely for the purpose of making a separation, when decay has penetrated through the enamel, and produced a cavity in the side of one or both of the teeth, will not be sufficient to prevent the further progress of decay ; it will in some degree retard it, but the disease will still go on unless the cavity be wholly obliterated, and the deposition of food prevented for the future.

When we have recourse to filing, a portion of the sound part must be removed with the unsound ; for were the carious portion only to be got rid of, the remaining cavity would

allow of subsequent collections of food, which must unavoidably renew the decay; but by removing the neighbouring parts to a level with the bottom of the morbid cavity, and thereby giving the whole a plane surface, the liability to future attacks of the disease is done away with. In performing this operation, the substance of the front surface of the tooth should, as far as possible, be saved so as to preserve its natural shape and appearance, which in most instances may be done by using the file in a slanting direction.

A strong prejudice exists in some individuals against the filing of the teeth, which is grounded on a mistaken idea that the removal of a portion of the enamel must necessarily lead to their destruction. Experience has long since proved the fallacy of this notion; for if the decay has not penetrated to the internal cavity, and a portion of healthy bone be still left to protect the membrane, the carious part may be removed with the file, and the tooth will continue free from disease. The bone within the enamel is of the same substance and density as the fangs, and it is

a very common occurrence for a portion of the fang of a tooth to become exposed in consequence of the receding of the gums ; the fang, being thus deprived of its natural covering, is equally liable to external injury with that portion of the tooth which has been deprived of its enamel by the file, yet we do not find the fang thus exposed subject to decay. I have no doubt therefore that the prejudice which has been alluded to may be traced to the unskilful performance of the operation, and to ignorance of the nature and progress of the disease.

During the first stage of caries, when the surface of the enamel is only discoloured, the passing of a thin file between the teeth will remove the obstruction and prevent a future lodgement ; but if the disease has advanced beyond its first stage, and produced a cavity in the side of the tooth, the simple operation of separating one tooth from the other, will not be sufficient to arrest the progress of decay ; for the orifice still remaining will of itself be capable of retaining particles of food, and consequently the corrosive action will still

go on excavating and undermining the enamel, until a portion of it, having lost its support, suddenly breaks off; a circumstance that would have occurred had no filing taken place. When this event happens soon after the process of filing, the patient is very likely to attribute it to that operation; but the reverse of this is the fact, for the operator, either not being aware of the true state of the disease, or being ignorant of the consequences of leaving an orifice in the side of the tooth, has contented himself with merely making a separation, and has failed in not carrying filing to a sufficient extent, so as completely to efface the cavity; the consequence of which is that the disease if left to pursue its natural course and to produce the effects described.

When decay begins in the interstices of the teeth, in a situation where it becomes necessary to have recourse to filing, it is advisable to perform the operation in the earliest stage of the disease, for at this period the opaque or dark portion may be removed without penetrating through the whole thickness of the enamel, a convincing proof, by the way, that

decay commences externally and not internally, as Mr. Fox supposes, nor upon the surface of the bone within the enamel, as Mr. Bell has imagined.

The advantages resulting from the early attention to filing, are not merely that the decayed part is removed and the disease arrested, but that these objects are effected without altering the natural shape of the teeth, a change which it is very desirable to avoid, particularly with those in front.

But when decay begins upon the grinding surfaces of the double teeth, or any other situation where filling is practicable, it is quite unnecessary to perform the operation during the first stage of the disease, it is better to wait until it has effected a small opening through the enamel, capable of admitting the point of a fine probe; the removal of the whole of the carious portion, at this period, will be no more than sufficient to give the aperture that form which will adapt it for retaining the stopping; and were the operation to be performed upon the first appearance of discolouration no advantage would be

gained, for an opening equal in size to that occasioned by the second stage of the disease would be required to be made.

Mistaken notions regarding the true nature of decay of the teeth and its exciting cause have led to premature treatment, not only in filling the teeth, but also in the operation of passing a file between them, which has been recommended by Mr. Fox and others as a preventive to decay; a practice which, to say the least of it, is exceedingly injudicious, and which never ought to be had recourse to before decay has commenced.

Mr. Fox says "The incisors of the upper jaw are very liable to become carious in consequence of being crowded or pressed much against each other. To prevent this disease from taking place, it is advisable to make a separation between each tooth with a very fine file."* Mr. Bell recommends similar treatment:—"When, from the want of room in the maxillary arch," says he, "the teeth are so crowded as to press with considerable force against each other, this pressure should

* Fox, Part II. page 145.

be removed by passing a very thin file between those which are in the greatest degree subjected to it."* If the pressure of the teeth against each other occasioned decay, as supposed by the authors just quoted, how does it happen that the lower incisors are not equally liable with the upper to the same disease? The lower front teeth are generally more crowded than the upper ones, and the pressure must be equally great, consequently if decay proceeded from this cause, the liability in the lower teeth would be as great as in the upper ones; but that this is not the case is a fact acknowledged by both these gentlemen, and must be obvious to every one who has given any attention to the subject.

I have before stated that the liability of the teeth to caries in this situation depends upon the formation of their interstices and their liability to retain particles of food. The experience of every day proves that decay is not produced by the pressure of the teeth against each other, for we constantly meet

* Bell, page 137.

with well formed and regularly arranged teeth whose sides press against each other without the least tendency to decay.

In taking a front view of the upper incisors, it will be observed that they are broad at their cutting edges, and in many instances diminish very suddenly in width towards their fangs, thus producing an opening between the gum and the points of union at their sides; but this is not all: when a tooth tapers suddenly there is generally a depression or neck immediately above where the union at their sides terminates, which forms a situation extremely liable to retain food, and consequently to produce decay;* on the other hand when the width of these teeth is more uniform and regular, the union at their sides extending to a greater distance from the cutting edges, the gums, if in a healthy state, send out processes which fill up the interstices, and thus prevent a deposition of food from taking place.†

With regard to the lower incisors, they are always more uniform in their shape than the

* Plate III. fig. 2, b, b, b, c. † Plate III, fig. 1,

upper ones, and do not present interstices of a similar kind to those we have described between the upper teeth, and on this account they are not so subject to decay. But there is also another cause why the lower incisors are less liable to decay than the upper, which was merely alluded to in a former part of this treatise, and which I shall now explain.

The saliva having a natural tendency to occupy the lower part of the mouth, the teeth there placed are constantly bathed with this fluid, which, by its property of dissolving the particles of food, is in a great degree calculated to remove them; or, by its decidedly antiseptic qualities, prevents the process of putrefaction; moreover, the interstices of these teeth being frequently filled up with an earthy substance, called tartar, deposited from the saliva, they are consequently not liable to lodgements of food, and accordingly these teeth, when they are lost, seldom perish from decay, but fall out from the absorption of the gums and sockets, occasioned by this calcareous concretion.*

* Plate III. fig. 8,

I now return to that stage of caries in which preventive measures are no longer available ; and when the only relief that can be obtained is by the removal of the decayed tooth. There are however many individuals who will not submit to the operation of extraction, under an impression that the pain will subside and the tooth still remain useful ; the erroneousness of this opinion, in the great majority of instances, will appear from the following statements.

I have before observed that, when toothache takes place, caries has extended to the internal cavity of the tooth, and excited inflammation in its lining membrane ; and it is upon this membrane, which is spread over and is closely attached to the bony walls of the internal cavity, that the blood vessels and nerves, which enter the tooth by the points of the fangs, are distributed in an infinite number of small ramifications. In this respect the crown of the tooth, or that part which is above the gum, differs essentially and completely from other bones, the latter being surrounded by an external membraneous covering called

the periosteum, which is protected from the action of extraneous bodies by the integuments and other textures ; whereas that part of a tooth which is intended for mastication, and therefore exposed, is supplied with a membrane placed in the centre of the organ, which is protected from external injury by the bone and enamel surrounding it.

It is upon this difference of construction between the teeth and other bones, that depends the more acute pain incident to inflammation of the internal membrane of the former than that which attends the inflammation of the investing membrane of the latter. One of the constant and necessary effects of inflammation in every structure of the body is a swelling of the part inflamed, and the consequence of this tumefaction, when the surrounding parts are soft and yielding, is a diminution of the pain, the degree of relief being in proportion to the softness of these parts and their consequent facility of giving way to distension ; accordingly when inflammation attacks the periosteum, or external membrane of a bone, the surrounding parts

being soft, and of course readily yielding to the expansion of the inflamed blood vessels, the pain is comparatively slight. On the contrary, when inflammation is excited in the internal cavity of a decayed tooth, there is an insurmountable resistance to the expansion of the inflamed vessels, which produces that most acute and excruciating pain, the tooth-ache.

The pain continues with intermitting paroxysms till the internal membrane becomes wholly obliterated, and only terminates with its destruction. When this has been accomplished, the only living power remaining to the tooth is derived from the periosteum or membrane which lines the socket of the tooth and envelopes its fangs.

At the period of decay just described, when the internal membrane is effectually destroyed, the tooth may be filled without producing the slightest pain during the performance of the operation, but its efficiency cannot be depended upon for the following reason. In a vast number of cases, the morbid process, which

effected the destruction of the internal membrane, is now communicated to that part of the periosteum which surrounds the extremity of the fangs, and comes in contact with the blood vessels and nerves at their point of entrance into the tooth; the consequence of this is the production and accumulation of a morbid matter which, so long as it has a free outlet through the cavity of the tooth, continues to ooze out, and is scarcely attended with any pain; but should the orifice of the tooth be filled under these circumstances, the matter having no means of escape is confined within the part where it is secreted, and the process of suppuration being thereby in some degree obstructed, a great increase and extension of the inflammation of the periosteum with acute suffering, and sympathetic swelling of the neighbouring parts, are the consequences. In this state of things one of two events takes place; either the confined matter effects its passage through the substance of the alveolar process and the gum immediately opposite the point of the fang, by which it continues

to discharge itself, and thus relieves the suffering occasioned by its confinement; or otherwise it insinuates itself between the fangs and alveolar process, and forcing a vent by the neck of the tooth, produces the detachment and destruction of the periosteum. The latter frequently occurs, and the only relief that can be obtained under such circumstances is by the removal of the tooth. This being occasioned by the operation of filling injudiciously, it often brings discredit upon the operation and prevents many from having recourse to it during the previous stages of the disease, when its success would be certain and complete.

Taking into consideration the great uncertainty of success in filling at this stage of the disease, a candid and skilful practitioner will in most cases recommend the extraction of the carious tooth in preference to the trial of a remedy so doubtful and frequently of so pernicious a tendency, and more particularly so in youth, when the removal of an imperfect tooth is of less importance, in as much as the vacancy will be filled up by the approach of the teeth on each side of it.

But there are circumstances under which the practitioner would be induced to try any expedient in order to save the tooth, as for instance when the principal support of one side of the mouth would be taken away by the removal of a molar tooth. If however under any circumstances, whether from the necessity of the case, or the importunity of the patient, the practitioner should be induced to resort to the operation of filling as the last chance of preserving the tooth, he ought particularly to mention the possibility of its failure, and the probability of being compelled ultimately to extract the tooth.

I have found, from long observation, that the operation of filling so rarely succeeds, if delayed until the internal membrane of the tooth becomes exposed and inflamed, that there are but few cases, under such circumstances, in which I could be induced to try the experiment; for where the result is not attended with success, the pain is increased and the evil aggravated.

In numberless instances of the above description, patients are constantly being imposed

upon by the false and delusive promises held out by empirics in their advertisements, who pretend by the application of their "mineral succedaneum," their "marmoratum," and their "anodyne cements," "to cure in one minute the most excruciating pain, and to form a whole tooth out of a stump." This is pure charlatanism, and yet how great is the number of individuals who are deluded by this mode of imposition. There is perhaps no other profession in which empiricism is so prevalent as in the department of dental surgery.

The very circumstance of sitting down to have a tooth extracted is attended with painful sensations, and the operation is certainly one of considerable severity, even when performed with the greatest skill; and although the suffering be but momentary, it is what most individuals naturally shrink from undergoing. Under this state of feeling the patient becomes the willing dupe of the charlatan, and is easily persuaded by him to try this or that nostrum, under the fallacious hope that relief may be obtained without being obliged to submit to the operation of having

the tooth extracted. This mode of treatment may benefit the charlatan, but it only prolongs and aggravates the torment of the patient.

I am not an advocate for the extraction of teeth where reasonable hopes can be entertained of preserving them with utility to the patient ; but where there is no probability of doing this, is it not wise to submit at once to the extraction of the tooth, and by so doing to get rid of a diseased organ, which is not only useless itself, but is also an impediment to the usefulness of the neighbouring teeth, and a constant source of annoyance and suffering.

The pain necessarily attending the removal of a tooth may be very much lessened, in all cases, by a skilful performance of the operation. The art of extracting a tooth with the least possible degree of suffering to the patient, can only be acquired by a long course of practice and observation ; added to which, it is absolutely necessary that the operator should have a perfect knowledge of the anatomy of the parts, that he should have instruments constructed upon the best principles, and the judgment to select the instrument best adapted for each individual case.

Some authors have laid down rules as to the particular method in which each tooth ought to be extracted: one is to be removed outwardly, another inwardly; the key instrument is to be applied in one case, and the forceps, &c. in another. I am, however, convinced that no general rule can be laid down which will be of utility in the performance of this operation; but that in the infinite variety of cases which occur, the operator must depend upon his own judgment and experience.

Of the different instruments hitherto invented for the extraction of the teeth, the key instrument and the forceps are decidedly the best. The principles upon which they are constructed adapt them for the great majority of cases, particularly that of the key, which is the instrument most generally used. Instances, however, must have occurred to every dentist in which the defects of these instruments would be brought forcibly under his notice; and various methods have been devised for remedying them in the key instruments. Here the defects are of two kinds,

and both depend upon the very construction of the instrument itself. The first is the difficulty of so adapting it, in different cases, that the point of the claw shall always be nearly opposite to, but rather above the centre of the fulcrum ; but if the fulcrum and the tape, or other material wrapped round it, be too small, the point of the claw will descend too low towards the neck or fang of the tooth, and there will be great risk of breaking away a considerable portion of the alveolar process ; whereas, on the other hand, if the fulcrum or bolster be made too large, the point of the claw will not descend sufficiently low, and in attempting to extract the tooth, its crown will almost certainly be broken off. This nice adaptation of the size of the fulcrum to each tooth to be extracted, depends entirely upon the practiced eye of the operator ; and this difficulty, therefore, can only be overcome by long experience.

The second defect is the impossibility of applying power to the instrument in more than one direction, which is a lateral one ; for if, after the claw has been properly fixed, and

the tooth been partly detached by the instrument, we attempt to change the direction of its line of action, and draw the tooth perpendicularly, as with a pair of forceps, the claw will inevitably move from the situation in which it had been placed, and loose its hold of the tooth altogether.

The defects of the forceps may be very briefly noticed. If the tooth be very much decayed, and an attempt be made to extract it with this instrument, the force necessary for its removal, unless it be very loose, will be such, that the walls of the carious part will be crushed together, and the fangs remain in their sockets. If the crown of the tooth be entirely removed by caries, and the fangs on a level with the edges of the alveolar processes, there will be no hold for the forceps. Knowing that these difficulties must often occur in using the key instrument and forceps, particularly when in the hands of individuals who have not had very considerable experience in the performance of this operation, I was induced to think that another instrument might be constructed which should

combine in itself all the advantages contained in each of these separately, and at the same time should be free from all their defects. This I accomplished some time ago, and after several years' experience in the use of this instrument, I have found it more than equal to my most sanguine expectations. It is represented in Plate VI. and its construction may be thus briefly described. It consists of two parts which move on a hinge, in the same plane, but, of course, in opposite directions; the extremity of one is a fixed fulcrum, and to the end of the other is attached a fixed claw, so that the point of the claw is in all cases opposite to the same point of the opposing fulcrum. From this construction of the instrument, it will be evident that no difficulty can ever arise from any difference in the size of the tooth to be extracted; while, at the same time, from the circumstance of the operator having the power of regulating the exact degree of force with which the claw shall be held against the tooth, it is also evident that the instrument may be used as a pair of forceps, and con-

sequently is applicable to all cases, whether the tooth be only slightly carious or so much decayed as to be on a level with the gums, or alveolar processes.

I shall now proceed to notice some of the consequences which result from retaining a carious tooth which cannot be filled, and allowing it to take its course through the future stages of decay.

First, the disease proceeds from one stage to another, gradually increasing in rapidity as the morbid cavity enlarges and becomes more capable of receiving and retaining a greater quantity of corrupting matter, until the whole crown of the tooth is destroyed and broken down to a level with the gums. At this period the progress of decay becomes less rapid upon the remaining parts of the tooth; for the surrounding walls, which formed this receptacle, being removed, the surface is comparatively smooth and the food is less liable to be retained and to undergo chemical change; the disease however proceeds at a slower pace and only terminates with the destruction of the last remains of the fangs.

Secondly, while the process of decay, which we have been describing, is going on, the breath of the individual is rendered offensive by the putrid substances accumulated in the hollow of the tooth, an effect which is too often attributed to derangement of the stomach, or other imaginary causes.

Thirdly, at this stage of caries the periosteum of the tooth is always more or less tender, susceptible of inflammation, and liable to be excited by every local or constitutional cause, so as to prevent the use, not only of the tender tooth, but of the whole of the neighbouring teeth, in the process of mastication.

Fourthly, when mastication is confined to one side of the mouth, a deposition of tartar is liable to take place on the teeth in disuse, the friction of the food having a direct tendency to prevent its accumulation on the teeth employed in mastication; the teeth in use will accordingly be comparatively free from this concretion, while those of the opposite side are incrustated with it to a considerable degree.

The pernicious effects of this deposit we shall have occasion hereafter to explain.

Fifthly, when the carious portion of a decayed tooth comes in apposition with the side of a sound one, the disease is communicated to the latter by the corrosive action of the putrid substance contained in the former.

These are the most usual occurrences that result from the retention of carious teeth. But other cases have come under my notice, and they are by no means uncommon, in which inflammation of the periosteum of those teeth situated immediately under the antrum or cavity of the cheek bone, has been communicated to the membrane which lines that cavity, thereby producing a disease of a very serious character, sometimes occasioning an exfoliation of a portion of the bony walls which compose it, in other cases, exfoliation of large portions of the alveolar processes, and occasionally of a part of the jaw bone itself. Another bad consequence results from retaining diseased molar teeth in the lower jaw, and more especially the *dentes sapientiæ*; this is the liability to the occurrence of ab-

scesses externally at the under edge and angle of the jaw, which are sometimes difficult to be healed, and always unpleasant in their consequences.

I have already stated that when suppuration has taken place in the periosteum of a tooth, the confined matter generally effects a passage through the alveolar process immediately opposite the point of the fang. The bony walls which enclose the roots of the teeth under consideration being much thicker than those of the other teeth, the accumulated matter cannot find so easy a passage in that direction ; and besides, the central portion of the jaw bone, into which the fangs of these teeth dip, being of an open and porous structure, the confined matter, having a natural tendency to sink, often accumulates in this situation, and finds an easier outlet through the base of the jaw, and its external coverings.

In the most favourable cases of abscess thus produced, scars always remain after healing, exactly resembling in appearance those of scrofula. In some cases, however, the process of

healing is rendered tedious by the exfoliation of bone destroyed by the purulent matter during its confinement. It is obvious that these consequences can only be effectually prevented, and the diseased process which led to them put a stop to, by the removal of the primary cause, namely, the decayed tooth; and here I may remark that not only in this but in every case, where inflammation and suppuration have arisen from such causes, the most speedy, safe, and decisive remedy, where it is practicable, is the immediate extraction of the tooth, which makes a free outlet for the confined matter. This is often objected to from a mistaken prejudice, that some injury would be sustained by the removal of the tooth before inflammation had subsided; upon this principle the case under our notice is treated by hot applications externally, thereby softening the parts and inducing the abscess to break outwardly, which ought by every means to be prevented. The mischief would be avoided by the removal of the tooth, and the only bad effect resulting from the operation would be the experience of

somewhat more pain, in consequence of the inflammation of the surrounding parts.

Before dismissing this subject it may be proper to obviate some other objections to the extraction of teeth irremediably diseased, which are very commonly entertained by individuals who ought to be better informed, and in whom such misconceptions could not be expected ; namely, that there is no end to the extraction of teeth when once begun ; that when one tooth has been removed, a short period only will intervene before more will require to undergo the same operation ; that the removal of one tooth takes away the support from the adjoining tooth, thereby in some way predisposing it to decay ; and also that the opposite tooth is liable to decay from some imaginary loss sustained by the extraction of the other, or from some mysterious sympathy.

It is very true that the teeth often decay in the manner just described, but it proceeds from very different causes to those brought forward by these objectors. The cause of the decay of the teeth in pairs has been already so fully explained that it is unnecessary here

to say more than that their liability to decay at or about the same period of time is owing to the similarity of their structure, and to their being in like manner formed so as to retain particles of food, and that the circumstance of one requiring the operation of extraction soon after another does not depend upon any imaginary sympathy, nor upon any effect produced in it by the removal of its fellow, but arises from the fact, that it was already in a state of progressive decay when the first was removed.

The allegation that the extraction of one tooth takes away the support from the adjoining teeth, and thereby predisposes them to decay, is equally erroneous; for when decay takes place on the contiguous sides of two teeth, they will be found to come in contact with each other towards their cutting points, and to diverge towards the gum, so as to adapt them for intercepting food in that situation; but the side of one is often more liable to this on account of its having a neck or groove calculated to retain a greater portion

of the putrid substance;* the consequence of which is that it will be sooner acted upon, and will proceed with greater rapidity to that stage of the disease in which the membrane is exposed and inflammation excited, so as to render its removal necessary on account of pain, long before the other has arrived at the same stage.

The removal of a carious tooth is so far from being the cause of decay in the adjoining one, that it is oftentimes the cause of effectually and permanently retarding its progress after it has commenced, by removing the contact between them, which gave occasion for the lodgement of food; this occurs when the operation of extraction has been performed before the disease has passed its first stage, when the putrid substance has only blackened the enamel upon the side of the adjoining tooth, and when no cavity has been produced; under these circumstances decay proceeds no farther, the discoloured portion of the enamel undergoes no change, and the tooth is saved.

* See Plate II. fig. 5, l, and Plate III. fig. 2, c, as compared with Plate III. fig. 1, a.

This is a case so obvious and of such frequent occurrence that it can scarcely be overlooked, even by the most superficial observer ; a demonstrative proof of the correctness of the theory advanced in these pages that the disease commences upon the surface, and is excited by external agency, and that it does not originate in the interior of the tooth, nor upon the surface of the bone within the enamel. When, however, the disease has reached the second stage, and a cavity has been produced before the removal of the tooth, which by its contact formed the interstice that retained the food, the cavity produced will of itself, even after the removal of the original cause of mischief, be sufficient to allow a deposition of food within it, and consequently will, if not remedied by the operation of filling or filing, proceed to that stage of decay when it will also require to be extracted.

In the preceding pages I have described the cause of decay in the teeth, and traced its progress ; but the loss of the teeth is occasioned by other causes besides the ex-

posure of the internal membrane. The tooth depends for its support upon a healthy state of the periosteum, or membrane which lines its socket and envelopes its fangs; the exposure and inflammation of this membrane is of itself sufficient to produce the destruction of the tooth. As the internal membrane is protected from the influence of foreign bodies by the enamel and bone which surround it, so the periosteum is protected from the action of external causes by the firm adhesion of the gums to the necks of the teeth; therefore a healthy state of the gums is absolutely necessary to ensure the safety, comfort and durability of the teeth; and if all the consequences arising from an unhealthy condition of the gums, the alveolar processes, and the periosteum, be taken into account, we shall find that the loss of the teeth occasioned by disease in these parts is very considerable.

There is such connection and sympathy existing between the gum, the socket, and the periosteum, and such mutual dependance upon each other for support, that the one cannot exist without the other. For example, when

the periosteum is destroyed, which it necessarily is by the extraction of a tooth, absorption immediately takes place in the socket and gums; on the other hand, the receding of the gums from the necks of the teeth is always accompanied with absorption, to the same extent, of the alveolar processes and periosteum. When inflammation is excited in either of these parts, the others also become diseased; but the mischief generally originates in the gums, and in the greater number of cases may be attributed to the want of cleanliness, and omitting the use of the tooth-brush.

The loss of the teeth from disease in these several parts is occasioned in three different ways. In the first place, the receding of the gums, from a cause which will be presently explained, renders the teeth liable to caries by producing openings between them,* which admit of their retaining portions of food; whereas, in a regular and well-arranged set of teeth, the gums, which have been kept in a healthy state, not only adhere firmly to the

* Plate III. fig. 4.

necks of the teeth, but send forth processes which fill up their interstices,* and thus prevent the retention of food. And here it is of the utmost importance to impress upon the mind of the reader the irremediable nature of the mischief which is occasioned by neglecting to keep the gums in a healthy condition; for when once disease has been excited in these parts, so as to detach them from the necks of the teeth, however long or short the distance they may have receded, the injury sustained is irremediable; the vital connection which previously existed between the now denuded portion of the fang and the gum, through the medium of the periosteum, is destroyed by the exposure; the gums cannot be brought back to their original situation; the evil is therefore permanent.

Secondly, the loss of the teeth is often occasioned by acute inflammation of the periosteum, terminating in suppuration, the result of which is the separation and destruction of this membrane, by which the tooth is severed from the socket, and is thus deprived of its

* Plate III. fig. 3.

support. It frequently, however, becomes necessary to remove the tooth in consequence of the pain produced by the inflammation of its periosteum ; and this membrane, thickened by the inflammatory action, often raises the tooth above the level of the others and occasions great pain through the consequent pressure against the opposing tooth in closing the mouth, and during the process of mastication. I have before stated that, when caries has exposed the internal cavity of a tooth, and excited inflammation in its lining membrane, the disease is often communicated to the periosteum ; but in the case now spoken of, an unhealthy state of the gums is the exciting cause, and the loss of the tooth is effected without the existence of decay.

Thirdly, the teeth are liable to become loose and fall out spontaneously in consequence of the gradual absorption of the gums, the alveolar processes and the periosteum, by which they are deprived of their support. This morbid process is unaccompanied by acute pain or inflammation of the parts, and is merely attended with a spongy, loose and irritable state of the gums.

The principal exciting cause of the disease above mentioned is the accumulation of a calcareous substance, called tartar, which is deposited upon the necks of the teeth. This earthy matter is originally contained in the saliva, by which it is held in solution, and consists principally of the phosphate of lime. When it first attaches itself to the teeth it is of a soft and slimy consistence, being combined with the thicker and more glutinous parts of the saliva; but when it has been allowed to remain upon the teeth for a certain period, the watery parts separate from the earthy matter, and the substance left becomes extremely hard. The teeth of every individual are more or less liable to this concretion, but those of some persons are particularly subject to it.

The parts where the deposit first takes place are those which are the most exempt from friction during the process of mastication; this is apparent from the fact that when mastication is confined to one side of the mouth, which is often the case in consequence of the presence of a diseased and tender tooth on

the opposite side, the teeth employed in mastication are comparatively free from the concretion, while those in disuse are often incrustated with it to a great degree. The necks of the teeth being most exempt from the friction of the food, and the action of the surrounding muscles, they are accordingly the parts on which this substance first begins to concrete; and moreover in these situations it finds a resting place in the furrows produced by the abrupt termination of the enamel and the free edge of the gum.

A deposit once established forms a basis for a further deposition, and, one layer being successively added to another, the accumulation goes on gradually increasing and insinuating itself below the edges of the gums, thereby detaching them from their connection with the necks of the teeth, and at the same time producing an irritable and spongy state of these parts, which are subject to bleed upon the slightest application of the tooth-brush.

As the tartar increases in quantity, it progressively takes possession of more and more

of the fang, causing the gum, the socket, and the membrane to retreat before it until it excites inflammation in the periosteum, and then, in consequence of the acute pain occasioned, the tooth must be extracted; or, should this not be the case, the tartar takes possession of the whole of the fang, and then the tooth losing its support drops out of itself.

The saliva naturally occupies the lower part of the mouth, consequently the front teeth of the lower jaw are the most subject to the injurious effects of this concretion; and although these teeth, as we have before stated, are the least liable to caries, they are the most subject of all the teeth to be lost from the pernicious effects of tartar.

Having pointed out the bad consequences of an accumulation of tartar upon the teeth, our next object is to shew how the mischief may be prevented.

When this substance is first deposited upon the teeth it is of a soft but glutinous consistence, and may, in all cases, be removed by the firm application of the tooth-brush, with the assistance of a safe and well prepared

tooth powder ; in some cases, indeed, in which there is but little tendency to its accumulation, and when it is naturally less tenacious, the tooth-brush and water alone are sufficient to prevent a deposition from accumulating to an injurious degree ; but in most cases the friction of the tooth powder is absolutely necessary, and to accomplish this object the teeth ought to be thoroughly cleansed once in twenty-four hours, for if this substance be allowed to settle upon them, it becomes exceedingly hard, and cannot be dislodged by the process of brushing.

The use of acids under these circumstances is sometimes resorted to by ignorant and thoughtless individuals, for the purpose of removing this concretion ; a practice which cannot be too strongly reprobated on account of the ruinous effects which result from it. An acid sufficiently powerful to destroy the tartar must at the same time operate upon the enamel of the tooth, the earthy part of both substances being phosphate of lime.

It may here be observed, that when it is necessary to have recourse to medicine con-

taining much acid, it is advisable to take it through a glass tube, as frequently practised; and by this means to save the teeth as much as possible from coming in contact with the medicine; by this simple precaution considerable mischief may be prevented.

The destruction of the teeth, however, is very often attributed to the effects of medicine, without the least foundation for so doing, and when the origin of the injury may be traced to a different cause.

The effect produced by acids upon the teeth, and that produced by caries are distinguished by very different characters; the latter is partial in its attacks, being confined to those teeth and the parts of them which retain food, so that one tooth may be diseased and the adjoining tooth perfectly sound; with the former it is quite the reverse, the effect produced is apparent upon the whole range of the front teeth which come in contact with the acid, and those parts of them too which are the least subject to decay, namely, their smooth front surfaces.

During a protracted illness, where much medicine has been administered of the description before alluded to, I have seen the whole range of the front teeth, including the incisores, the cuspidati, and the bicuspides, denuded of their enamel from their necks half way to their cutting edges ; the enamel being thinnest in this situation, and thickening gradually towards the cutting edge of the tooth, consequently the part described becomes sooner dissolved from the effects of the acids.

But to return to our subject : when tartar has been allowed to accumulate upon the teeth until it acquires a hard consistence, and is no longer capable of being dislodged by the process of brushing, it ought to be removed with the small instruments adapted for that purpose ; and it is of importance to remove every particle of it, for if the smallest portion of it be allowed to remain it will form a basis for a further deposition.

After the operation has been performed, the daily use of the brush, with a proper tooth powder, is necessary for the purpose of removing

the viscid matter in which the tartar originates. An accumulation of it upon the teeth is invariably attended with a loose, irritable, and spongy state of the gums; and to restore these parts to a healthy condition after the tartar has been removed, (for it is impossible to do so while this substance is allowed to remain) I know nothing more effectual than tincture of myrrh diluted with two parts of water. This mixture should be firmly brushed into the gums: merely rinsing the mouth with it is not sufficient.

And here I would observe that a very mistaken notion prevails regarding the treatment necessary to keep the gums in a healthy condition, and also regarding the treatment which is required to restore them to a sound state when diseased. Many persons have an idea that the gums are in danger of being removed from the necks of the teeth by the firm application of the tooth-brush; consequently the brush is used very slightly, and therefore very ineffectually; and the result is an accumulation of tartar, occasioning irritation in the gums, which become painful and subject to bleed

even from the gentle treatment I have been describing. In this state of things brushing is either dispensed with or performed in a manner which is altogether nugatory.

To preserve the gums in a healthy state the teeth must be kept clean. To restore them to a healthy state when diseased the exciting cause must be removed, and for the future the teeth must be kept clean. This can only be accomplished, in most cases, by the thorough application of the tooth-brush, with the assistance of tooth-powder. There is not the least danger of brushing the gums from the necks of the teeth; on the contrary, that degree of brushing which is necessary to keep the teeth clean will be found beneficial to the gums, and by a continuation of this mode of treatment they become every day less irritable and less subject to bleed upon the application of the brush, till at last they acquire a healthy action and adhere tenaciously to the necks of the teeth. The use of the tooth-powder is to prevent an accumulation of tartar, not to remove it; for when once this substance has been allowed

to settle upon the teeth, it is no longer capable of being removed without the aid of instruments. This process is what is generally termed scaling the teeth, a phrase which no doubt derives its origin from the circumstance of this earthy incrustation being separated from the teeth, during the operation, in the form of scales.

Mistaken notions exist in the minds of some individuals respecting the removal of tartar from the teeth, which they imagine must be attended with mischievous consequences, such as that the enamel sustains an injury which predisposes the teeth to caries, or that they are in danger of being loosened by the operation. This prejudice, like many others, may, I doubt not, be traced to the untimely and injudicious performance of the operation. There are instances where the tartar has been permitted to remain upon the teeth for so long a period, and to accumulate to such a degree, that the sockets and gums have receded to the extreme points of the fangs, and the teeth being retained in their situations principally by the support of this substance which cements

one tooth to another, the removal of it under these circumstances would certainly occasion their loss rather sooner than would have been the case if left to their own course; but no skilful practitioner would attempt performing the operation under such circumstances, as he would immediately perceive a case of this nature to be irremediable. On the other hand, the timely removal of the tartar, before the greater portion of the fang has been taken possession of, and the daily use of the brush and tooth-powder for the purpose of preventing a future accumulation, will permanently arrest the mischief; and although the denuded part of the fang can never be restored to its original state, the link of union between it and the gum being dissolved in consequence of the destruction of the periosteum and the absorption of the alveolar process to an extent equal to the exposure of the fang, yet the remaining portion of the periosteum and the surrounding parts will continue in a healthy condition, and a sufficient hold will still be left in the socket to secure the tooth in its situation.

Having pointed out the injurious effects which result from an accumulation of tartar upon the teeth, and shewn how readily the mischief may be prevented, I presume it is scarcely necessary to add a single remark further upon this subject, taking it for granted that the reader must be convinced of the absurdity of the prejudice which supposes that the teeth sustain injury from the removal of this extraneous substance, and also that ignorance of the evil will no longer form an impediment to the means of prevention.

Should the advantages which the individual would himself derive not be a sufficient inducement to prompt him to adopt and persevere in the treatment recommended, a regard for the feelings and comfort of those about him ought surely to urge him to the propriety of divesting his teeth of this offensive and unsightly concretion; for what can be more disgusting to those who consider cleanliness an essential, than to be doomed to enter into anything like close conversation with a person whose teeth are incrustated with this fœtid accumulation.

I have now fully explained the nature and progress of the two destructive diseases to which the teeth are liable, namely, caries and tartar; by the corrosive action of the former, an opening is effected through the enamel and bone which surround and protect the internal membrane, thus exposing it to the influence of foreign bodies which necessarily excite inflammation in this part, and occasion the destruction of the tooth: by the instrumentality of the latter, the gum is forced from the neck of the tooth, thus depriving the periosteum which envelops the fang of its natural covering, and exciting inflammation in this membrane, so as to require the removal of the tooth in consequence of the pain produced, or otherwise causing gradual absorption of the surrounding parts until the tooth becomes so loose as to drop out.

These are the evils to be guarded against, and if it were possible to keep the teeth perfectly free from tartar, and to remove the particles of food from their indentations and interstices before a chemical change takes place, there would be no tendency to disease.

Gum boils, abscesses, and exfoliation of the alveolar processes are, almost in every instance, the results produced by one or other of the two primary evils above mentioned; and for such diseases there is no cure but that of the removal of the exciting cause, namely, the diseased tooth.

When the insidious character of the process of caries, and the true nature of the diseases to which the teeth are liable, become more generally known and correctly understood, the propriety will be seen of that watchfulness of these organs which I have recommended, and by which alone the progress of decay can be arrested and the necessity prevented of having recourse to the painful and disagreeable operation of extraction, now so frequently required. Indeed I may boldly assert that in nineteen cases out of twenty in which the teeth are lost from the effects of caries or of tartar, this evil might have been prevented and the teeth permanently saved by the adoption of timely and proper treatment.

Persons are accustomed to consult the dentist for the same reason that they do the

physician or the surgeon, to be relieved from pain. It is true that the object of the physician or the surgeon is to cure disease ; the object of the dentist is, or rather ought to be, to prevent disease. But as long as the true nature of the process of caries is misunderstood, the application to the dentist will not, in a great majority of cases, be made till the occurrence of pain compels the attention of the patient to the subject. The mischief, however, will then be found to be irreparable, and the only resource is the extraction of the decayed tooth. If we for one moment take into consideration the structure and formation of the teeth, we shall see that it would be quite as reasonable to expect that a man could exist in a state of health after a portion of his cranium has been removed, and the brain laid open to the direct action of foreign bodies upon it, as that a tooth should continue in a healthy condition and free from pain after an opening has been made through its enamel and bone, and the vascular membrane lining the internal cavity exposed to the influence of foreign bodies.

In the former pages of this treatise I have adopted the ordinary mode of designating the process of caries, and have called it disease; but, as disease and pain are usually co-existent, I shall now, in order to prevent a misunderstanding of my own views, restrict the future application of the term disease to that stage of caries when pain occurs.

Whatever action or process may be going on in the enamel or bone of a tooth, so long as such action is confined to those parts, pain is never produced, for both these structures are strictly inorganic.

That the enamel is an inorganic substance is now I believe universally admitted; but a different opinion is maintained by some writers with regard to the bony part of the tooth, and in a subsequent page I shall again revert to this disputed point, merely asserting here that the bony portion of a tooth has none of the vital properties which characterise the bones in other parts of the body, that it is destroyed by caries without pain being produced, exactly as is the case with the enamel, and that it is solely owing to this absence of

pain during the progress of caries through the bone that this process is allowed to go on unchecked in so many instances till it at length lays open the cavity of the tooth, and so allows particles of food and other matter to come in contact with the internal membrane. It is only when this has taken place and the membrane thus exposed to irritation becomes inflamed, that tooth-ache commences, and that, in the true sense of the word, the tooth may be said to be in a state of disease which is almost invariably incurable.

I am well aware how natural it is to infer that so long as the teeth are free from pain they must be in a sound and healthy condition; and in consequence of such an opinion to withhold attention from them till they become troublesome. This indeed is the system constantly acted upon, and from this want of knowledge on the subject arises all the evil; but my object throughout this treatise has been to shew the fallacy of this imaginary security, to point out the danger of waiting till pain occurs, and to urge the necessity of applying to the dentist, so that he may arrest

the progress of the chemical action of the decomposed particles of food on the enamel and bone, before the cavity of the tooth is laid open, and the vascular and delicate membrane within exposed.

It is a well-authenticated fact that the teeth of the lower animals are in almost every instance exempt from disease, and it may therefore be asked why are the human teeth so peculiarly predisposed to caries, requiring so much care and watchfulness for their preservation? This appearance of peculiar liability to disease in the human teeth I shall be able, I have no doubt, to explain satisfactorily and in strict accordance with the theory advanced in this treatise.

Both Mr. Fox and Mr. Bell have attributed this predisposition to caries to some peculiarity in the organization of the human teeth; but if we compare the teeth of man with those of other animals the most nearly allied to him in formation, we shall see that the theories hitherto advanced are clearly insufficient to explain this liability to disease in the human teeth alone. An examination of

the teeth of apes and monkeys will shew a close resemblance in structure, organization, number and arrangement, with the same organs in man; the chief if not the only difference being that in the *Simiæ*, the canine teeth are rather longer and more pointed, with a small interval between them and the lateral incisors. The similarity is observed both in the temporary and permanent sets; the temporary set of teeth in these animals comprise twenty in number, eight of which are molar teeth, and they are succeeded by eight bicuspides in the permanent set. The same arrangement takes place in the human teeth; the jaws in both instances elongate posteriorly to make room for the permanent molar teeth, and, when completed, the number and classification in both cases are exactly the same.

I have taken repeated opportunities of closely inspecting these organs in many kinds of the *Simiæ* tribe, and at different periods in the life of these animals, but I have never met with a single instance of a carious tooth in them. This exemption may, in my opinion,

be accounted for by taking into consideration the nature of their food, which is of a kind the most opposite to that of the human being, and the least likely to be retained in the dental fissures and interstices.

The teeth of our common domesticated animals, viz. the horse, cow, sheep, &c. are likewise exempt from caries, and in these instances, as in that of the apes, the food requires so much mastication, that the long continued attrition which it undergoes in order to prepare it for the stomach, serves to keep the teeth themselves perfectly clean.

This greater degree of mastication of the food by other animals not only prevents a lodgement of particles in the fissures and interstices of the teeth, but also obviates the possibility of tartar being deposited upon them. It is indeed a mistake to suppose that the human teeth are injured by the mere process of mastication, for the very reverse of this is true, and these organs are constantly lost on account of the slight mastication necessary with our food, which is so much softened by our modes of preparing it for table, as to

ensure the retention of some minute portions of it in those parts of the teeth which I have so often described.

Having, however, acquired artificial habits in our mode of living, and especially in the preparation of our food, it becomes necessary to employ artificial means to counteract the mischief which might otherwise be produced.

Man, strictly speaking, is the creature of habit and circumstances; his reason and ingenuity enable him to overcome numerous difficulties, to live in all climates, to derive nourishment and support from all kinds of food, and to defend himself against the extremes of heat and cold, and other destructive influences of local situation. It is not so with the lower animals of the creation, their range is confined to that climate and to that locality best adapted by nature to supply their wants; and we find the teeth of animals in a state of nature not only well adapted for the different kinds of food upon which they subsist, but we also observe that there is no tendency in the food to injure these organs.

The greater irregularity in the arrangement of the teeth of man also renders them more liable to caries than those of the lower animals; indeed it may be safely asserted that an irregular distribution, and a diversity in the indentations and interstices are met with almost exclusively in the human teeth*, and rarely occur even in those tribes of the human race who still remain in a savage state. I shall leave it to those more extensively acquainted with comparative anatomy and physiology than myself, to account for these facts; I am convinced, however, that a perfect deposit and a regular distribution of the enamel very much depends upon a healthy and robust state of the constitution during the period when that substance is being formed. In some cases the secretion of the enamel appears to have been defective at the commencement,† and to have been succeeded by a healthy deposit; in other instances the secretion may have begun properly, but, before

* This irregularity in the arrangement of the teeth is frequently observed in particular breeds of the smaller kinds of dogs.

† Plate IV. fig. 3, d, d.

the crown of the tooth has been completely covered, derangement in the state of the health generally has perhaps disturbed the action of the membrane, and an imperfect secretion will have been the consequence.* These alterations may, and no doubt do, occur in some constitutions before the enamel is complete, and this appears to me to be the only probable way of accounting for this defect in its formation.

In the same way I would also account for that denuded condition of the teeth, occasionally met with, in which a portion of the enamel is gradually dissolved and removed as if a round file had been applied across the anterior surfaces of the teeth, and the depressions afterwards highly polished. This loss of substance is produced, in some instances, I doubt not, by the too frequent application of the brush across the front surfaces of the teeth, instead of applying it upwards and downwards; but I have frequently met with instances of this loss of enamel where it could not be attributed to the friction of the

* Plate IV. fig. 4, e, e.

tooth brush. In this case the secretion of the enamel was not originally deficient in quantity, but this substance appears to have been, in these situations, of a softer nature than on the other portions of the teeth.

There is another circumstance, however, connected with the secretion of the enamel upon the teeth which must be noticed. It is one which, I believe, has been overlooked by previous writers, although it is of great importance as being one of the principal predisposing causes of caries. In order however to make it sufficiently clear, I must describe first the mode in which the enamel is formed, and for this purpose I shall select as an example one of the molar teeth, these being the teeth to which I particularly allude. At first the enamel is deposited on those parts of the surface of the tooth which will ultimately form the most prominent parts of the crown, and there will, therefore, at the commencement be several insulated spots of this substance, which will gradually increase in size and in thickness, and at length coalesce so as to constitute a continuous layer over that portion of the organ

which is necessarily exposed for the purpose of mastication. The parts where the union of these several portions of enamel takes place, are the pits and fissures on the grinding surface of the tooth; occasionally, however, when these pits and fissures are very deep, a defect in the formation of the enamel is observed in these places. The secreting membrane appears to furnish an abundant supply of enamel up to the very period when the insulated portions of this substance are apparently on the point of uniting; but exactly at this time the membrane ceases to furnish the necessary secretion in this situation only, the process going on in all the other parts; the consequence of this is that a fissure will be formed in the enamel extending down to the bone,* and as this fissure occurs only at the bottom of the deep pits and indentations of the teeth, it will necessarily much increase the liability to caries of such teeth, by receiving and retaining the more liquid portions of food or other substances, which will pass down these fissures and penetrate to a greater or less

* Plate IV. fig. 9, b.

extent the softer bone beneath. I have no doubt but that the stained appearance thus given to the bony structure has often been mistaken for caries of that part, and has led to the belief of decay commencing in the interior of the tooth; the fissure in the enamel, often very small, being overlooked.

I have been able almost invariably to trace a defective secretion of the enamel, which occasionally takes place on the incisors and anterior molar teeth of the permanent set, to a deranged state of the health during the first few months after birth, it being at this early age that the formation of the enamel of these teeth commences. I may also advert to the extreme rareness of irregularity either in the arrangement or in the secretion of the enamel of the temporary teeth, which are formed in the jaws before birth; the fœtus being much less liable to derangement in its health than the recently born infant, the first set of teeth will be so much the more likely to be perfectly developed than those which are to succeed them.

It is generally admitted that those of the human race who inhabit warm climates and live chiefly on vegetable diet, are but little liable to caries of the teeth. Attempts have been made to explain this by attributing it principally to the lower temperature at which the food is taken. A little consideration, however, will show the unsatisfactory nature of this explanation; for, in that case, in individuals living under similar circumstances, the liability to caries ought to be general and alike in all the teeth, and not partial, as is acknowledged to be the fact, for the *dentes sapientiæ*, the molar teeth, the bicuspidæ, and the upper incisors, are subject to decay in different degrees, and decay is of rare occurrence in the lower incisors.

The true explanation appears to be that, with the more simple diet, a greater degree of mastication is necessary, and the food itself will possess less of those adhesive qualities which it acquires from our more varied and refined modes of preparing it. I may further observe that the injury does not arise from those fibres so frequently retained in the

interstices of the teeth, and which, by their presence, excite irritation in the gums ; for at this period such fibres have not undergone decomposition, consequently no chemical action is produced on the parts of the teeth with which they are in contact, and it is not till the fibres have become decomposed, and the irritation in the gums produced by their more solid form has ceased, that the chemical action on the teeth commences. The greater part of the mischief is occasioned by the softer and more adhesive portions of our nutriment which fill up the irregularities on the surfaces of, and the openings between the teeth, and afford no evidence to us of their presence, but which, on that very account, require to be guarded against with the greatest watchfulness on our part. I do not consider the disposition to caries to be produced so much by the kind of food which we take as by the tenacious character which it acquires from the modes of cookery which civilization and luxury have introduced.

In a former page I have slightly adverted to the subject of the inorganic nature of the bony

part of the teeth, and I shall now examine it somewhat more in detail.

That the enamel of the teeth is truly inorganic is now so generally admitted, that I may leave that part entirely out of view, and I shall, therefore, in the following remarks, confine myself to the consideration merely of the bony structure. Mr. Fox's theory of caries has been noticed in this treatise; the substance of it may be stated in the following words:—From some cause, but what that cause may be is not very clearly made out by Mr. Fox, inflammation is excited in the vascular membrane lining the cavity of a tooth, and in consequence of such inflammation the membrane separates from the bone with which it was in contact; a death of some part of the tooth speedily follows, and caries or decay is the result; the caries beginning, according to this writer, in the interior, and making its way to the exterior surface of the tooth. As I have already, I believe, sufficiently pointed out the erroneous nature of this view of the subject, I shall here only observe that Mr. Fox supposes that inflammation of the internal mem-

brane precedes caries, whereas I have proved that caries always precedes and actually produces inflammation in the membrane, by exposing it to the direct and irritating action of food and other extraneous matter. Moreover, if the theory which Mr. Fox has advanced were correct, the operation of filling and filing the teeth for the purpose of arresting decay would be perfectly useless; this treatment, however, is well known to be effectual, by permanently putting a stop to the further progress of decay.

The theory of Mr. Fox, therefore, I may now finally dismiss, and proceed to that of Mr. Bell, which is absolutely based on the assumed truth of the very subject at issue, viz. the vascularity of the bone of the tooth. The theory of Mr. Bell, like that of Mr. Fox, rests on inflammation; but here the inflammation is no longer supposed to be in the internal membrane but in the bone of the tooth itself; the author adding, that as the external surface of this bone, or that portion of it immediately beneath the enamel, possesses vital powers of the lowest grade on account of its density, and its being

the part most remote from the source of its vessels and nerves, it will be the least able to resist the effects of inflammation, and gangrene of this part will be the consequence. I agree with Mr. Bell that its vital powers are of a very low grade, so low indeed that it possesses none of the vital properties which characterise other bones. "The loss of substance occasioned by the friction of mastication is not repaired; a part broken off is never renewed, but the fractured surface remains unchanged; a hole occasioned by decay is never again filled up. None, in short, of those processes of restitution, which so strikingly characterise all organized bodies, for which alone powers of life and growth can ever be required, take place in the present instance; so that if the bone of the teeth possess vessels, they exist to no purpose, and manifest their presence by none of the usual phenomena."

"Such is, precisely, the reasoning employed to shew that the enamel is not vascular; and every argument tending to prove that position, will apply with equal force to shew the want of vascularity in the bone of the tooth. If it be

broken off it is never regenerated ; if it be filed away, it is never reproduced. The same facts hold good of the bone of the tooth, and should lead us to the same conclusion.”*

These are the remarks of a writer whose opinions on any part of human physiology are deserving of the highest consideration ; I mean Mr. Lawrence, whose language I have preferred employing, as conveying in few words what would only be weakened by any alteration of my own.

If Mr. Bell's theory were correct, the gangrene or decay ought always to commence at that part of the surface of the bone which is actually the most remote from the vascular membrane of the tooth ; whereas decay is first observed at those parts of the surface of the bone which are really nearest to the membrane, such parts corresponding in a great degree to the deep pits and depressions on the exterior of the tooth. Again, all the teeth have a similar general formation ; in all of them there is a bony wall surrounding an internal cavity, and a layer of enamel of variable

* Article “Cranium,” Rees's Cyclopædia.

thickness exterior to the bone; now if the theory of this author were tenable, all the teeth having thus a similar structure ought to have a similar and equal predisposition to caries; every one, however, conversant with dental surgery, and of course Mr. Bell himself, knows and admits that this is not the fact; all parties particularly noticing that special liability to caries in certain classes of the teeth, which I venture to assert is to be accounted for only by the explanation that I have given.

There is another circumstance which bears strongly on this point, viz. the greater liability of the teeth to caries in youth than in the later periods of life. In youth the surface of the bone immediately within the enamel is much nearer to the internal membrane than in the more advanced stages of life;* for as this membrane continues to deposit layers of bone until the cavity is nearly filled up, the surface of this substance must of necessity be further removed from the centre of circulation, and consequently the predisposition to gan-

* Plate IV. fig. 9 and 10, c, c.

grene ought to be greater in the advanced periods of life than during its more youthful stages; but that this is not the case is a well-authenticated fact.

I might here conclude my remarks on the theory of inflammation of the bone of the teeth, but there are a few other observations which I still wish to make, both as shewing its untenable character and as supporting the view which I take of the inorganic nature of the bone of the teeth.

In order to supply the loss of the natural teeth the dentist fixes other teeth either on a gold frame or on one made from the tooth of the hippopotamus; and this frame with the teeth so fitted to it is in a proper manner inserted in the patient's mouth; but in the fitting and connecting the teeth with the frame the greatest nicety is required, for if any crevice or interval, however small, be allowed to exist between the frame and teeth, a recess will then be made for the reception of minute particles of food, and a process of caries will commence in the extraneous teeth, exactly like that which takes place in the teeth naturally contained in the jaw.

Sometimes the crown of a front tooth is through accident or decay broken off, and it becomes desirable for many reasons that the deformity or defect so produced should be remedied. To accomplish this the fang of the fractured tooth is filed down to a level with the gum, and the surface is made slightly but regularly concave; the crown of a similar tooth is then to be attached to the fang in the following manner; its surface, which is to be applied against the fang, is made convex so as to fit exactly to the concave surface, and the two are held firmly together by means of a gold pin, one end of which is screwed into the crown to be attached and the other then inserted into the natural orifice of the fang, the nerves and blood vessels within having been previously destroyed by the actual cautery. But in this operation, as in the one before described, unless the fitting of these two parts, namely, the extraneous crown and the fang attached to the socket, be so accurately performed as to leave no external aperture or crevice whatever, a place for the lodgement of particles of food will exist, and a process of caries

will speedily occur, which will go on as much in the crown so grafted, as in the fang to which such crown is fastened.

Having had this occasion to advert to the grafting of a part of a tooth on a fang still naturally attached to its socket, I will take this opportunity of explaining how it is that this operation often occasions inflammation.

When, by the process of caries, the cavity of a tooth has been laid open, the internal membrane becomes inflamed and disease supervenes, causing in that part matter to be secreted which escapes through the carious opening of the tooth; in such cases, if the cavity be plugged up by the insertion into it of the gold pin or pivot, the escape of the morbid secretion will be prevented, exactly as occurs after the improper filling up of a decayed tooth; the disease will extend to the periosteum, and inflammation will be excited in that membrane, which will become in consequence detached from the fang; or the confined matter will gradually force its way through the alveolar process and its external covering, and an abscess or gum-boil will be

produced. In doubtful cases of this kind the safest plan is to insert the artificial tooth on a gold socket.

When the operation of grafting is resorted to in a case in which the internal membrane of the tooth has not been exposed, and consequently not inflamed, and of course when the periosteum of the fang is still in a perfectly healthy condition, the application of the actual cautery to the internal membrane, and its consequent destruction, will prevent any diseased action being communicated to the periosteum, and the operation will be quite successful.

To return, however, from this digression ; I consider the sole office of the vascular membrane lining the cavity of a tooth to be the following:—By the process of mastication the enamel at the surface is gradually worn down and the bony structure itself becomes at length exposed to the same attrition, and is also ground away. If no provision were made to counteract the effects of this wasting action, the cavity of the tooth would soon be laid open ; but to guard against this, additional bone is slowly but unceasingly deposited within by the

lining membrane, and, as is well known, the cavity of the tooth is gradually diminished in capacity, until in old age it is nearly obliterated. To supply this additional bone appears to be the only function of the membrane lining the cavity of a tooth, and this opinion is supported by facts which we obtain from comparative anatomy. In the case of the hippopotamus and other rodentia the teeth are quickly ground away by the great degree of attrition which their food requires, and would soon be completely destroyed did not the vascular pulp or membrane within these organs supply new bone, as rapidly as it is worn off externally; and it may be observed also that in these animals the bone is very soon brought into action.

Gold and platina are introduced not only into the enamel of the human tooth but into this supposed vascular and sensible bony structure; now, from our knowledge of the laws of the animal economy, we know that the presence of a foreign substance in other parts of the body will certainly be attended by inflammation of such parts; but does this

occur in the bone of a tooth? The gold or platina introduced into the cavity of the bone which caries has produced, not only excites no inflammation there but actually arrests, when properly done, the very process of decay itself, and has been known to remain in such situation thirty years without producing by its presence the slightest irritation.

Mr. Hunter fed young pigs with madder several weeks in succession, and then killed them; when he found that although all the other bones of the body were stained with the dye, this was not the case with the teeth to the same extent; for here it was evident that only those parts of the bone of the teeth which had been formed while the animals were undergoing the experiment, had received any tinge from the madder; and that the older portions of the bone retained their natural and usual colour. The same author also states that when the teeth have once been thus stained they never regain their former appearance, though it is matter of fact that a colour thus given to other bones will be lost when the food of the animal is no longer mixed with the colouring matter; a strong argument

that the bone of the teeth possesses at least no absorbent vessels; but it is well known that absorbents are invariably found in all the vascular textures of the body. "Is it at all probable that a vascular and sensible part should be destined to perform the trituration of the different hard bodies which constitute our food, and be exposed to the mechanical attrition which this office must necessarily occasion?"*

From what has been stated it will be evident to the reader that the various circumstances connected with caries of the teeth are capable of being explained in strict conformity with the theory I have advanced. Some of these circumstances are, the partiality of caries in attacking certain classes of teeth in preference to others, the *dentes sapientiæ* being those most liable to decay, the molares next in frequency, then the *bicuspidæ*, and lastly the upper incisors, while the canine teeth and incisors of the lower jaw are generally exempt from it; the liability of the teeth to decay in pairs; the greater frequency of decay in youth than in the after periods of life,

* Article "Cranium," Rees's Cyclopædia.

and the hereditary predisposition to it often observed in particular families:—all these circumstances are strictly in accordance with my theory, which is in fact a legitimate inference deduced from them, whilst the attempts which have been made by various authors to account for them by other causes have signally failed. The very operations performed in dental surgery lead to and support the same view, for the filling up of a cavity produced by caries arrests the progress of the mischief by preventing a future lodgement of food, and the filing out of a decayed part has the same beneficial result only because it makes the surface of the tooth perfectly plane and unfitted to retain extraneous matter. Moreover, if in artificial teeth cavities exist in which a lodgement of extraneous substances can take place, a process of caries will commence in them in every respect resembling the caries of the natural teeth.

I trust that I have succeeded in making the reader acquainted with the true cause and progress of decay of the teeth, and that he will now see the necessity of that careful and

constant watchfulness over these organs which I have recommended; and also that he has the means in his own power of preserving them from the only destructive diseases to which they are liable, namely, caries and tartar.

EXPLANATION OF THE PLATES.

PLATE I.

This Plate represents a complete set of permanent teeth; shewing the posterior surfaces of the incisors and canine teeth; the grinding surfaces of the bicuspidæ, the molares, and dentes sapientiæ; also the irregularities upon their grinding surfaces where food is liable to be retained, and consequently the situations where decay takes place.

Fig. 1, the upper range of teeth; **A**, the front incisores, or cutting teeth; **BB**, the lateral incisores, or cutting teeth; **CC**, the cuspidati, or canine teeth; **DD**, the bicuspidæ or small grinding teeth; **EE**, the molares, or large grinding teeth; **FF**, the dentes sapientiæ, or

wisdom teeth ; G, the gum covering the half of one of the dentes sapientiæ, and thus forming a recess between the concave and pitted surface of the tooth and the over-lapping gum. In this situation particles of food are more liable to be retained than in any of the other parts of the teeth, and consequently the dentes sapientiæ are the most subject to caries.

Fig. 2. A similar view of the teeth in the lower jaw ; A, the front incisores ; BB, the lateral incisores ; CC, the cuspidati ; DD, the bicuspides ; EE, the molares ; FF, the dentes sapientiæ ; G, the same as described in the upper jaw.

PLATE II.

There is great variety in the formation of the surfaces of the molar teeth in different individuals ; the few specimens in this Plate, however, will be sufficient to shew the formation of those teeth which are, and of those which are not, subject to caries.

Fig. 1 and 2 are teeth exceedingly liable to decay in consequence of food being retained in the deep pits upon their grinding surfaces. The parts which the letters point out, are not represented as being in a state of decay ; but there is difficulty in shewing the depth of the pits occasioned by the irregular formation of the enamel, without at the same time producing the appearance of decay as having already commenced. The teeth distinguished by the letters A, F and H, are subject to decay only in one situation upon their grinding surfaces ; G is liable to decay in two places ; and B, C, D and E, are not only liable to caries in two places on their grinding surfaces, but also in one on their sides ; the latter is occasioned by a fissure which extends across the grinding surface of each of these teeth, and forms a pit in the side. If a tooth similar to some of those described be cut through in a longitudinal direction, the fissure will be found to extend through the enamel to the surface of the bone within. *See Plate IV. fig. 9, B.*

Fig. 3. The enamel is regularly distributed upon these teeth, and their surfaces are com-

paratively level; therefore they are not subject to decay, because they are incapable of retaining particles of food.

Fig. 4. The surfaces of these teeth have been worn down by friction; consequently they are not liable to decay, because no lodgement can take place. I, J and K, shew the enamel to be worn away and the bone coming into action.

Fig. 5. A bicuspis of the upper jaw, shewing the conical form of the crown of the tooth towards its neck; L, the contracted and fluted part where decay in these teeth generally takes place.

Fig. 6. The bicuspid, the molar, and the dens sapientiæ of one side of the upper jaw. M, N, O and P, the situations where decay takes place on the lateral surfaces of these teeth. By the receding of the gums interstices have been produced which are capable of receiving and retaining the particles of food.

Fig. 7. Q and R, two molar teeth in the lower jaw, with fissures extending across their grinding surfaces and running down their sides. This formation frequently occurs, and when

deeply marked always produces decay. S, a dens sapientiæ of the lower jaw, in which decay has taken place. The dentes sapientiæ are very subject to caries on the side next to the cheek, and it is occasioned by a tendency of the food to lodge upon the broad and flattened surface of the gum; the flattened formation of the gum in this situation is produced by the sudden thickening of the bone which forms the basis of the coronoid process.

PLATE III.

Fig. 1 represents four incisors of the upper jaw which are not subject to caries, because the uniformity of their width admits of their sides uniting all the way from their cutting edges to the gums; and consequently no food can lodge between them.

Fig. 2, four incisors of the upper jaw, which are extremely liable to caries at their sides. The interstices between these teeth are occa-

sioned by the conical formation of the teeth. Food is retained at the parts marked BBB, where the union of their sides terminates. The teeth marked A and C are represented as removed from their sockets, in order that their different formations may be seen more distinctly.

Fig. 3, four incisors of the upper jaw which are not subject to caries. The gums are in a healthy condition ; they throw out processes which fill up the openings between the teeth, and exclude all extraneous matter.

Fig. 4, teeth similar in formation to those last described. In these, the gums, so long as they remained in a healthy condition, filled up the openings between the teeth ; but by neglecting to use the tooth-brush, tartar has accumulated, the gums have receded, and interstices have been produced which are liable to retain food and occasion decay at the parts on their sides which the letters DDD point out.

Fig. 5. When the teeth are apart from each other, as here represented, there is no liability

to decay ; interstices of this formation being incapable of retaining food.

Fig. 6, the incisors and canine teeth of the upper jaw. The teeth to which the letters FF refer are not subject to caries, the formation of their interstices and the state of the gums being similar to those in *Fig. 3*. But from the irregular position of the teeth marked EEE, the gums are prevented from filling up the openings between the teeth, and consequently food is retained at the points where the teeth unite, and decay is the result.

Fig. 7, the incisors and canine teeth of the lower jaw ; shewing the gums to be in a healthy condition, adhering firmly to the necks of the teeth, and filling up the openings between them.

Fig. 8, similar teeth, which have been neglected. Tartar has been allowed to accumulate, which has forced the gums from the necks of the teeth, and has occasioned the absorption of a portion of their sockets.

PLATE IV.

Fig. 1, a view of the posterior surfaces of the upper incisors. In general the formation of these teeth is similar to the two marked **AA**, having smooth and rather concave surfaces posteriorly, which are incapable of retaining food; and therefore such teeth are not subject to decay in this situation; but occasionally they are deeply indented like those marked **BB**, consequently food is retained in these depressions, and decay is the result.

Fig. 2, 3 and 4, the anterior surfaces of six front incisors of the upper jaw. These teeth usually present smooth and convex surfaces similar to the representations given in Plate III. and are not liable to decay; but sometimes they are deeply pitted like the two marked **CC**, and in other instances they are defective in the formation and substance of their enamel, like those marked **DD** and **EE**. In these situations they are subject to caries, because they are capable of retaining food.

Fig. 5 and 6, a permanent molar tooth of the lower jaw of a child about eight years of

age, cut through in a longitudinal direction, for the purpose of shewing its internal structure, as compared with *Fig. 7* and *8*, a tooth of the same kind in a person upwards of fifty years of age.

Fig. 5, *A*, the crown, or that part of a tooth which is covered with enamel, and exposed; *B*, the neck, or the part of the tooth which is embraced by the gums so long as they are retained in a healthy condition; *C*, the fangs, or that portion of the tooth which is embedded in the alveolar process, or socket, and surrounded with a membrane called the periosteum.

Fig. 9 and *10* are representations of figures *6* and *7* magnified, for the purpose of shewing more distinctly the distribution of the enamel on the one tooth as compared with the other; and also the change which is produced in the cavity of an old tooth by a gradual filling up of bone.

Fig. 9 represents prominences, *AA*, upon the grinding surfaces of this section, corresponding with two elevations of a similar nature upon the removed section, which, when together, formed a deep pit or fissure in the

centre of the masticating surface of the tooth. It will be observed at B, that this fissure extends through the enamel, the consequence of which is that the more liquid portions of the food are admitted and brought in contact with the surface of the bone. In this situation the food is retained, and cannot be dislodged by any process of brushing. This formation is by no means an uncommon occurrence, and in such cases decay may be said to commence upon the surface of the bone; but it must be evident to every one that the disease is produced by external agency. C, the substance of bone, between the enamel and the cavity of the tooth, through which decay has to penetrate before it reaches the internal membrane and produces tooth-ache; F, the openings at the points of the fangs, where the blood vessels and nerves enter; E, the ducts through which they pass; and D, the cavity where they spread out upon the membrane which lines the internal walls of the tooth.

Fig. 10, AA. The grinding surface of this tooth is nearly level, so that no food can lodge; B, its enamel solid and compact,

which prevents extraneous matter from being admitted to the bony substance of the organ ; consequently a tooth of this formation is not liable to caries. C, the substance of bone between the enamel and the cavity of the tooth, thicker than in figure 9 ; F, the points of the fangs where the blood vessels and nerves enter ; E, the ducts through which they pass nearly obliterated ; and D, the cavity almost filled up with bone. Circulation in this organ must be at a very low ebb, particularly at the points of the bone which are the most remote from the centre ; nevertheless we do not find a tooth of this description liable to decay.

Fig. 11, AA, the position which the canine teeth generally take when the jaw is not sufficiently expanded to admit them into the range ; BB, the anterior bicuspides, which should be removed, and so allow the canine teeth to come into their proper place.

Fig. 12 and 13 are sections of a canine tooth of the upper jaw, shewing its external and internal formation. This tooth is seldom affected with caries, and when decay does

take place it always begins at the parts marked A and B, situations which are nearest to the internal membrane; and decay is never found to commence at the point marked C, which is the most remote, excepting in cases similar to the representations given in figure 3, where the enamel is defective in its formation.

PLATE V.

Fig. 1 represents one of the central incisors of the upper jaw shutting within those of the lower.

Fig. 2, the same, shewing the method by which this deformity is remedied. A gold plate is accurately fitted and firmly secured to the lower range of teeth; it inclines inwardly across the cutting edges of the teeth which inclose the upper incisor. In shutting the mouth the posterior surface of the irregular tooth acts against the inclined surface of the

plate, and by the pressure thus produced the tooth is gradually moved forward into its proper situation. The plate at both ends encloses and rests upon the grinding surfaces of the bicuspidæ which bear it up against the pressure of the irregular tooth, and prevent the lower edge of the plate from being forced against the gums. The same principle is adopted whether there be two or more of the upper teeth shutting within those of the lower jaw.

Fig. 3 is a view of the plate separated from the teeth.

Fig. 4 is a plate adapted for two front incisors similarly situated to the one described. In this case the bicuspidæ have not yet made their appearance; it therefore becomes necessary to support the plate against the molar teeth, and to prevent the lower edge of the plate in front from pressing against the gums, it is also supported against the cutting edges of the lower incisors.

PLATE VI.

Fig. 1 is a view of the separate parts of a newly invented instrument for the removal of teeth. A, the claw; B, the fulcrum; C, the nut or screw; D and E, the washers; F, the cork.

Fig. 2, the claw, in consequence of the square formation of its bore, is retained in a fixed position, so that its point, A, is always in a correct line with B, the fulcrum. By placing the washers D and E together, the claw is made to act either before or behind the fulcrum. The nut, or screw, E, at the extreme point of the instrument, secures the claw and washers in their respective situations. The cork, F, is made to fit the bore in the fulcrum, and is placed in its situation with the greatest facility; this is an advantage, it being desirable to use a new cork for every operation. The blades of the instrument are kept sufficiently apart by the spring, G, so as to admit the largest tooth between the point of the claw and the fulcrum.

PLATE VI.

Fig. 1 is a view of the separate parts of a newly invented instrument for the removal of teeth: A, the claw; B, the fulcrum; C, the nut or screw; D and E, the washers; F, the cork.

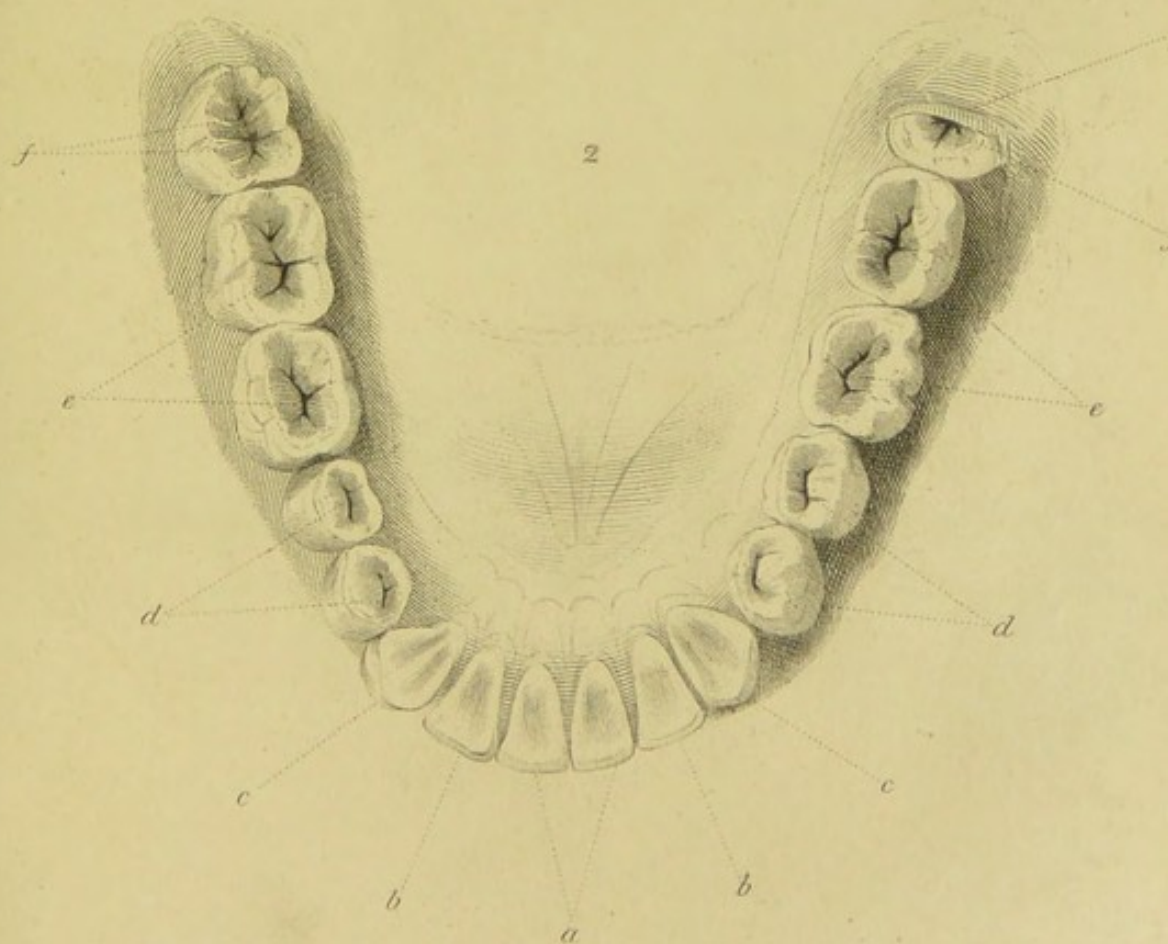
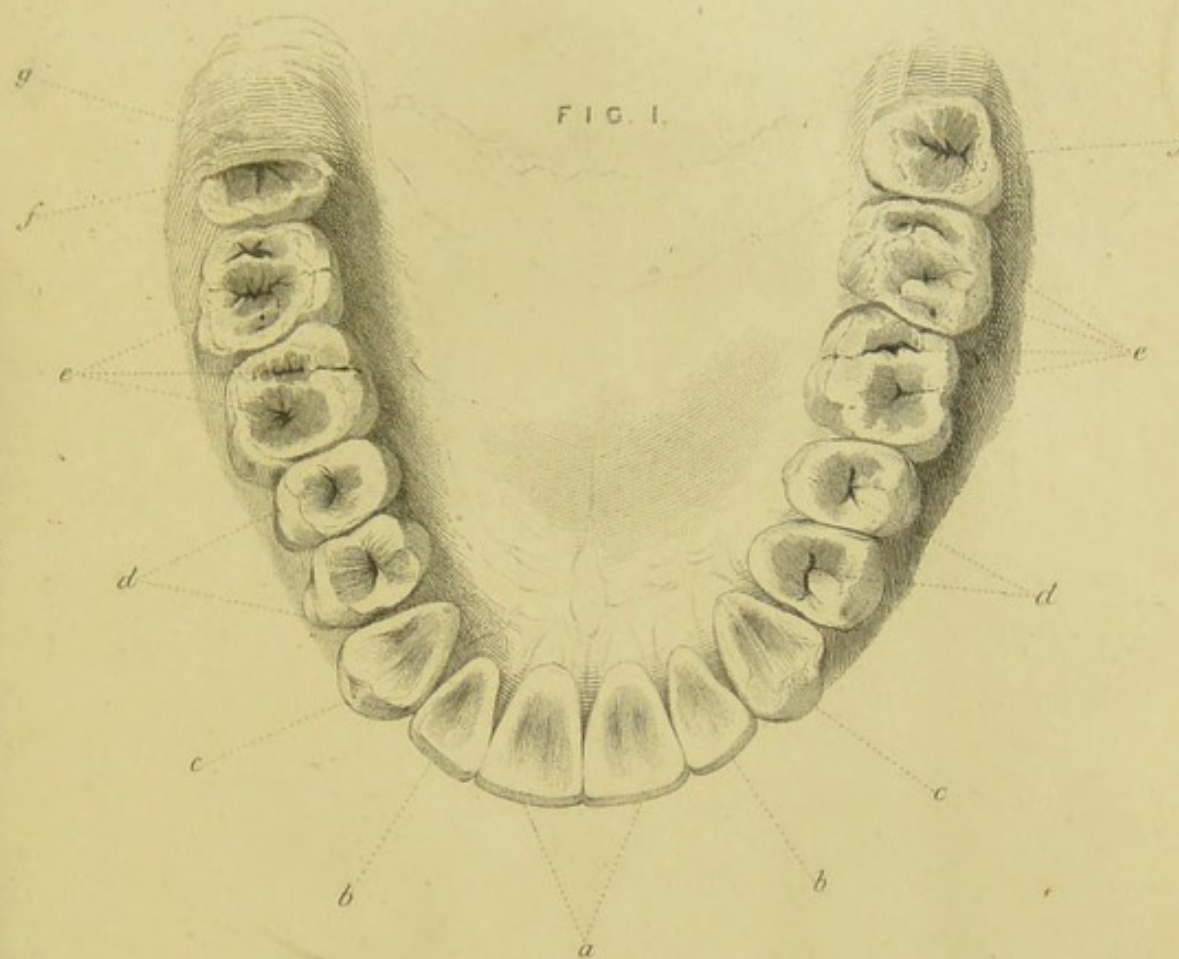
Fig. 2, the claw, in consequence of the square formation of its point is retained in a fixed position, so that its point A is always in a correct line with B, the fulcrum. By

placing the washers E together, the claw is made to move before or behind the fulcrum. The nut or screw, C, at the extreme point of the instrument, secures the claw and washers in their respective situations. The cork, F, is made to fit the bore in the fulcrum, and is placed in its situation with the greatest facility; this is an advantage, it being desirable to use a new cork for every operation. The blades of the instrument are kept sufficiently apart by the spring G, so as to admit the largest tooth between the point of the claw and the fulcrum.

PLATE VI

Fig. 1 is a view of the separate parts of a newly invented instrument for the removal of teeth. A, the claw; B, the fulcrum; C, the spring; D and E, the washers; F, the screw.

The claw, in consequence of the extreme flexibility of its base, is retained in a position at right angles to the fulcrum. By placing the washers E together, the claw is made to act ^{in a direction} before or behind the fulcrum. The end of screw, F, at the extreme point of the instrument, secures the claw and washers in their respective positions. The claw, F, is made to fit into the base of the fulcrum, and is placed in its position with great facility: this is an advantage, it being desirable to use a new claw for every operation. The blades of the instrument are kept sufficiently apart by the spring, G, so as to admit the finger tooth between the point of the claw and the fulcrum.



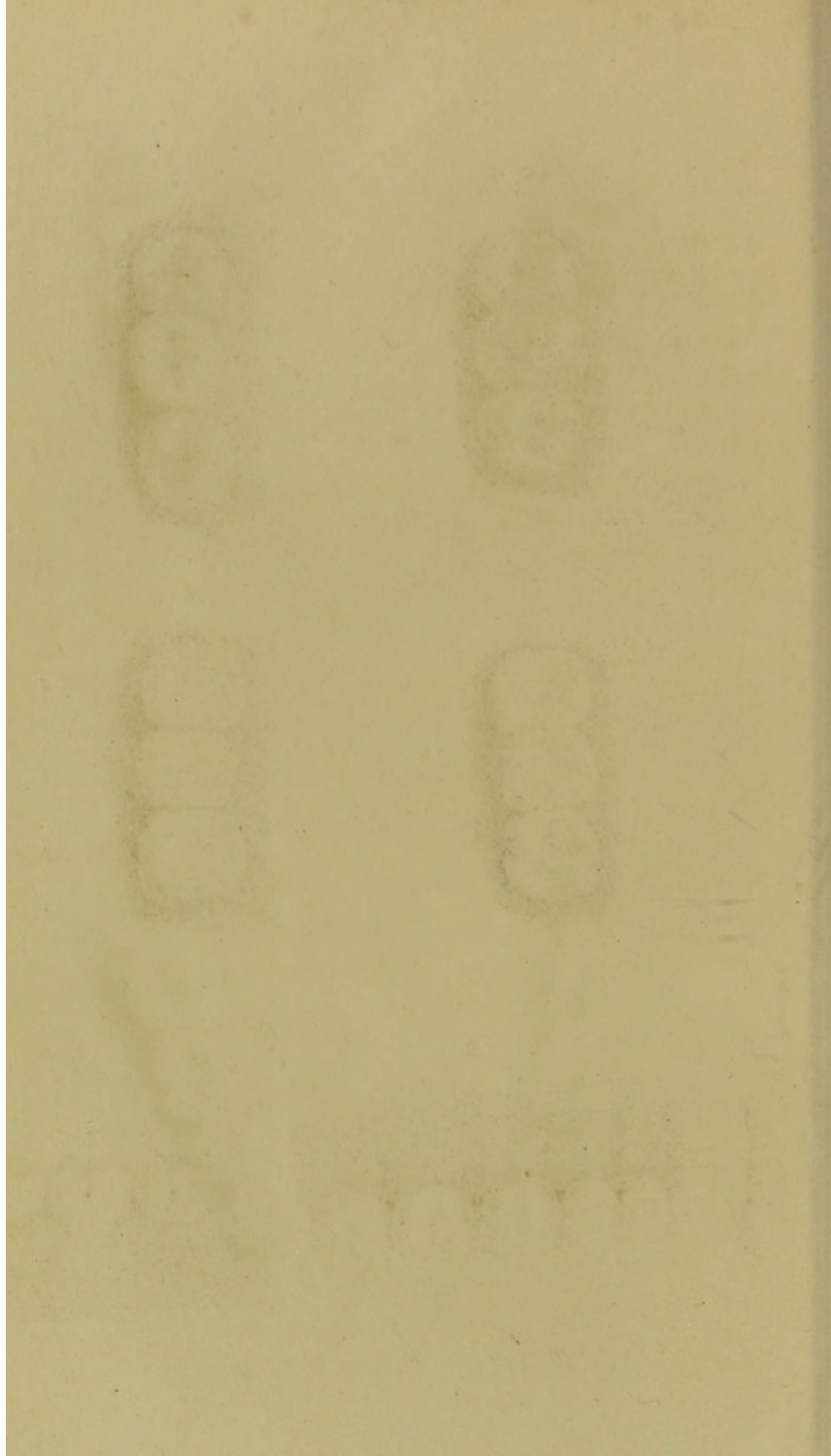
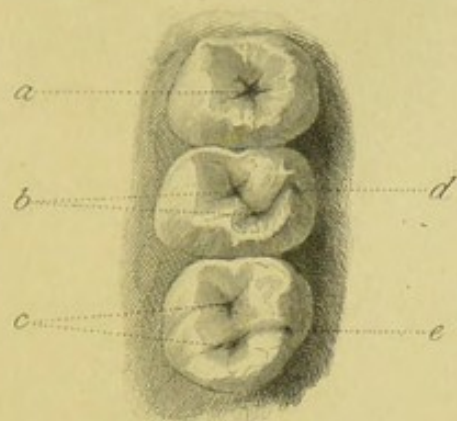
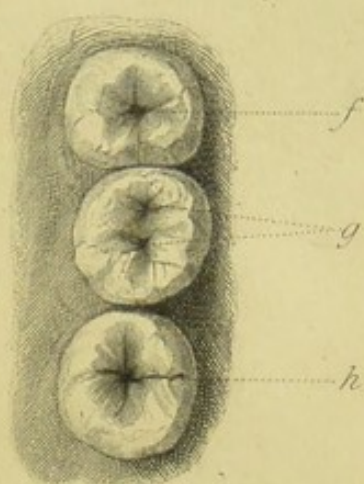


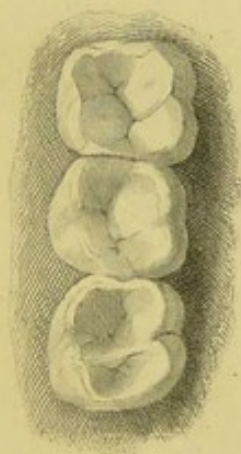
FIG 1



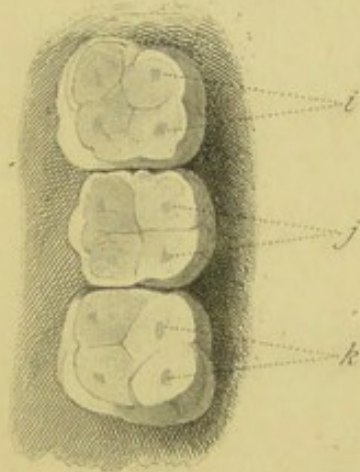
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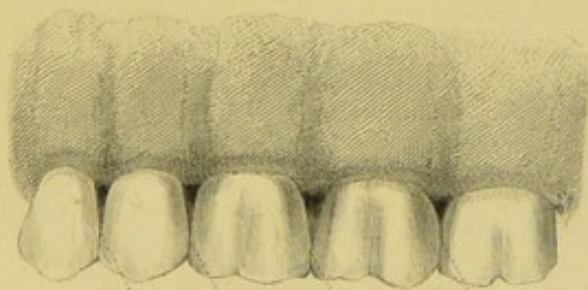
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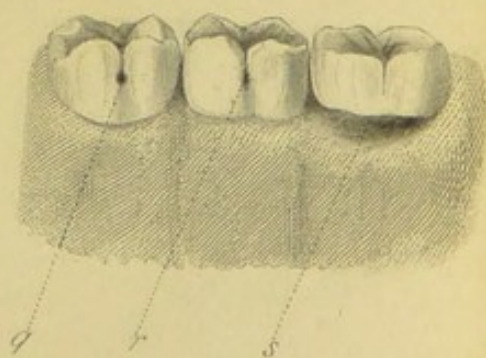
5



6



7



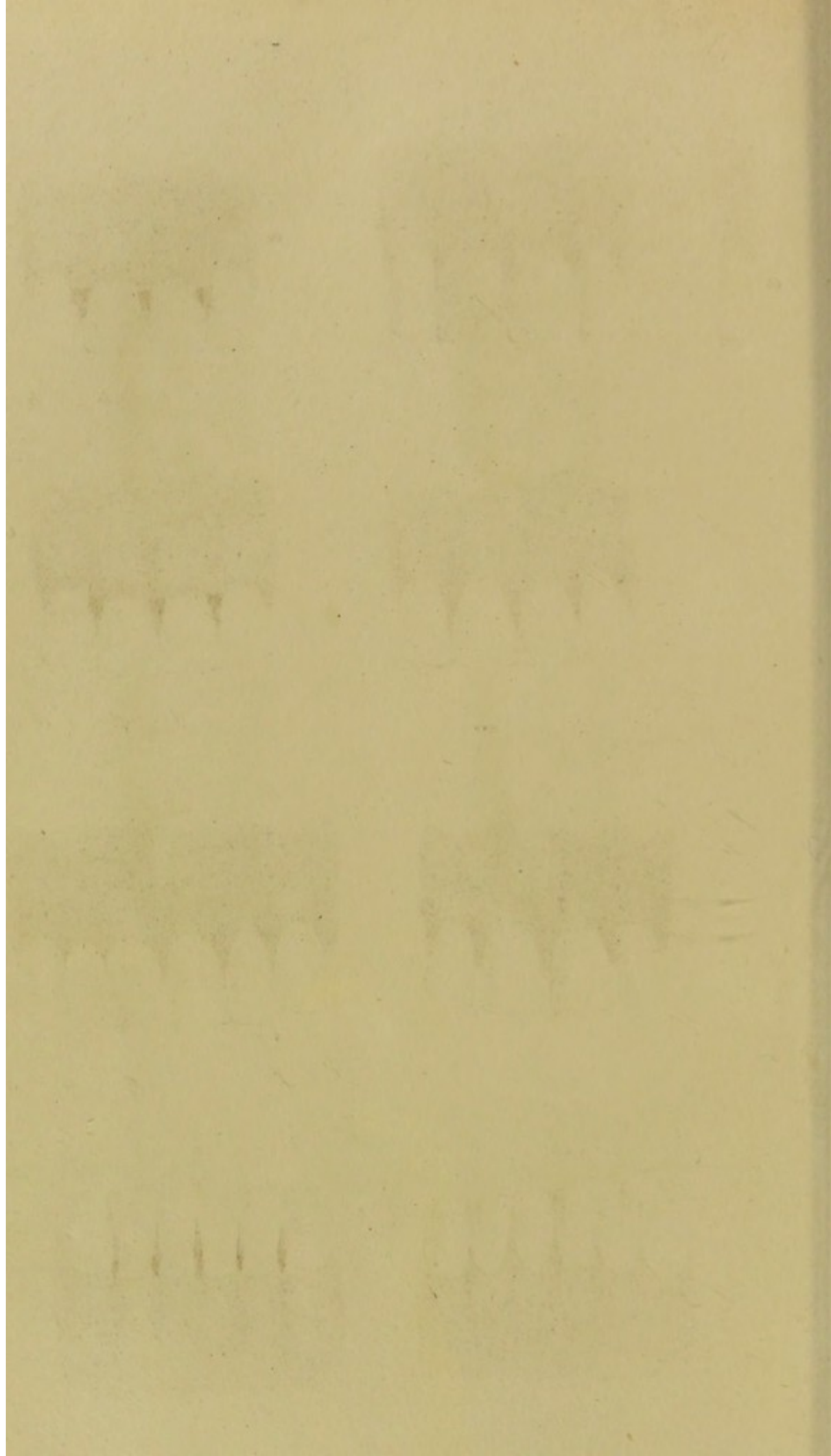
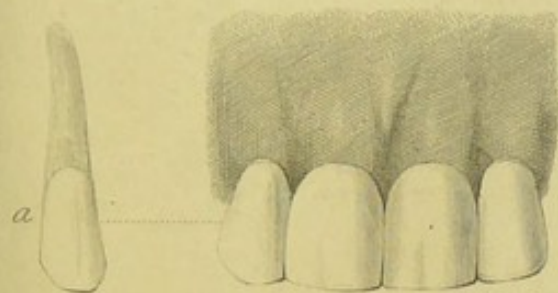
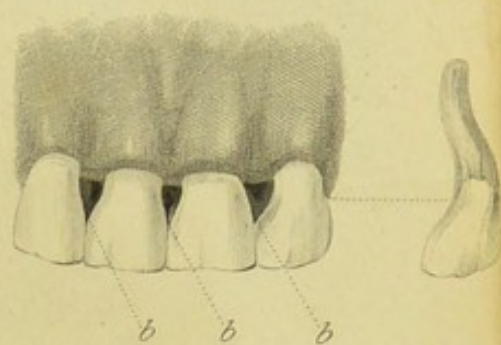


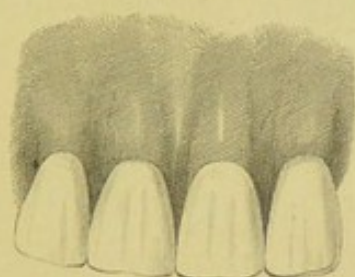
FIG. 1.



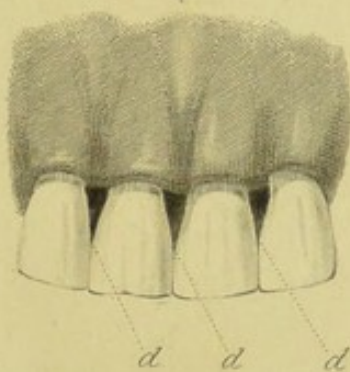
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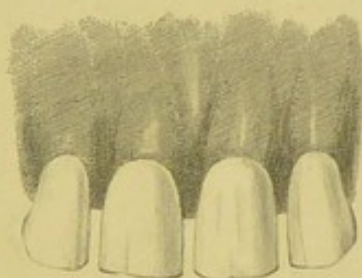
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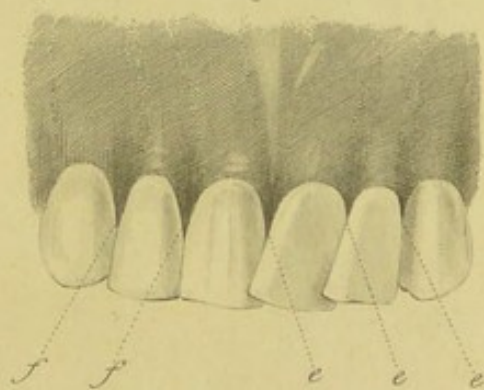
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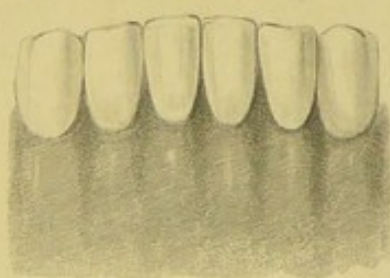
5



6



7



8

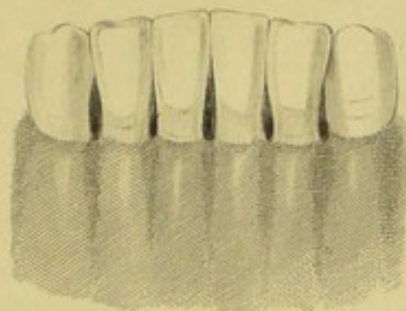
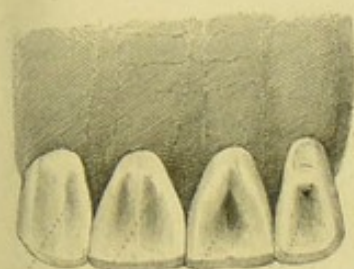




FIG 1



a b b b

2



c c

3



d d

4

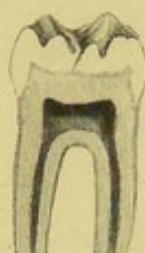


e e

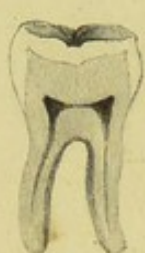
5



6



7

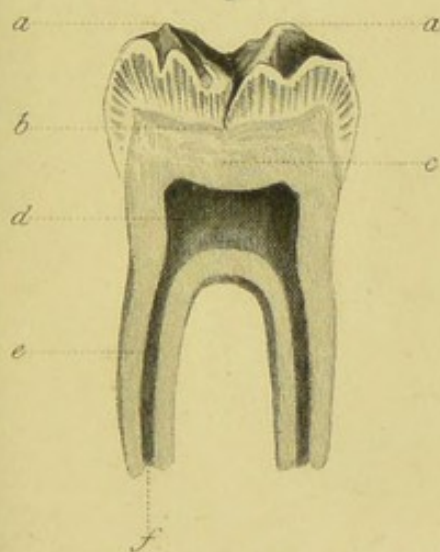


8

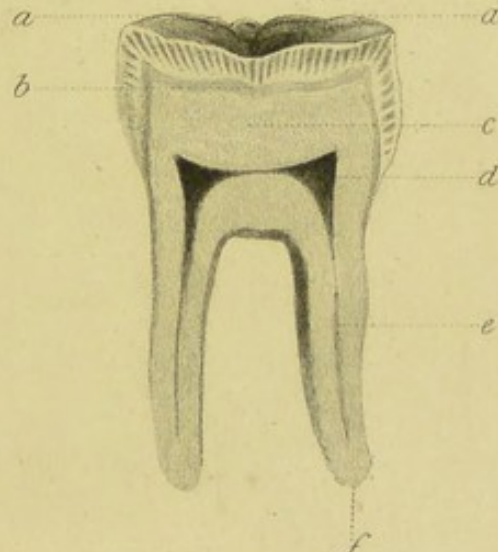


a

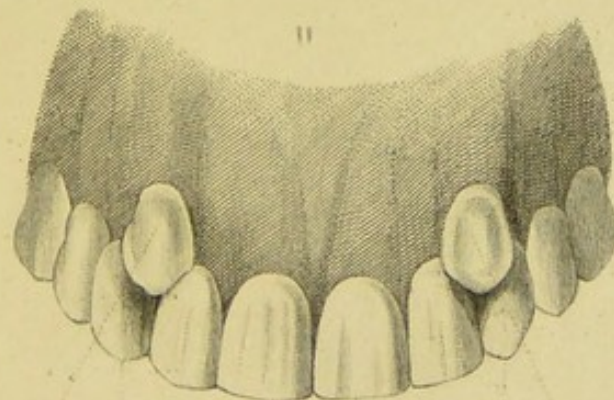
9



10



12



a b b a

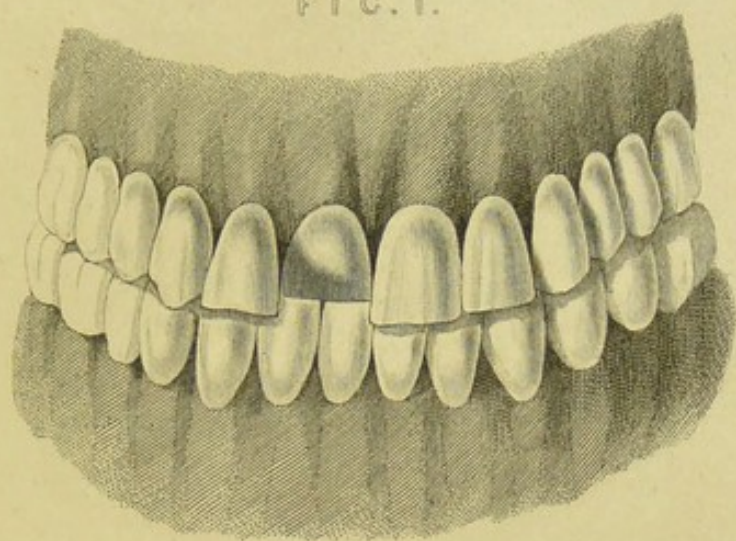
13



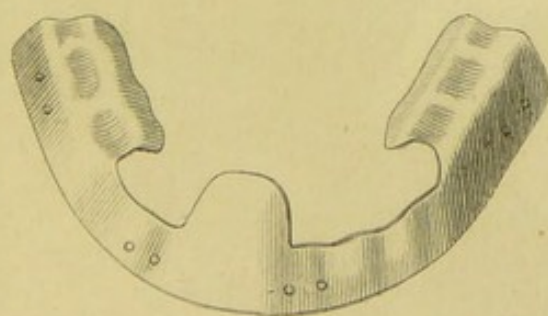
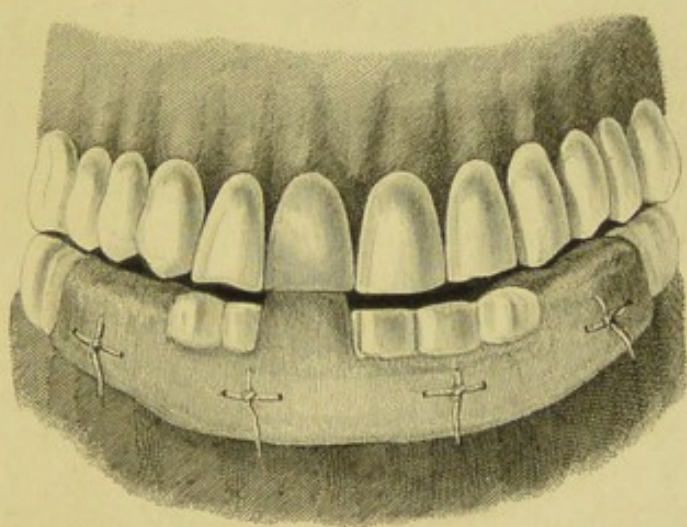
b c



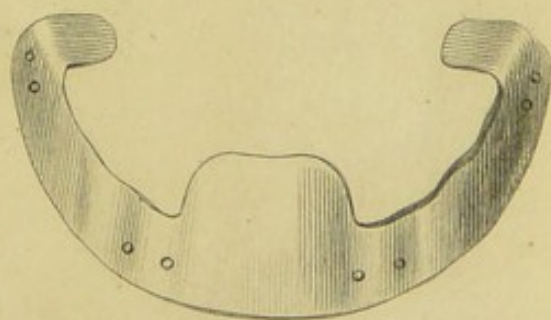
FIG. 1.



2



3



4



